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ADM

AUSTRALIAN DEFENCE MAGAZINE

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ADM EXCLUSIVE

FROM THE SOURCE

Air Marshal Mel Hupfeld, Chief of Air Force looks to the future.

100

AIR FORCE CENTENARY 2021

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FROM THE SOURCE

Chief of Air Force Air Marshal Mel Hupfeld

"WE ARE NOW IN THE SECOND CENTURY OF AIR FORCE, A FAST-MOVING ERA FOR AUSTRALIAN AIR AND SPACE POWER"

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100 YEARS OF RAAF

EWEN LEVICK & NIGEL PITTAWAY | MELBOURNE

SUBMARINES – and nuclear-powered submarines in particular – have dominated conversations in the virtual hallways of *ADM* since the surprise announcement of the AUKUS alliance in September. There are very many unanswered questions about the Morrison Government's decision to scrap the Attack class program, walk away from a deal with the French and seek a nuclear solution. There have been no meaningful answers to our questions to date, but we are watching developments closely and will be writing a lot more on the subject in future issues of this magazine.

But this issue of *ADM* is all about airpower, specifically in light of this year being the 100th Anniversary of the Australian Air Force, formed on 31 March 1921 (the 'Royal' prefix was bestowed in August of that year). The RAAF had planned a comprehensive series of events for its 100th birthday year which would have seen its capabilities showcased in every state and territory – but then COVID-19 complicated plans.

"THE QUALITIES OF A WELL-TRAINED AND MOTIVATED WORKFORCE WILL GIVE RAAF THE EDGE"

A large presence was planned to coincide with the 2021 Avalon Air Show to be held in February, but this was first moved to November and then cancelled altogether. In a similar manner, it was originally planned to publish this special edition of *ADM* in February but this moving calendar has meant it is only in your hands now.

From cover to cover this magazine is packed with stories and images that chart the journey of the RAAF past, present and future. While this is somewhat of a departure from our normal format, the 100th Anniversary of a service is a significant milestone, so we hope you enjoy the work our talented team has produced for you this month.

From a historical overview of the RAAF, written by accomplished author and historian Stewart Wilson, through to in-depth analysis of some of the capabilities that make up the modern Air Force, to a thought piece on what Air Force's priorities may be as it looks towards the future. This is all underpinned by our From the Source interview with Chief of Air Force, Air Marshal Mel Hupfeld and his thoughts are reproduced in full within.

Airpower is becoming increasingly important in the Indo-Pacific region and, since its inception in 1921, the RAAF has had to adapt to changing geopolitical circumstances – from defence of the Empire, to defence of Australia, wars or confrontations in Korea, Malaya, Vietnam, Indonesia (over East Timor) and, most recently, the Middle East. With rise of a new superpower in the region – one which is developing a formidable military force that is capable of projecting power over great distances – the RAAF not only has to maintain a technological advantage over an adversary, but redress the disparity in numbers.

While there are projects underway to develop solutions to these problems – Boeing's 'loyal wingman' Airpower Teaming System being one example – the RAAF's most important asset remains its people. This issue of *ADM* is crammed full of pictures of RAAF platforms, but it is its people that enable machines to deliver the desired capability. The qualities of a well-trained and motivated workforce will give RAAF the edge it needs as time goes on, and the same is true for Defence Industry.

As Air Marshal Hupfeld says in his From the Source interview this month: "Our people are our future, and our future is everything."


Ewen Levick


Nigel Pittaway

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LEFT: The Virginia-class submarine USS *Hawaii* conducting a scheduled port visit to HMAS Stirling in 2014.

WHICH SUBMARINE WILL AUSTRALIA BUILD?

JULIAN KERR | SYDNEY

NOW it's been decided that the RAN is to acquire a fleet of nuclear-powered hunter-killer submarines (SSNs), the question is – which one?

Given that Australia's technology partners in this nuclear enterprise are the US and the UK, the choice comes down to the US Virginia-class, the UK Astute-class or – unlikely but who knows – perhaps an Astute-class boat fitted with a US combat management system and deploying US weaponry.

Some Australian-specific customisation to either class could be involved, but it's hard to envisage the acceptability of anything but minimal modifications to a proven in-service design when moving to the nuclear option is adding years to what was already an unhurried Attack-class schedule.

Nothing is ever simple, and a further complication is both the US and the UK have now initiated programs for their next-generation successors to the Virginia and Astute classes.

The timing of the US SSN(X) and UK Submersible Ship Nuclear Replacement (SSNR) programs ensures their relevance to Australia, probably not as potential platforms but featuring enhanced capabilities capable of inclusion in late-build Virginia-class or Astute-class boats.

The first nuclear boat for the RAN is expected to be completed around 2035, completion of the first US SSN(X) is scheduled for 2031, while a firm timeline has yet to be disclosed for the SSNR, but it's likely to be required around 2035 when first-of-class HMS *Astute* completes 25 years of service.

Under the US Navy's current shipbuilding plan, the final four of 39 Virginia-class submarines will be procured in 2032 and 2033. The seventh and final Astute-class boat will be commissioned in 2026.

Both types represent the cutting-edge of Western hunter-killer technology.

A Virginia-class submarine is 115 metres long, has a 10.36 metre beam, displaces 7,900 tons, has a submerged speed of more than 25 knots, and a 134-strong crew. The boat is powered by a single General Electric pressurised water nuclear reactor and a pump jet propulsor (developed by BAE Systems for the UK's earlier Swiftsure-class SSNs).

In terms of weaponry, a Virginia boat deploys two Virginia Payload Tubes (VPTs), each with six cells for 1,700km range UGM-190 Tomahawk Block IV land attack cruise missiles, and four 21" torpedo tubes for Mk-48 ADCAP torpedoes or mines. The final eight (Block V) boats of the class will feature a new Virginia Payload Module (VPM) midbody section housing an additional 28 Tomahawks, boosting Tomahawk inventory to 40, boat length to 140 metres and displacement to 10,200 tons.

An Astute-class submarine is 97 metres long, has an 11.3 metre beam, displaces 7,000 tons, has a submerged speed of up to 30 knots, and a 98-strong crew. The boat is powered by a single Rolls Royce pressurised water nuclear reactor and a pump jet propulsor.

In terms of weaponry, an Astute boat has six 121" torpedo tubes with stowage for up to 38 Spearfish heavyweight torpedoes and/or UGM-109 Tomahawk Block IV land attack missiles.

According to the US Congressional Research Service, the latest Virginia-class Block IV costs an estimated A$4.4 billion. The UK National Audit Office prices an Astute-class boat at A$2.6 billion.

As experience has shown, construction in Australia in whole or in part could be expected to add significantly to those amounts.

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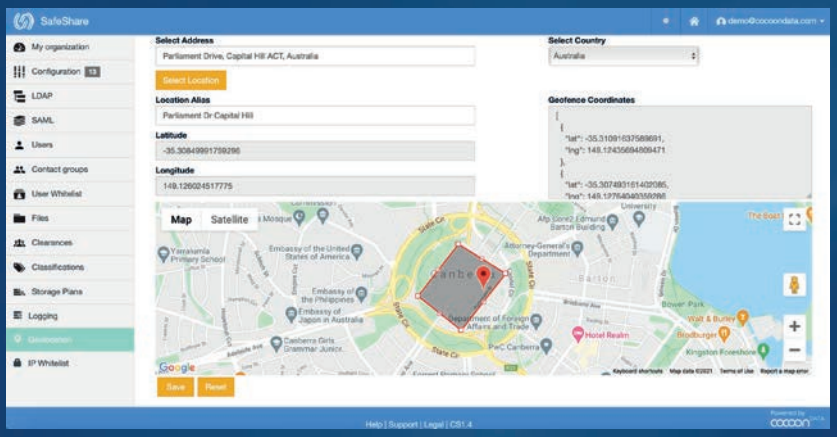

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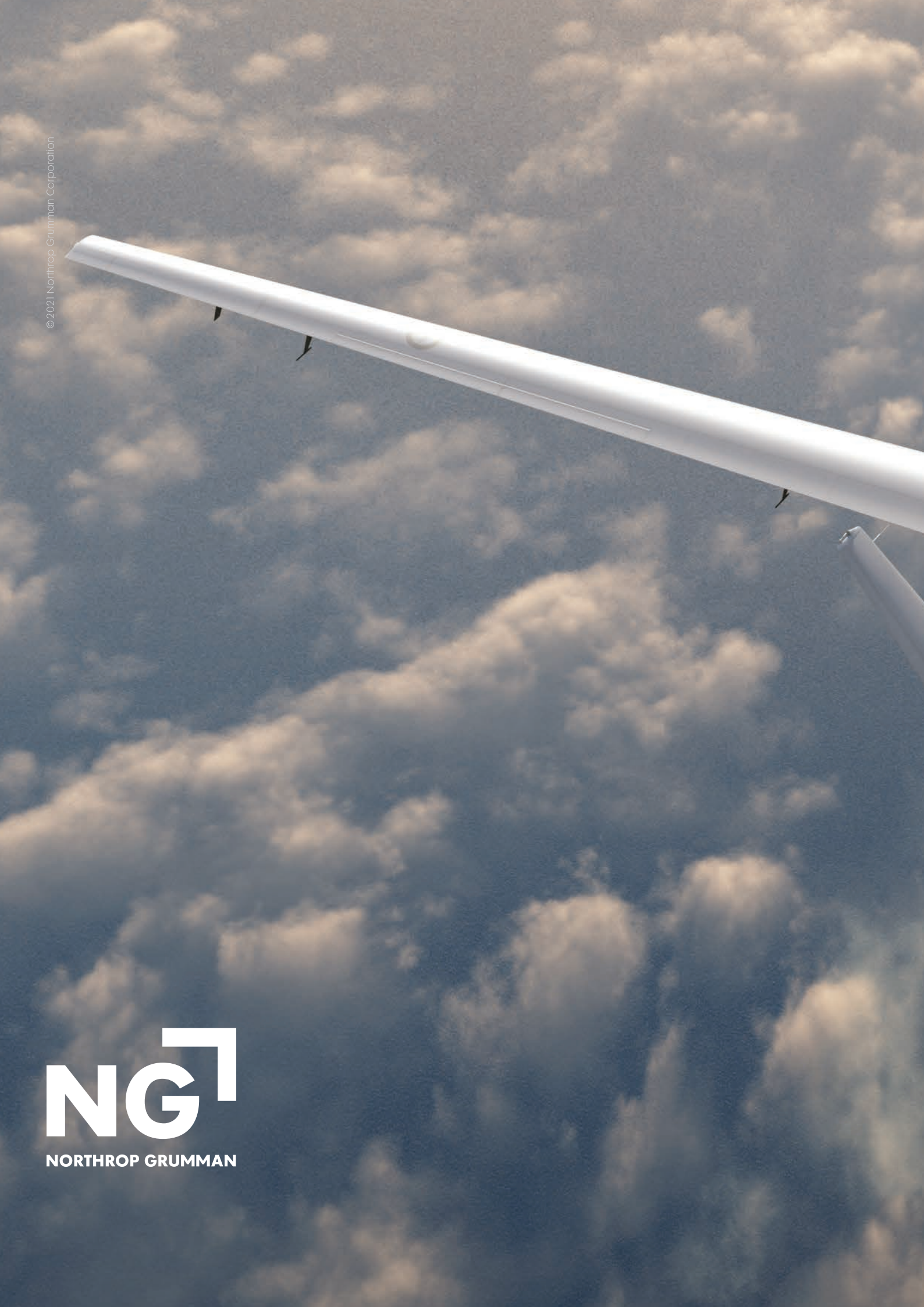

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Team Australia's Guided Weapons Enterprise

A resilient Australia is a secure Australia, founded in sovereign capability and self-reliance. The path forward must reflect two key considerations: What can we do today to support the future need? And what does a future focused strategy look like for establishing a strong local supply chain to support that capability and its evolution?

We believe that a sovereign guided weapons capability will leverage the latest technology from Australia and our allies to enable scaling up a local supply chain to meet the weapons requirements of the joint force to defence against the current and future threat. Australia cannot afford to rely on old ways of managing those supply chains if they are going to be responsive and resilient. 'Just-in-time' deliveries from distant overseas suppliers will not alone provide surety or adequately support Australia in a modern, fast-paced conflict if that supply is easily interrupted.

What we know now is that the current threat is complex, it's in our region and it is evolving rapidly. In his 2021 annual threat assessment, Director General ASIO Mike Burgess said "to detect and defeat our adversaries, we have to do things they think are impossible". To solve the impossible requires a sophisticated solution to a problem yet to be defined. The characteristics of the threat demands faced by Australia's defence industry, and indeed, the global security community grow daily. Our challenge is to architect a systems eco-system so advanced that we enable at its core, the ability for the solution to evolve faster than the emergent threat.

We also know that to achieve the enduring sovereign guided weapons enterprise ambition we must take a holistic approach to the whole of guided weapons and explosive ordinance life cycle and value chain. We know there are a multitude of strategic partnerships across Primes and small to medium sized businesses here in Australia that when brought together as an enterprise, can seek to define the impossible problem and marry it to a sovereign solution. Helping shape the 'art of the possible' is the introduction of the AUKUS agreement in September, which sets the stage now for a new level of transformational tripartite national security cooperation and tech transfer between the USA, UK and Australia.

A future focused strategy, we call it the 'Kill Chain to Supply Chain' strategy, is required to look to the future with clear focus, and back-cast to the present to determine the most compelling path forward. The primary risk of not adopting a forward looking strategy now, especially in guided weapons, nuclear-submarines, Integrated Air and Missile Defence systems and sovereign military space capability is the speed at which the threat is evolving. That is to say, the establishment of a supply chain and manufacturing capability based on today's need definition will surely not be able to answer, scale and adapt to the rapidly evolving threat expectations of 2030 and beyond, and could be doomed to be operationally and technologically redundant – it will be about leveraging the firm foundations of our existing manufacturing capabilities and adapting and evolving this capability with a focus on our future guided weapons and 'kill chain' imperatives.

ABOVE: *An interceptor missile is launched by U.S. Army soldiers at White Sands Missile Range during Flight Test 5 (FT-5), December 12, 2019. This test was the most sophisticated and difficult development test yet for the Army's Integrated Air and Missile Defense (IAMD) Battle Command System (IBCS), developed by Northrop Grumman.*

ABOVE LEFT: *Northrop Grumman supports the warfighter to integrate Air and Missile Defence systems.*

Northrop Grumman has a deep heritage in guided weapons and explosive ordnance, from small to medium calibre ammunition, fuses, warheads and propulsion across a range of guided weapons, to AARGM missile, hypersonics and advanced weapons. For decades, Northrop Grumman has protected allied forces by designing, developing and delivering weapons of increasing complexity and capabilities for expanded missions and domains which are already evolving to meet the emerging threat. We continue to build upon that legacy to pioneer weapons and related Integrated Air and Missile Defence systems that consistently outmatch the range, speed, precision and firepower of fielded adversary weapon systems, with the parameters of current and emerging threats in mind. We do this by intentionally solving the problems of the future through continuous innovation, and in our design methodologies and modular and open system architectures.

A critical enabler for establishing a sovereign guided weapons manufacturing capability in Australia will be technology release, in particular the US technology release that is required to ensure Five Eyes interoperability and access to world-leading, advanced guided weapons technology. Technology release will still require an overarching Government-to-Government arrangement to be established to enable strategic alignment and a framework for seeking broader technology release in support of future adaption.

Establishing the required Government to Government agreements at all necessary intersections must also be approached from an aligned political, diplomatic, and regulatory whole-of-government perspective to align strategy, phasing of engagement and messaging and practical paths to release success.

The Government to Government arrangements must then support industry to industry engagement. To be effective this will require US Primes, in parallel, to be seeking the equivalent technology release within the same strategic context in clear support of Australia's policy ambitions. Technology transfer could be direct to Australian industry but is best facilitated through the US Prime's Australian entity, who is often better positioned to translate the Australian context for the parent company and coordinate the Australian small to medium enterprise engagement at the local level. This will not only entail establishing the required stakeholder relationships and trust, but also facilitation of Technology Assistance Agreements and the Manufacturing Licensing Agreements, which will also require a longer timeline and forward planned approach for maximum optimisation of benefits.

Cooperative programs, including AUKUS, provide an opportunity for Primes to play a collaborative role with US Defence counterparts. This can enable the ability to influence requirements and to leverage Australian industry into our international supply chains. This cooperation also supports better adaption to the Australian sovereign need.

Northrop Grumman Australia stands ready to support Defence in the further development of the Sovereign Guided Weapons Enterprise and any future facing response to the landscape of emergent threats. We believe that the next critical steps in formulating the guided weapons manufacturing capability include:

A critical review of the guided weapons capability required to meet the challenges of the evolving threat beyond 2030 be conducted, leveraging the 'art of the possible' under AUKUS and the analysis used to inform the 2020 Force Structure Plan, including known Integrated Air and Missile Defence imperatives;

Industry, as a fundamental input to capability, being fully harnessed to help assess and provide options to Government for the incremental path forward to achieve this future focused guided weapons capability outcome in partnership;

A whole-of-government tied together approach be adopted to shaping Government to Government arrangements with the United States and United Kingdom Governments in particular, which in turn supports industry to industry engagement with Primes; and

Initial steps be taken to establish a guided weapons enterprise and governance framework to define arc of left and right, to support the ongoing development of the sovereign guided weapons and explosive ordnance manufacturing ambition.

These initial steps should then fundamentally enable the development of a cohesive future-ready guided weapons strategy that is built out on a solid foundation of next-gen tech and the enduring industry relationships that will be critical to the Enterprise's on-going readiness and success. ■

Chris Deeble, executive director, strategy, Northrop Grumman Australia.

U.S. NAVY

A U.S. Navy MQ-4C Triton conducts first flight in the multi-intelligence configuration.

MQ-4C Triton progressing to meet Australia's critical maritime ISR needs

Following the full coalition withdrawal of military forces from Afghanistan, Australia reflects on being a crucial ally in Global War on Terrorism following the 9/11 attacks. In November 2001 Australia became a critical waypoint for the first operational deployment of Global Hawks in the U.S. military response to the terrorist attacks.

Australia's first exposure to high-altitude, long-endurance unmanned intelligence, surveillance and reconnaissance occurred in April 2001 when a U.S. Air Force RQ-4 Global Hawk equipped with maritime modes arrived at Royal Australian Air Force Base Edinburgh for a six-week demonstration.

The 2001 Global Hawk demonstration and ensuing deployment would play a role in Australia's eventual entry into the cooperative development program with the U.S. Navy for the MQ-4C Triton, a maritime sibling of the Global Hawk.

The MQ-4C Triton is an unprecedented and unrivaled capability. Because of its operating altitude and more than 24-hour endurance, Triton is able to surveil more than 2.5 million square kilometers of ocean and littorals in a single flight. Its unblinking multi-intelligence sensor suite will be able to detect nearly any activity in its coverage area.

The U.S. Navy completed first flight of the multi-intelligence configuration of the Triton system in July, a critical milestone on the path to both the U.S. Navy' and RAAF's initial operating capability. Concurrent with testing and refining the multi-intelligence capability, Northrop

Grumman is utilizing a manned surrogate to evaluate Triton's ability to meet other mission sets such as over-the-horizon targeting.

Today the first RAAF MQ-4C Triton fuselage is nearing build completion at Northrop Grumman's manufacturing facility in Moss Point, Mississippi.

Once finished, on track for November 2021, the fuselage will be transported to Palmdale, California where it will be wed to its wing and complete final assembly and test flights. The RAAF's first Triton is on schedule to be complete and ready for delivery in 2023. ■

Jake Campbell, Triton program director, Northrop Grumman Australia.

RAAF TO REPLACE DAMAGED GROWLER

NIGEL PITTAWAY | MELBOURNE

THE US State Department has approved the sale of a former US Navy Boeing EA-18G Growler airborne electronic attack aircraft to Australia, to replace an almost-new example lost in a runway incident in the US in 2018.

Under the US$125 million deal Australia will acquire one EA-18G in Lot 38 (or later) configuration from US Navy stock and it will then be modified to RAAF specifications to enable commonality with the remainder of the fleet.

"The proposed sale will allow Australia to effectively maintain its current force projection capability that enhances interoperability with US forces well into the future and maintain their original primary level of aircraft authorised," the Defense Security Co-operation Agency (DSCA) statement reads.

"This aircraft would replace Australia's EA-18G (A46-311) aircraft lost in an accident at Nellis Air Force Base."

Australia purchased twelve new-build Growlers under Project Air 5349 Phase 3, in lieu of converting a similar number of its F/A-18F+ Super Hornets into electronic attack configuration. The first aircraft (A46-311) was handed over to the Commonwealth at Boeing's Super Hornet and Growler production facility in St Louis in July 2015.

The Growler is operated by No. 6 Sqn, based at RAAF Amberley and provides a force-level Electronic Warfare capability – the only such capability outside the US Navy and US Marine Corps today.

The former US Navy aircraft will replace an aircraft which suffered and uncontained failure of one of its two General Electric F414 engines during take-off for an Exercise Red Flag mission on 28 January 2018. Although the crew were able to exit safely, the aircraft was extensively damaged by fire and the hulk was placed into storage at the US 309th Aerospace Maintenance and Regeneration Group (AMARG) at Davis Monthan, Arizona, in October 2018.

Defence is yet to announce or confirm the proposed sale, but has been considering options for the restoration of the Growler fleet to its original size since 2018.

NIGEL PITTAWAY

ABOVE: The RAAF lost a Growler in a runway incident in 2018.

CDIC TO BE REPLACED

EWEN LEVICK | MELBOURNE

THE Centre for Defence Industry Capability (CDIC) will be replaced by the end of the year, Minister for Defence Industry Melissa Price has revealed.

The CDIC was subject to a government review released last year, which recommended strengthening the alignment between Defence, defence industry and the CDIC by relocating it to the Department of Defence rather than resting in the Department of Industry, Science, Energy and Resources with Defence secondees.

Minister Price told *ADM* in January that the subsequent restructure was 'progressing well'.

However, in recent comments to AIDN, Minister Price revealed that the CDIC would be replaced with a 'new organisation'.

"Finally, before the end of the year, I will also launch a new organisation that replaces the Centre for Defence Industry Capability as the one-stop shop for defence industry support and guidance," Minister Price said. "It will work with industry associations, state and territory officials, SMEs and primes to deliver the capability our ADF needs to keep Australians safe and secure.

"I look forward to launching this organisation and the system that will be put in place to support each state and territory across the country."

Shadow Minister for Defence Industry Matt Keogh said more certainty was needed in defence industry following the cancellation of Sea 1000.

"New branding is not enough," Minister Keogh said. "At a time where the futures of many defence SMEs and workers remains uncertain due to the scrapping of the 'Future Submarine' contract, it's more important than ever that our local defence industry is supported."

Defence acknowledged *ADM*'s request for comment but did not provide a response.

DEFENCE

LEFT: Minister for Defence Industry Melissa Price on a visit to RAAF Base Williamtown.

THALES AUSTRALIA

LEFT: Customers for Australian TNT could include General Dynamics, American Ordnance and the US military itself.

US APPROVES AUSTRALIAN TNT FOR MILITARY USE

EWEN LEVICK | MELBOURNE

THE US Department of Defense has certified Australian-made TNT to military specifications, paving the way for Australian TNT to be exported to the US from the Commonwealth-owned and Thales-operated plant in Mulwala, NSW.

In a joint statement released following the 31st Australia-United States Ministerial Consultations (AUSMIN 2021), Foreign Minister Marise Payne welcomed the decision.

"Australia also welcomes the recent decision for Australian-made TNT to be certified to US military specifications as an alternate source of supply for the US," Minister Payne said.

Mulwala is one of only a limited number of facilities worldwide capable of producing TNT. The US imports large quantities of TNT supplies for military purposes.

ADM understands that the certification process began prior to the Covid-19 pandemic. US defence officials physically assessed the plant in Mulwala, and further trial and assessment work on Australian TNT samples then continued in the US ahead of final certification.

"It means we can engage with US customers who utilise TNT as part of their manufacturing process to supply the US military," Dion Habner, Managing Director of Australian Munitions, Thales Australia, said.

Those customers could include General Dynamics, American Ordnance and the US military itself.

TNT currently produced in Mulwala is mostly used for domestic military and civilian purposes in Australia. According to Habner, US certification means that Thales could double production of TNT to meet American demand – although increased freight costs remain a challenge.

Until recently Thales Australia sourced toluene (a key ingredient of TNT, or trinitrotoluene) from overseas but has now secured local supply from Viva Energy in Geelong.

"We're really pushing to secure local supply of those key ingredients," Habner said. "The next US orders requiring TNT could be released next year, meaning we'd hope to see the first shipments exported in the back end of next year.

"Defence's support and engagement with the US Department of Defense has been really beneficial."

Thales Australia is also using locally-made TNT to establish an Australian domestic filling and production capability for the 155mm M795 high-explosive artillery projectile. This activity is part of the Cooperative Research and Development Agreement (CRADA) between the US Army's Development Command Armaments Center and Thales Australia.

"We're working on the technology transfer to stand up this capability in Australia," Habner said. "Having our locally-made TNT certified to American standards is a critical step in this process."

Thales' site in Mulwala also produces military-grade rocket propellant, solid fuel rocket motors and boosters, while the company's plant in Benalla manufactures high explosive artillery rounds.

The company signed a $1.1 billion agreement with the Commonwealth in 2020 to operate the two facilities for the next decade.

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DEFENCE

COMMS INTEGRATOR BACKS TAOT INTO THE FUTURE

Rohde & Schwarz Australia is completing mid-life upgrades to the Royal Australian Air Force's Transportable Air Operations Towers (TAOTs), ensuring the RAAF has the latest technology to support deployed operations in defence of Australia for years to come. With recent success providing communications solutions for Navy, the company is well poised to demonstrate its communications expertise in other domains.

In 2008, the RAAF sought the acquisition of a forward deployed air traffic control capability. Rohde & Schwarz Australia answered the call as prime and systems integrator, engaging with subcontractors and suppliers throughout Australia and internationally to provide a solid foundation for the successful delivery of capability and the provision of cost-effective sustainment through life.

In 2012, three TAOTs were delivered, with the Rohde & Schwarz Australia / GTESPO (now S&CSPO) team receiving a High Commendation for Defence/Industry Team of the Year for Minor Acquisition in 2009.

Now, the first TAOT has rolled out of the Rohde & Schwarz Australia Systems Integration Facility having completed the first tranche of mid-life upgrades to assure the capability and extend its service life to 2030 and beyond.

"These upgrades commenced in 2019 will serve to not only remediate obsolescence, but also to incorporate new technolo-

R&S AUSTRALIA

MAIN: Leading Aircraftwoman Rebecca Hay and Corporal Thomas Geraghty raise the transportable air operations tower, at RAAF Base Scherger in Queensland, to commence operations on Exercise Talisman Sabre 2021.

LEFT: The first AOT to complete initial mid-life upgrades is loaded onto a truck at Rohde & Schwarz's systems integration facility in Sydney.

gies, enhance operational capability, and harden security," said Rohde & Schwarz Australia Managing Director Gareth Evans.

The TAOT will be delivered to the RAAF with completely modernised systems including internet protocol (IP) based voice communications and recording, airfield monitoring and control, network and time synchronisation. Other enhancements include an upgrade to IP radios, cyber hardening, provisioning of new interfaces, and new uninterrupted power supplies, air conditioning, and smoke detectors.

"Having delivered the TAOT's impressive capability to Air Force as prime systems integrator we're very proud to be continuing our relationship, ensuring that capability remains at the cutting edge of air traffic control technology," Evans said.

"I'm especially proud of our team who have managed to complete this complex upgrade despite significant resource constraints and supplier issues imposed by COVID-19.

"The TAOT fleet will continue to be modernised as part of a spiral upgrade program to assure the capability and extend their service life to 2030 and beyond," Evans continued.

A TAOT unit was recently deployed to RAAF Base Scherger in Far North Queensland during the biennial multinational exercise Talisman Sabre 2021. During Operation Bushfire Assist in summer 2019-20 a TAOT assisted civilian and military aircraft conducting remote firefighting and humanitarian aid missions.

Evans said the TAOT example isn't the only communications system integration success story for the Australian subsidiary, now celebrating its 40th year downunder. He points to more recent wins including the new fully integrated communications systems for the RAN evolved Cape class patrol boats. The six boats will be fitted with the company's Naval Integrated Communications System (NAVICS) with multi-layer security and secure external line of sight (V/UHF) and beyond line of sight communications (HF).

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The company was contracted by Austal in June 2020 and subsequently completed factory acceptance testing of the first ship set in May 2021 – an exemplary performance highlighting the maturity of the capability the subsidiary has developed over its 40 years. The company has also delivered external communications systems for Navy's new auxiliary oiler and replenishment ships and guided missile destroyers.

"Generally, Rohde & Schwarz is well known for being a test and assurance partner – providing our test and measurement 'box' solutions and services which cater to a wide range of customers from within the media and broadcast, research, telco, and aerospace and defence communities," Evans said.

"But we've proven our mettle both here and internationally integrating the latest generation, secure voice-over-IP communications solutions for military customers across all domains."

Rohde & Schwarz has established a very competent integration capability for Australian industry in Sydney to complement its existing maintenance and world-class calibration facilities.

"This ensures Australian jobs are created and supply chain opportunities continue not just for Australia's naval shipbuilding effort but also for other communications applications in the Land, Air, and Joint domains," Evans said.

"Just as for Air and Maritime we know we can make a big difference in Land, and we're closely exploring how we can leverage our cutting-edge tactical communications pedigree for the local customer."

"We're also currently expanding our footprint across the country to further support our ability to bid for and win projects in this domain."

www.rohde-schwarz.com.au

LOYAL WINGMAN TO BE BUILT IN TOOWOOMBA

BOEING

LEFT: Boeing Australia is currently developing six aircraft in partnership with the RAAF.

BOEING has selected Toowoomba as the preferred site to build the 'Loyal Wingman' Airpower Teaming System.

The site, developed in partnership with the Queensland Government in the Wellcamp Aerospace and Defence Precinct at Wellcamp Airport, will be the company's first aircraft assembly facility of its kind outside of North America.

The Loyal Wingman made its first flight in February 2021.

"In choosing Wellcamp Airport, Boeing have taken an important step towards delivering their purpose-built final assembly facility," Premier Annastacia Palaszczuk said.

"This announcement follows our success with Australia's first commercial drone flight testing facility at Cloncurry Airport last December, of which Boeing was a first user," Treasurer and Minister for Investment Cameron Dick said. "It's the result of an arrangement our government entered into with Boeing Australia last year to support the establishment of the primary final assembly facility for the Boeing Loyal Wingman here in Queensland, subject to defence orders."

The uncrewed aircraft is designed to operate as a team, using artificial intelligence to extend the capabilities of crewed and uncrewed platforms.

"We are confident in the future production outlook for this world-class, innovative aircraft," said Boeing Defence Australia Vice President and Managing Director Scott Carpendale. "We're thinking long-term about this investment, which could assist Australia to gain future work share in other global defence and aerospace opportunities, in addition to the Loyal Wingman assembly.

"The Wellcamp Aerospace and Defence Precinct location is attractive due to its access to a flight line, clear flying days, commercial flight access from major cities and ability to support the rapid pace at which the Airpower Teaming System program is growing.

"Sustainable aerospace is a critical focus for Boeing, and Wagner Corporation's use of sustainable construction methods supports our vision to create a leading sustainable aerospace manufacturing facility from the ground up, including renewable technologies and human-centric design," Carpendale said.

Boeing Australia is currently developing six aircraft in partnership with the RAAF, with flight testing ongoing.

BALE DEFENCE TO DELIVER ROUGH TERRAIN VEHICLE

A FAMILY-OWNED engineering company based in Port Macquarie has been awarded an $8.47 million contract to deliver the ADF's next generation rough terrain vehicle fleet.

Minister for Defence Industry Melissa Price said the contract with Bale Defence to build 40 vehicles would create six new jobs in Port Macquarie and support the ongoing employment of another 18 Australian workers, injecting $6.17 million into the local economy.

"The rough terrain vehicle provides an important tactical, light, all-terrain land capability used by the ADF on operations and exercises both in Australia and overseas," Minister Price said.

"Bale Defence provided the first generation of rough terrain vehicles to the ADF.

"This contract ensures Australia can continue to manufacture, modernise and enhance this critical capability locally, to meet our Defence Force's evolving requirements."

Member for Cowper Pat Conaghan said the contract with Bale Defence was yet another example of regional Australia leading the charge for innovation and technology.

"I'm not at all surprised that a project of this calibre has come out of the Cowper electorate on the Mid North Coast," Conaghan said.

"We're an innovative bunch, and to see that ingenuity rewarded like this is fantastic news for our region.

"Huge congratulations to Bale Defence for the recognition of excellence by securing this exciting contract, and I look forward to seeing the project come to fruition."

DEFENCE

RIGHT: Bale Defence provided the first generation of rough terrain vehicles to the ADF.

FIRST OPERATIONAL BLOCK III F/A-18 SUPER HORNET DELIVERED TO US NAVY

BOEING

LEFT: Boeing will continue to deliver Block III capabilities to the Navy through the mid-2030s from three lines.

BOEING has delivered the first of 78 contracted Block III F/A-18 Super Hornets to the US Navy.

Block III gives the US Navy 'the most networked and survivable F/A-18 built with a technology insertion plan that will outpace future threats.'

"The fleet needs capabilities to keep its edge," said CAPT Jason Denney, US Navy F/A-18 and EA-18G program manager. "Getting the first operational Block III in our hands is a great step forward in supporting our capability and readiness goals."

Block III's new adjunct processor translates to a fighter that Boeing says will do 'more work and in far less time', increasing a pilot's situational awareness. The jet is ready to receive apps-based solutions that will allow upgrades to the aircraft throughout its life span.

"We invested in Block III technology and developed the capabilities in partnership with the US Navy to meet its emerging requirements," said Jen Tebo, Boeing vice president of F/A-18 and EA-18G programs. "The hardware upgrades are complete. Today we are maximizing the open hardware and software and developing the apps to keep Block III ahead of future threats. We are giving Navy pilots the tools to make the fastest and most informed decisions possible now and in the future."

Boeing will continue to deliver Block III capabilities to the Navy through the mid-2030s from three lines. One new build production, and two Service Life Modification lines extending the life and eventually upgrading Block II Super Hornets to Block III. The first aircraft delivered will complete the US Navy flight test program before deploying to a squadron.

BABCOCK AWARDED MAJOR CONTRACT FOR HIGH FREQUENCY RADIO COMMS

A £110 million (A$208 million) contract has been awarded to Babcock International Group to deliver the UK's new Defence Strategic Radio Service (DSRS) to critical military operations.

DSRS uses the Earth's ionosphere, part of the upper atmosphere, to allow radio signals to be sent and received across thousands of kilometres. This allows communications to be rapidly delivered across a variety of domains to service personnel.

The new communications service removes the traditional requirement for direct-line-of-sight between the transmitter and user. Members of the UK Armed Forces will reportedly be able to communicate more effectively and quickly in challenging terrain, such as built-up cities, mountains and jungles.

"Babcock is delighted to be awarded the new Defence Strategic Radio Service contract which builds on our extensive experience and knowledge in this field," Babcock Chief Executive David Lockwood said. "In collaboration with both our partners and customer we will work together to deliver a secure, resilient and advanced solution that will ensure DSRS users receive assured services, in support of the critical operations they perform, that are fit for today and ready for tomorrow."

Babcock says the new system will also be critical for flight safety communications to all military aircraft while also supporting the 'mayday' fallback facility for the wider UK aviation community.

RIGHT: The new radio service aims to boost communications across multiple terrains and domains.

While used by the UK Armed Forces, the radio system will also support civilian tasks when required, including mountain rescue and civilian aircraft emergency communications.

DSRS works across all single Service capabilities and can be integrated with communication systems of global allies, improving the UK's ability to command and control its forces worldwide.

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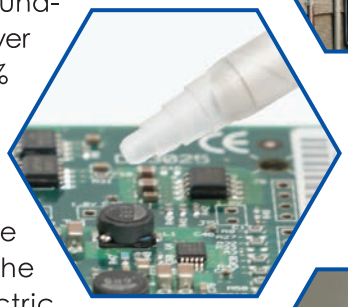
In addition to being the world's only current producer of high-performance, non-flammable, batteries, we have solved one of the most significant challenges hindering graphene's potential: manufacturing the purest graphene on a mass-production scale. In September 2020, we announced the ground-breaking achievement of developing a process to produce 90% mono-layer graphene, making us the first, and only, producer to break the 50% content barrier. In March 2021, we achieved 95% mono-layer graphene and are fast approaching 98% (confirmed by AFM, TEM, SEM and XRD techniques).



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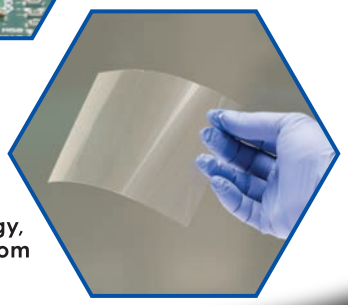

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TASMANIA'S HYDROGRAPHIC EXPERTISE IN DEMAND

TASMANIAN COMPANIES AND ORGANISATIONS PROVIDE VALUABLE MARITIME SERVICES AND HIGHLY SPECIALISED SKILLS AND UNDERSTANDING IN THE HYDROGRAPHIC AND OCEANOGRAPHIC DOMAINS.

Boasting the largest concentration of marine science and oceans expertise in the southern hemisphere, Tasmania's hydrographic and oceanographic organisations are experiencing unprecedented demand.

With private sector, government and academic and research organisations all based out of Australia's island state, Tasmania has become both a hub and a beacon for the marine sciences.

Organisations such as AMC Search, Offshore Unlimited, Veris Australia, TideTech and the CSIRO Marine National Facility are among recognised world-leaders in their respective fields, all headquartered in the middle of the strong, deep oceans below 40°S.

Tasmanian Defence Advocate, Rear Admiral (Rtd) Steve Gilmore said Tasmania has extensive experience working with maritime security agencies, commercial operators, and the Royal Australian Navy to improve ship operations and maritime safety.

"It is no wonder the state has the greatest concentration of marine science and oceans expertise in the southern hemisphere".

Not only are the services and solutions we offer being used right here in Tasmania for application globally, we're now seeing them provided in oceans around the world to better understand localised environmental conditions in the exact places that marine operations will be taking place.

Tasmanian hydrographic services are helping to improve navigational safety and marine operations, both above and below the waterline, helping to unlock new economic and commercial opportunities, boost security and defence, build scientific understanding and enable better environmental protection.

Even national organisations based in other locations like the Australian Hydrographic Office within the Royal Australian Navy are looking to Tasmania for services to support producing the official digital maps of Australia's sea and coastal areas, to ensure ships and watercraft operate more safely in Australian waters.

One of the most prominent Tasmanian-based hydrographic expert organisations is AMC Search, the training and consultancy division of the Australian Maritime College. Headquartered in the north of the state, AMC Search specialises in using the latest hydrodynamic modelling technology for realistic port and vessel interactions by simulating infrastructure and environments to test and optimise operations and systems.

More recently AMC Search has been conducting training on the safe and effective operation of Autonomous Maritime Systems (AMS), both autonomous underwater vehicles and un-crewed surface vessels, to the Navy's mine warfare and hydrographic teams from its specialised facilities at Newnham and Beauty Point in northern Tasmania. The training provided encompasses activities from logistics of AMS launch and recovery to data extraction and analysis, the only such training program available within Australia.

Another Tasmanian company seeing increased demand is Hobart-based Offshore Unlimited.

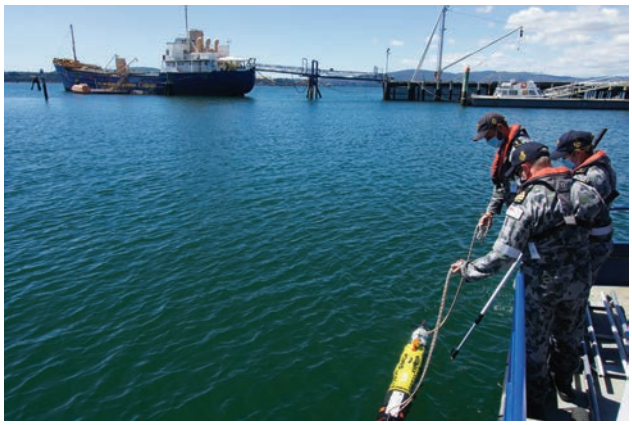
Since commencing operations in 2007, the company has established a modern fleet of support vessels servicing Australia's maritime needs including the oil and gas industry and science and aquaculture sectors, as well as conducting construction and hydrographic survey.

Recently, Offshore Unlimited partnered in the Department of Defence's HydroScheme Industry Partnership Program, providing vessels to support hydrographic survey operations around Australia to build an Australian hydrographic survey industry capability for non-military needs.

Not only will this work benefit Defence, but it will be of value to the many non-defence users of high-resolution bathymetric and oceanographic data that will be collected under the program.

Also with offices in Tasmania is Veris Australia, a leading provider of spatical data services, employing more than 500 staff around the country.

Offshore Unlimited vessel 'Outer limit' – Image courtesy Offshore Unlimited



RAN personnel undertaking training at the Australian Maritime College – Image courtesy Dr Damien Guihen, AMC Search

'RV Investigator' at the CSIRO Marine Laboratories in Hobart – Image courtesy of CSIRO

The company's digital and spatial capability using 3D sonar and laser scanning technology is in high demand for producing detailed 3D mapping and modelling of features and structures.

Veris offers a tailor-made solution to ensure assets remain safe, operational and efficient with survey and mapping results being used to provide a complete three dimensional as-built model of the structure both above and below the waterline.

Focused on safe maritime operations, Tasmania's TideTech is also seeing local and international success through their weather, wave and ocean monitoring and forecasting services.

Based on official and academic sources not available elsewhere, TideTech's solutions cover the range of data necessary for safe maritime operations including detailed projections covering global weather conditions, waves, sea temperature, ocean and tidal currents as well as modelling of tidal elevations, currents, storm and tide surges.

Also located in Hobart, the CSIRO's Marine National Facility is Australia's only dedicated blue-water research centre providing an impressive multi-disciplinary marine research capability which enables a wide-range of research activity.

With its ocean-class research vessel the RV Investigator, the Marine National Facility supports biological, oceanographic, geological and atmospheric research, as well as marine education and training.

The vessel is funded for year-round operation, providing up to 300 research days each year and supports Australia's contribution to large international research programs to address research questions in a global context.

With these national and world-leading entities and a range of other oceanic and marine expert bodies such as the Institute of Marine and Antarctic Studies, the Southern Ocean Observing System, the Integrated Marine Observing System, the Blue Economy Cooperative Research Centre, the CSIRO's Oceans and Atmosphere centre, CLS Oceania and Imbros all located in Tasmania, it is no wonder that we are increasingly being sought for our hydrographic and oceanographic expertise.

For more information visit:
www.stategrowth.tas.gov.au/defence

POSEIDON FLEET MODIFICATIONS COMPLETE

DEFENCE

LEFT: Group Captain John Grime stands with staff and personnel from Surveillance and Response Systems Program Office, No. 92 Wing and Boeing.

BETTINA MEARS | DEFENCE

A SIGNIFICANT capability milestone has been achieved for Air Force's P-8A Poseidon platform.

Operated by units under the command of No. 92 Wing, the P-8A Poseidon fleet underwent extensive modifications over a period of 12 months to support future upgrades to the capability.

The completion of the modification program was marked with the finalisation of works on P-8A Poseidon aircraft A47-006 on July 28 at RAAF Base Edinburgh, near Adelaide in South Australia.

The works were carried out by Boeing in partnership with personnel from the P-8A Enterprise, which includes supporting elements from Boeing Defence Australia, Airbus Australia Pacific, No. 92 Wing and Surveillance and Response Systems Program Office.

Officer Commanding No. 92 Wing Group Captain John Grime said it was an important capability outcome.

"The P-8A fleet is now future-proofed and ready for the technical upgrades that lie ahead," Group Captain Grime said.

"This tranche of modifications included wiring upgrades to expand and enhance the mission systems fitted to the aircraft and improve interoperability; as well as networking for air-to-air, air-to-ship and air-to-ground communications in support of the joint force.

"These modifications will position the P-8A Poseidon as the premium maritime surveillance aircraft in the world.

"The project forms part of the P-8A Cooperative Program, which continues to deliver important capability outcomes, achieving results through seamless and highly successful Air Force and Defence industry collaboration.

"92 Wing is really proud of our contribution to these projects and our role in these partnerships, which ensures we maintain the capability edge for Australia and our coalition partners."

RECURRING ENGINE DEFECT STRANDS HMAS *DIAMANTINA*

EWEN LEVICK | MELBOURNE

HMAS *Diamantina* was stranded in Vanuatu in September following the detection of a recurring 'defect' in the main engine.

The ABC reported that the Huon class minehunter was stuck in Port Vila, Vanuatu as a maintenance team arrived on board the MV Sycamore to fix the problem.

Defence said it expected the ship to return to Australia under its own power, contrary to media reports that it may have had to be towed home.

The minehunter was in Vanuatu to provide maritime surveillance as the country stands up its Guardian class patrol boat.

"Defence can confirm that HMAS *Diamantina*, a Huon-Class Minehunter Coastal vessel, developed a maintenance issue that delayed its planned return from Port Vila in Vanuatu back to Australia," a spokesperson said.

"The Defence-contracted vessel MV *Sycamore* sailed from Sydney to Vanuatu with a maintenance team and equipment to support repairs and HMAS *Diamantina* is expected to return to Australia under her own power.

"The movement of personnel across both vessels is being managed in a COVID-safe manner in order to prevent personnel from either vessel interacting with the local community."

RIGHT: The Huon class minehunter was stuck in Port Vila, Vanuatu.

ADM understands that the defect in the main engine has been experienced previously on HMAS *Diamantina* but is not considered an issue across the other Huon class vessels.

In January, Defence made a down-select decision to explore a variant of the OPVs for the new Mine Countermeasures and Survey Vessels under Project Sea 1905 Phase 1, which will replace the Huon class from the middle of this decade.

DEFENCE

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SAAB SIGNS CONTRACT WITH MARSHALL FOR DEPLOYABLE HEALTH CAPABILITY

SAAB

ABOVE: Marshall will deliver three of its Marshall Military CT scanners for use as part of the deployable medical modules.

SAAB Australia has moved a step closer to delivery of Australia's deployable health capability with the signing of an A$8.28 million contract with key technology supplier and capability partner, Marshall.

Under the contract, applied-engineering firm Marshall will deliver three of its Marshall Military CT scanners for use as part of the deployable medical modules being delivered by Saab to the ADF under the JP 2060 Phase 3 project.

Once operational and deployed, the scanners will enable field medical staff to create detailed diagnostic images of patients – enabling immediate and accurate treatment in the field.

"Safe, effective and reliable medical equipment is critical to Australia's deployable health capability in ensuring world-class clinical care," Andy Keough, Saab Australia Managing Director said. "That's why we're delighted to have Marshall Land Systems on board. They are a leading supplier of proven deployable health systems and their CT scanners are currently being used by armed forces across the globe."

Saab signed a contract with Defence in 2020 to deliver more than 550 deployable health modules. The $370 million order is to be fulfilled between 2020 and 2024. Modules within the program will include features such as surgical theatres, x-ray, CT scanning and ultrasound equipment, and trauma, intensive care and ward units.

Marshall Land Systems Managing Director Ray Cutting says the scanners being supplied for the project have a proven operational record in the most hostile of environments.

"I am delighted that Saab Australia has decided to partner with us on this critical element of the JP2060 Phase 3 program," Cutting said. "Our innovative and award-winning CT scanner system is designed to meet clinicians' needs for the highest quality diagnostic imagery, even in the most austere environments, and can be operational within four hours of arrival on site."

Cutting says the benefit of having access to CT imagery in the field cannot be overstated.

"The unit will give military surgeons vital CT imagery on deployed operations to quickly and accurately diagnose trauma for severely injured patients. Potentially, more lives will be saved."

The CT units are being supplied in the United Kingdom by Philips and will be maintained in Australia by the locally based Philips team.

CT scanners combine a series of x-ray images and use computer processing power to create cross sections of targeted body parts. This allows medical staff to view bones, blood vessels and soft tissues inside the body. ■

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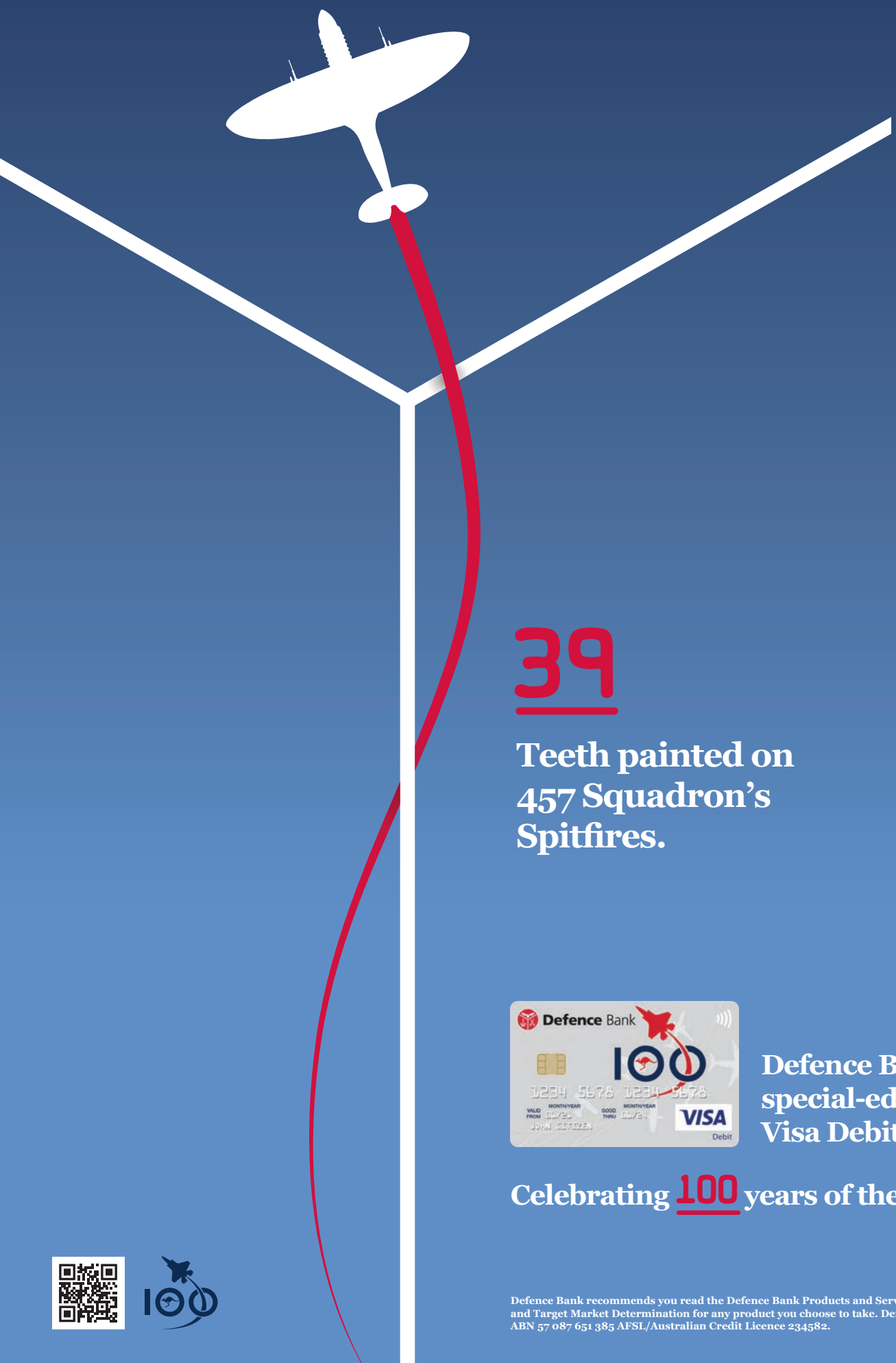

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Teeth painted on 457 Squadron's Spitfires.

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PRINCES TRUST

FINDING TREASURE IN THE SCRAP HEAP

RAAF veteran Zach Briggs is preserving history by transforming unserviceable military aeroplanes into one-of-a-kind artworks with help from Prince's Trust Australia.

LYNDSAY ANNE | GEELONG

BRIGGS has found a unique way to preserve history by repurposing abandoned military and civilian aircraft into custom furniture after previously serving 12 years in the RAAF as an aviation technician.

As he prepared for transition into civilian life, Briggs completed an industrial design degree at university and, while driving past the RAAF Amberley base museum, he saw an old aeroplane being cut up for scrap. Feeling disheartened at the thought of it going to waste, he approached museum staff.

"You could turn this stuff into things you can use. You could have a conference table in your office made out of an aeroplane wing, you don't have to throw it out," he told them.

The museum staff gave him the wing of an ex-RAAF MB.326H Macchi and asked him to make the table.

Over the next 12 months, Briggs built the conference table and made bottle openers and key rings with the off-cuts. Word spread quickly and he began receiving emails asking him to make more. People requested custom made furniture and shared personal stories with him about their military history. Touched by their stories, Briggs realised his designs meant more to people than he thought - it was a way for people to connect with their own military experiences and those who had served before them.

"That's when I realised, it also creates emotional connection with people. People see value in something that speaks to and connects with them," he said. "So, I started thinking maybe there's some level of importance to what I'm doing."

Briggs discovered many unserviceable military and civilian aeroplanes being used as scrap metal. He realised he could combine his creativity and skills in aviation and engineering to preserve history, contribute to environmental sustainability and create a meaningful future for himself when he transitioned to civilian life.

"I felt it was a tragedy watching these old aeroplanes go to the scrap yard. I had an opportunity here to not only do something I love, but to do something that is sustainable, and preserve history in a unique way," he added. "It makes me happy, so I thought it would be great idea to try and make a business out of it."

Feeling inspired, he began sketching more designs but was unsure how to run his own business. While attending a transition seminar in preparation for his discharge, he discovered Prince's Trust Australia, a not-for-profit charity that helps veterans and their families become entrepreneurs. Shortly after discharge, Briggs completed their Enterprise Program, equipping him with the skills, confidence and network he needed to explore his ideas and launch his own business.

"It was easily the best thing I did in my transition," he said. "It definitely gave me the confidence to get my foot over the line and give it a go, because the hardest thing was that big step."

It is now two years since Briggs launched his own business, Relic Design & Craft Co. He collects parts from neglected civilian aeroplanes and purchases military aircraft parts from museums, which in turn helps them gather funds to keep operating. He strictly uses only unserviceable parts and, if he is offered a serviceable part, he offers it to museums.

"I think creativity is driven by emotions. There's definitely an emotional connection with everything I work on. My background in aviation, my passion for art and design, everything I see and experience, is reflected in everything I create," Briggs said.

Each piece comes with the type of aeroplane, its military history and which part of the aeroplane it has been made from.

OPPOSITE PAGE: The conference table made for the RAAF Amberley base museum from recycled Macchi wings

RIGHT: Zach Briggs served as an aviation technician in the RAAF for 12 years before his transition to civilian life

Examples of his designs include a desk lamp from an emergency oxygen bottle from a Caribou, office chairs using seats from an Air New Zealand 737 – and a coffee table from the seat mounting frame; and a coffee table and bookshelf from the flaps of a PC-9.

His current project involves constructing a conference table using the wingtips and elevator of a DC-3. He is also planning pop-up shops and exhibitions to showcase his designs and is keen to share his passion for creating pieces that are meaningful, sustainable, and bring to light the history of the aircraft from which it was made.

Prince's Trust Australia's Enterprise program is an entrepreneurial training program designed to give ex-serving and transitioning ADF members and their partners the support to explore self-employment.

Launched in 2015, it has since supported 500 participants, more than 50 activities and the establishment of more than 100 businesses that remain in operation today.

PRINCES TRUST

Prince's Trust Australia is part of The Prince's Trust Group, a global network of charities founded by HRH Prince of Wales. Enterprise is guided by an Advisory Council, chaired by His Excellency General, David Hurley (Retd) and attended by MAJGEN Natasha Fox, Defence Head of People Capability. ■

Lyndsay Anne is an RAAF veteran, Enterprise alumna and freelance writer.

DEFENCE

JP9360 TO PROVIDE A SHARP FOCUS ON SPACE

Underlining the growing importance of the space domain, the Commonwealth plans to invest around seven billion dollars in developing ADF space capabilities over the coming decade.

NIGEL PITTAWAY | MELBOURNE

THE investment in space is flagged in the Defence Strategic Update 2020 (DSU2020) and underpinned by the announcement in May of the creation of a dedicated Space Division within the RAAF, to be led by the current Head Air Force Capability, Air-Vice Marshal Cath Roberts.

The Space Division will come into being in January 2022 and will assure Defence's access to space, enabling multi-domain operations by overseeing the development of a sovereign space capability. While a sovereign satellite capability will be delivered under other projects, the establishment of a sovereign space domain awareness (SDA) program first will be a key enabler.

"We use space daily for understanding the weather, navigating, access to geospatial information and sharing information across Australia or across the world," Chief of Air Force Air Marshal Mel Hupfeld noted when he announced the formation of an RAAF Space Division. "Defence is delivering capabilities including space domain awareness, sovereign controlled satellite communications and space-based Earth observation, and navigation."

To oversee the development of a sovereign SDA capability, Defence launched JP9360, (Space Domain Awareness) in 2020, which brings six earlier projects together as a single program. In September this year, Defence further briefed industry that the delivery of capability under the overarching JP9360 project will be sought via a series of tranches that will take advantage of maturing technologies.

MAIN: DST's High Frequency Line of Sight Radar Receiver Array near Coondambo, captures signals reflected from overhead satellites, during SpaceFest 2019 at the Woomera Test Range in SA

BELOW: DST and RAAF personnel in front of a FireOPAL sensor developed in collaboration between Curtin University and Lockheed Martin Australia during SpaceFest 2019 at the Woomera Test Range in SA

WHY SDA IS IMPORTANT

Modern society is heavily dependent on space-based systems for its day-to-day existence. Things we all take for granted, such as ATMs, internet banking, mobile telephones, GPS-based navigation systems and vital services such as air traffic control are heavily dependent on space-based systems. From a Defence perspective, many modern weapons, navigation and communications systems are also reliant upon satellite-based position and timing services.

Space is also becoming an increasingly congested environment and malicious intent by an enemy aside, the exponential growth of objects in space – both close to the surface in Low Earth Orbit (LEO) and further out into the cosmos in Geostationary Earth Orbit (GEO) – increases the risk of collision on almost a daily basis.

According to the European Space Agency (ESA) in January 2021 there were more than 34,000 objects orbiting the Earth, each one larger than 10cm in size. Under its Starlink communications program, Elon Musk's Space X has plans to add more than 40,000 satellites into LEO in coming years and the rapid commercialisation of the space industry is expected to add many thousands more.

Objects in orbit travel at speeds of around ten kilometres per second and even something as small as a flake of paint deposited in space during the launch process has the potential to disable a satellite. Even worse, every collision creates more space debris, further increasing the risk of collisions occurring. This is known as the Kessler Syndrome, named after NASA astrophysicist Donald Kessler who, in 1978, predicted the continued generation of space debris will reach a point where collisions become inevitable.

Formerly known as Space Situational Awareness (SSA), Space Domain Awareness is therefore a critical priority and the largest contributor to this is the US, which maintains a network of sensors distributed around the world – including Australia – as part of its Space Surveillance Network (SSN). Data collected by the SSN is transmitted to the US Combined Space Operations Center (CSpOC) at Vandenberg Space Force Base in California, where it is collated into a master Space Objects Catalogue and distributed (in unclassified form) to the wider space community.

With all of this in mind, the desire to have a sovereign awareness of space will be pivotal to a Defence satellite capability over the coming years.

"We know that space is not a benign environment where everyone plays nicely, we need to be able to independently verify whether our satellites are experiencing a malfunction or if they're under attack, so we can make the right decisions to protect and defend them," Director General Air Defence and Space, Air Commodore Philip Gordon, explained. "SDA is absolutely critical to space control and everything we do in space. It seeks to give us an independent ability to assess and verify what's going on in space, and at the same time contribute to a broader SDA enterprise with the US and our allies."

"WE USE SPACE DAILY FOR UNDERSTANDING THE WEATHER, NAVIGATING, ACCESS TO GEOSPATIAL INFORMATION AND SHARING INFORMATION ACROSS AUSTRALIA OR ACROSS THE WORLD"

In addition, as powers in the Indo-Pacific region further develop intra- and inter-theatre missile capabilities, the knowledge of what should be in space and what shouldn't has become a cornerstone of Australia's desired Ballistic Missile Defence (BMD) capability.

"We want to make sure we consider data on everything above the surface of the Earth (arbitrarily determined to be more than approximately 100km), as it turns out, some of the things we really care about start in the atmosphere, travel through space and then come back into the atmosphere," AIRCDRE Gordon added.

INITIAL STEPS

Australia has been contributing data to the US SSN in the civil domain for many years, largely through the capabilities of EOS Space from its facilities at Mt Stromlo in the ACT and Learmonth in WA. From a military standpoint, SDA activities are also being undertaken from Australia, albeit in conjunction with the US and our unique geographical

DEFENCE

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LEFT: The C-Band space tracking radar at Learmonth is operated by the RAAF's No. 1 Remote Sensor Unit

BELOW: In April 2021, Air Surveillance Operators at No. 1 Remote Sensor Unit based at Edinburgh concluded training on the first RAAF Space Surveillance Telescope

position – coupled with relatively benign weather patterns, a stable political system and a growing and skilled space industry – provides the basis for a sovereign SDA network.

Under Air 3029 Phase 1 a US C-Band Space Surveillance Radar (SSR) was relocated from Antigua in the Leeward Islands and installed in a purpose-built facility at Learmonth, beginning in 2014. The facility is operated by Australian personnel with data received transmitted back to the US and achieved Final Operational Capability (FOC) in March 2017.

In addition, a Space Surveillance Telescope (SST) installed at Learmonth under Air 3029 Phase 2 is expected to become fully operational in coming years. The SST will offer a wide-field view of deep space, including the ability to track dimly-lit objects out in the GEO belt. Also installed in a purpose-built facility, the SST achieved the 'First Light' milestone (denoting the first image recorded) in March 2020 and training of RAAF air surveillance operators began in April this year.

"JP9360 (SPACE DOMAIN AWARENESS) AIMS TO DELIVER A DISTRIBUTED, MULTI-TECHNOLOGY AND MULTI-LAYERED APPROACH"

Sustainment of the SSR and SST will fall under the auspices of JP9360, as will the construction of a co-located SST Mirror Recoating Facility (MRF), beginning in 2022. The on-site MRF facility will reduce the risk of damage to the telescope's large and expensive mirrors, which would otherwise have to be shipped to a US-owned facility in Hawaii.

A SOVEREIGN SPACE CAPABILITY

Launched in July 2020, JP9360 consolidates six space surveillance projects – Air 3029 Phase 2, Space Surveillance Telescope Relocation; JP9350 Phase 1, ADF SSA Mission System; JP9351 Phase 1, ADF SSA Indigenous Sensors; JP9352 Phase 1, Space Surveillance Radar Replacement; JP9355 (Overhead Persistent Infra-Red Enhancement); and JP9356 (Overhead Persistent Infra-Red Enhancement) – into a 'program of programs' approach.

JP9360 (Space Domain Awareness) aims to deliver a distributed, multi-technology and multi-layered approach and among the capabilities sought are threat warning, attribution and detection, tracking, and the ability to characterise natural and man-made objects.

After considering industry responses to a Request for Proposal (RFP) released in mid-2020, CASG's Wide Area and Space Surveillance Project Office (WASS SPO) and Space Acquisition Project Office (SAPO) released a revised roadmap in September and will now seek to deliver capability under a number of tranches.

The 'tranched' approach is intended to be flexible enough to respond to rapidly-developing sensor and mission control systems technology and acquisition of the first tranche, in the form of ground-based optical (GBO) sensors, is expected to begin in mid-2022. Further tranches are expected to be offered for government consideration on a roughly two-year cycle.

AIRCDRE Gordon said GBO solutions are felt to be more technically mature than other proposals at the present time and although they will initially be operated by industry, under a 'Data as a Service' (DaaS) mechanism, later tranches of JP9360 will seek to acquire a sovereign mission system.

"We've chosen that path deliberately to de-risk this (initial) tranche and make some early progress, (because) we don't have to build facilities. We can pay industry to deliver a DaaS capability – we don't have to go through a Public Works process, we can pay industry to deliver a DaaS capability and we believe that gives us the ability to work at the speed of relevance. We're not choosing one GBO sensor, I've challenged the team to find a way to support up to three companies to deliver three different systems, so we can start receiving a diversity of information," AIRCDRE Gordon explained.

"Importantly, we're not choosing between different types of submarines, we're choosing which will be the next batch of capabilities we introduce into our system, and which will need more time and investment to mature. This is not a binary choice, but about building out multiple sensors to give us multiple vantage points."

DEFENCE

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THE ROYAL AUSTRALIAN AIR FORCE: 1921-2021

With a century of professionalism, dedication and valour behind it, the Royal Australian Air Force is today one of the most effective air arms in the world, thanks to some far-sighted planning and implementation. As the 21st century progresses, the RAAF is not only well prepared for the connected 'digital age', but also fully immersed in it.

STEWART WILSON | BUNGENDORE

Aviation has had a relatively brief history in the overall scheme of things, but the 118 years since the Wright brothers has seen rapid, almost unimaginable advances in technology as it applies to aviation.

RAAF

NIGEL PITTAWAY

ALTHOUGH officially formed in 31 March 1921 as the Australian Air Force – the 'Royal' prefix was approved by King George V the following August – this auspicious occasion did not mark the beginning of military flying in Australia.

That was in March 1914 when a Bristol Boxkite and Deperdussin were test flown at Point Cook on the shores of Victoria's Port Phillip Bay. These flights were the first conducted by the recently established Australian Flying Corps (AFC), which like its British counterpart (the Royal Flying Corps) was part of the Army and its personnel carried Army ranks.

Investigations into the establishment of an Australian aviation corps had begun as early as 1910 and in early 1911 a Bristol Boxkite was demonstrated to Army officials. In December of the same year an advertisement was placed in the Commonwealth Gazette calling for "the appointment of two competent mechanists and aviators."

"INVESTIGATIONS INTO THE ESTABLISHMENT OF AN AUSTRALIAN AVIATION CORPS HAD BEGUN AS EARLY AS 1910 AND IN EARLY 1911 A BRISTOL BOXKITE WAS DEMONSTRATED TO ARMY OFFICIALS"

Two BE.2A biplanes and two Deperdussin monoplanes were ordered in mid-1912 and in August Lt H A Petrie was appointed Australia's first military aviator. In September 1912 the formation of the Australian Flying Corps (AFC) and Central Flying School (CFS) was approved and in December a Bristol Boxkite was ordered.

Point Cook was then selected as the site for the CFS and the first four students – all Army officers – began training in August 1914, just two weeks after the start of World War I. Lt Richard Williams was the first to qualify for his wings the following November and he went on to become the RAAF's first Chief of Air Staff, a post he held on three separate occasions during his long and illustrious career.

INTO BATTLE

The AFC was the only Commonwealth air arm to see active service during World War I, beginning in 1915 with the establishment of the Half Flight in Mesopotamia (Iraq) in response to a request from the Indian Government for assistance.

Later incorporated into the Royal Flying Corps, the Half Flight was followed by a number of AFC squadrons in Egypt, Palestine, France and Britain. Australians who flew with RFC units included some who would later become household names in aviation including Charles Kingsford Smith, Bert Hinkler, Hudson Fysh, Lawrence Wackett, Ross Smith and P G Taylor.

A total of 460 officers and 2,234 other ranks served with the AFC in World War I, along with another 200 pilots and observers who flew with other flying services.

DECLINE AND REBUILDING

After WWI, the AFC was disbanded and replaced with the temporary Australian Air Corps, still controlled by the Army. This period witnessed a virtual end to military flying in Australia apart from the activities of the Central Flying School at Point Cook.

Plans to establish a permanent air force continued and in September 1920 Prime Minister Billy Hughes announced that an independent air arm would be established as part of Australia's armed forces. A sum of £500,000 ($1,000,000) was granted and the Australian Air Force formally came into being on 31 March 1921.

At that point the AAF was in the remarkable situation of having more aeroplanes than personnel! Manpower strength comprised 21 officers and 130 other ranks whilst the number of aircraft on strength was 157. Most of these were 128 'Imperial Gift' aircraft from Britain – DH.9A bombers, DH.9 army co-operation aircraft, SE.5A fighters and Avro 504K trainers. Point Cook remained the RAAF's only flying base in those very early days.

ABOVE: The RAAF entered the new world of modern, high technology, multi-role fighters in 1985 with the arrival of the F/A-18 Hornet, the service's first computer-driven 'electric jet'.

RAAF

RAAF

Gradual expansion followed in the 1920s with the establishment of new bases and the introduction of new aircraft. But with the 1930s came the Great Depression and severe cost cutting, and in the early part of the decade the very future of the RAAF was in doubt.

Sense eventually prevailed and some expansion occurred mid-decade. By the time the war against Germany began in September 1939 the RAAF had 310 officers and 3,179 other ranks in 12 squadrons based at six airfields. Aircraft strength was 246 of which just 164 were operational types. Despite the modest expansion program of the mid and late 1930s, the RAAF's frontline aircraft were at best obsolescent with modern combat types lacking.

"DESPITE THE MODEST EXPANSION PROGRAM OF THE MID AND LATE 1930S, THE RAAF'S FRONTLINE AIRCRAFT WERE AT BEST OBSOLESCENT WITH MODERN COMBAT TYPES LACKING"

That situation was helped to some extent with orders for Lockheed Hudson medium bombers and Short Sunderland flying boats, while local manufacture of the Wirraway general purpose trainer and Tiger Moth basic trainer was in hand. Lacking was any sort of modern fighter.

In 1939 the chances of Australia itself being attacked seemed remote, but when Japan entered the war in late 1941 and directly threatened, defensive capability was found lacking. At the time of Japan's attack on Pearl Harbour on 7 December 1941 the RAAF had 177 aircraft on first line strength (plus four squadrons in Malaya under RAF control) with another 306 in reserve.

Only two squadrons were equipped with anything even faintly resembling a modern fighter - the unsuccessful Brewster Buffalo - and they were in Malaya about to be all but wiped out by the advancing Japanese.

Of the front-line aircraft available to the 17 RAAF home squadrons (three of which were in New Guinea) 101 were Wirraways, 53 were Hudsons, 12 were Catalina flying boats and 11 were Seagull amphibians. The reserve force comprised Fairey Battle single-engined light bombers, Avro Ansons and more Wirraways.

COMING OF AGE

The RAAF underwent massive expansion in World War II. By its end the RAAF was the fourth largest air force in the world, after the US, Britain and the Soviet Union with no fewer than 75 operational squadrons, 17 of which fought their war entirely in the northern hemisphere against Germany and Italy.

Of these, 15 were established as Australian squadrons under RAF control using increasing proportions of Australians who had trained under the Empire Air Training Scheme, a massive Commonwealth undertaking designed to provide 50,000 trained aircrew annually.

Australia's contribution was the training of 27,387 aircrew as well as providing elementary training for an additional 10,351 pilots, navigators and wireless-air gunners. To meet this need, large numbers of Tiger Moths and Wir-

RAAF

ABOVE LEFT: The RAAF's predecessor, the Australian Flying Corps (AFC) was controlled by the Army and the only Commonwealth air arm to see active service in WWI. Here, No 1 Squadron AFC personnel parade in Palestine in early 1918 with commanding officer Major Richard Williams.

ABOVE: The Hawker Demon fi hter-bomber and army co-operation aircraft was the RAAF's only 'combat' aircraft in the mid-late 1930s with 64 operated from 1935.

LEFT: The privately-owned Commonwealth Aircraft Corporation (CAC) was established in 1936 by a group of Australian industrialists who were concerned about the growing threat of war and the nation's lack of preparedness for it.

THE DEFENCE STATE

FOR 100 YEARS SOUTH AUSTRALIA HAS SUPPORTED THE MEN AND WOMEN OF THE ROYAL AUSTRALIAN AIR FORCE THROUGH TRAINING, TESTING, RESEARCH AND OPERATIONS IN AEROSPACE AND SPACE ACROSS THE COUNTRY AND THE WORLD.

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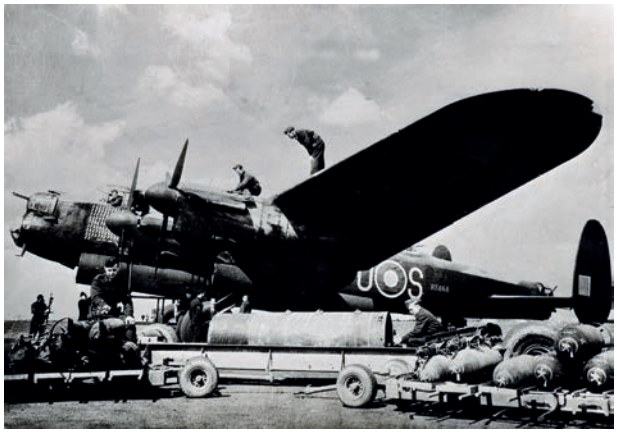
Images courtesy of Department of Defence and DSTG.

ROBERT WISEMAN COLLECTION

ABOVE: A massive industrial mobilisation followed the establishment of the government-owned Department of Aircraft Production. Its first product was building the Bristol Beaufort light bomber under licence for the RAAF.

RIGHT: 460 Squadron RAAF's famous Lancaster 'S for Sugar' being bombed up for yet another mission. The bomber is now preserved at the RAF Museum at Hendon.



ROBERT WISEMAN COLLECTION

raways were manufactured locally and other aircraft including some 1,000 Avro Ansons and nearly 400 Airspeed Oxfords were imported.

Australian airmen were involved in every theatre of operations in the northern hemisphere whether as part of the 'Australian' squadrons or regular RAF units. Bomber Command in particular received a huge contribution – some 20,000 men – but at a high price with 3,486 losing their lives.

Japan's strike on Pearl Harbour in December 1941 and its subsequent rapid advance through the Philippines, Malaya, Singapore, New Guinea and the Dutch East Indies made Australia suddenly very vulnerable.

The RAAF's lack of fighters was now a critical factor: this point was rammed home on 19 February 1942 when Darwin suffered the first of 64 air raids it would endure between then and the end of 1943. Other northern Australian towns and cities would also be bombed by the Japanese, among them Townsville, Broome and Katherine.

Fighters for the RAAF became the priority and the Australian-built CAC Boomerang was hurriedly designed and flown as insurance against more capable aircraft failing to arrive from overseas.

As it happened, fighters did arrive in the shape of Curtiss Kittyhawks initially and then Supermarine Spitfires. Offensive aircraft were also in short supply for the RAAF's Pacific activities and some imaginative planning and a huge industrial effort which resulted in the establishment of the Department of Aircraft Production saw Bristol Beaufort light bombers coming off production lines in Melbourne and Sydney from late 1941. These were followed by Beaufighters in 1944.

Aircraft production during World War II was an important part of the overall effort in that it saved overseas resources as well as giving the RAAF some independence as to its choice of equipment. Australian factories produced more than 3,600 aircraft between 1939 and 1945 including trainers, fighters and strike aircraft.

Initially, Australia's fight with Japan was a defensive one – particularly in the heroic defence of Port Moresby and other parts of the New Guinea area – but as the allies began to gain the ascendency from 1943, defence turned to attack as the Japanese were turned around and gradually forced back.

In combination with American, British, New Zealand, Australian and other allied ground, sea and air forces, the RAAF played a significant role in all of this.

The RAAF enlisted 189,700 men and 27,000 women during WWII. Of these, 10,562 lost their lives (half of them in the European theatre) and 3,192 were injured.

continued p44

HONOURING 100 YEARS OF THE ROYAL AUSTRALIAN AIR FORCE

Founded in values of service, courage, respect, integrity and excellence, the Royal Australian Air Force (RAAF) has been defending the people of Australia for the last century. Since 1927, Boeing and the RAAF have partnered to create next-generation products and push the boundaries of air defence. Boeing also proudly welcomes RAAF veterans into our workforce, where they continue to support Australia's defence. As enduring partners, we recognize the centenary of the RAAF and we look forward to many more years of partnership, innovation and protection.

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BOEING

Honouring 100 Years of the Royal Australian Air Force

Partnering for the future of Australian airpower

On 27 March 1939, the first Wirraway aircraft manufactured for the RAAF by Boeing heritage company Commonwealth Aircraft Corporation (CAC) took to the skies above Melbourne for the first time.

It was a milestone flight, not just because it was the first aircraft produced by CAC, but because it signaled the beginning of a long and proud partnership between Boeing and Australia's Air Force.

Since that history-making event more than 80 years ago, Boeing has continued to partner with the RAAF, through an era of unrivalled technological advancements, to help redefine Australian airpower.

There is no more potent example of the importance of Boeing's innovation and future focus, or its commitment to supporting the RAAF's evolution, than the Loyal Wingman, conceived through an intimate understanding of the RAAF's future force needs and a dedication to developing disruptive technologies.

Designing, developing and manufacturing a semi-autonomous aircraft using artificial intelligence to complement and extend airborne missions is ambitious for a country that hasn't built a military aircraft in more than 50 years.

But the speed at which the research, development and prototyping phases were completed, and the aircraft's successful inaugural flight earlier this year, demonstrates the expertise within Boeing's Australian workforce, the strength of Australian industry and the resoluteness within the RAAF to evolve for the 21st century battlespace.

"Our in-country technological know-how, innovative mindset and collaboration isn't just harnessed on Loyal Wingman," said Scott Carpendale, Boeing Defence Australia's vice president and managing director. "It's inherent in our 2800+ local workforce, which includes many RAAF veterans, and all other Boeing-led defence programs, which are enhancing capability and supporting mission readiness of the Air Force's frontline platforms and systems."

Since 2015, the RAAF's E-7A Wedgetails have been undergoing the most far-reaching systems upgrade since their introduction into service in 2010 and one of the most complex aircraft upgrades ever undertaken in Australia.

The RAAF's desire to establish a world-leading sovereign mission system capability has seen the majority of that development work performed in-country by Boeing Defence Australia with support from the global Boeing enterprise. The advanced software engineering workforce that has emerged is also supporting the UK Wedgetail program, demonstrating the importance and value of investing in local talent and technology, not just for Australia but for our allies.

ABOVE: The RAAF's E-7A Wedgetails are currently undergoing the most far-reaching systems upgrade since their introduction into service, with the majority of development work being performed in-country by Boeing Defence Australia.

RIGHT: The Loyal Wingman, designed and developed in Australia with the RAAF, will complement and extend airborne missions.

While the program primarily applies mandatory compliance upgrades to the fleet, it is setting the foundations for the capability's technological evolution over the coming decades to ensure it remains the world's most advanced and dependable AEW&C platform for current and future operators.

Understanding the RAAF's future force requirements and developing technology roadmaps that prepare it for its central role in the joint force is just one way Boeing supports the RAAF to achieve the Force Structure Plan. Ensuring fully operational and capable weapon systems for today is an equal imperative.

"Boeing aircraft make up one-third of the RAAF's fleet and Boeing Defence Australia is the sustainment prime contractor for all of them, partnering with the RAAF and local industry to keep each platform mission ready," said Carpendale.

"Our expertise in platform sustainment, training and through-life support doesn't just come from what we deliver, but how we deliver it, and that's via the Platform Steward model."

Under this approach, developed collaboratively with the Capability Acquisition & Sustainment Group, Boeing's sustainment contracts operate under a single management framework that includes contractor and Commonwealth employees and Australian defence industry, together with RAAF operators. It supports the effective management of current and future fleet requirements by focusing on fleet reliability, availability and capability above all else.

The model includes working in close partnership with the US Navy on spiral development programs for the F/A-18F Super Hornets, E/A-18G Growlers and P-8A Poseidons to ensure each platform keeps pace with evolving technology.

Boeing also works with RAAF capability managers to leverage digital engineering and operational modelling using the Systems Analysis Laboratory within Phantom Works International in Brisbane. This modelling helps the RAAF understand the capabilities they will need to meet future threats or increased rates of effort, and to develop growth paths to achieve these operational outcomes and maximise the utility of their existing weapon systems.

Delivering best-for-capability solutions also involves harnessing the latest technologies to improve platform readiness, availability, safety and relevance, while reducing overall cost of ownership.

Boeing's suite of industry-leading, locally-developed data analytics tools are delivering enhanced maintenance, repair and overhaul, and supply chain outcomes through the use of big data analytics, artificial intelligence, machine learning and other evolving technologies, as well as specialised software developed by Australian SMEs.

The strong and enduring partnership that is enabling outstanding performance in the air domain has formed the basis of Boeing's approach to supporting the RAAF as it forges ahead with its Force Structure Plan to build a sovereign space capability.

Boeing Defence Australia is merging US-developed space technology and solutions with existing in-country expertise to create solutions that provide Australia with the best possible capability and sovereign control.

The partnership – between Boeing's satellite business, which continues to support commercial and government satellite programs with the US military's most modern wideband communications satellite, WGS-11, Boeing Defence Australia and a range of key local businesses – has great potential for Australia to expand space-based and space-enabled capabilities.

Today's partnership between Boeing and RAAF – spanning some of the world's most technologically-advanced platforms and systems within the air and space domains – is a far cry from the one that sent the first Wirraway soaring into the clouds eight decades ago.

In this centenary year, Boeing honours the remarkable achievements of the RAAF's aviators, past and present, and takes pride in its enduring partnership that has helped evolve the RAAF into the revolutionary, world-leading Air Force it is today.

RAAF

LEFT: The RAAF's workhorse fighter 'at home' during WWII, the Curtiss P-40 Kittyhawk. The RAAF received 848 of various models during the war – these are P-40Ns.

"IN 1939 THE CHANCES OF AUSTRALIA ITSELF BEING ATTACKED SEEMED REMOTE, BUT WHEN JAPAN ENTERED THE WAR IN LATE 1941 AND DIRECTLY THREATENED, DEFENSIVE CAPABILITY WAS FOUND LACKING"

POST WAR, LITTLE PEACE

Inevitably, the end of WWII saw a massive reduction of the RAAF and other branches of the armed forces. At its peak in 1944 the RAAF had 164,341 personnel on strength. In the two years following the end of the war the numbers dropped dramatically to 10,000 by early 1947 and just over 8,000 a year later with the prospect of a rise to 14,000 under plans for the post-war RAAF.

By 1950 the fleet comprised Lincoln bombers, Mustang and Vampire fighters (the latter the RAAF's first operational jet), Dakota transports, Catalina flying boats, Mosquito survey aircraft and an assortment of trainers including the Tiger Moth and Wirraway.

Many new types joined the RAAF in the 1950s - the Meteor jet fighter, Canberra jet bomber, the Neptune anti-submarine maritime bomber, Winjeel piston-engined trainer, Sabre jet fighter and right at the end of the decade, the first batch of Hercules transports. Of these, the Canberra, Sabre and Winjeel were built in Australia, as had been the Lincoln and Vampire.

The world may have officially been at peace, but Australia and other nations soon found themselves embroiled in another war in 1950-53 (or 'Police Action' as it was officially described) in Korea.

No 77 Squadron's Mustangs were based in Japan as part of the British Commonwealth Occupation Force at the time and stayed on, operating from both Japan and Korea. The squadron's Mustangs were replaced with Gloster Meteors in April 1951, giving the RAAF its first combat experience with jets.

Even before Korea, the RAAF had become involved in another South-East Asian conflict, the anti-communist terrorist campaign in Malaya. 38 (Transport) Squadron and its Dakotas was the first to go there in early 1950, quickly followed by 1 Squadron's Lincoln bombers.

Operating from Singapore, this deployment proved to be a lengthy one for the Lincoln crews, lasting eight years during which time they dropped nearly 15,000 tons of bombs on the terrorists, or 85 per cent of the total allied effort.

The Malayan campaign heralded a strong and lengthy RAAF presence in the area, culminating in the building of a permanent RAAF base at Butterworth, Malaya and another at Ubon, Thailand.

This was the period of confrontation with Indonesia when war with Australia's northern neighbour was a possibility. Australia's military planning revolved around that scenario at the time.

1960S AND VIETNAM

The 1960s saw the RAAF obtain further major items of equipment including the supersonic Mirage III fighter, another squadron of Hercules transports, the first Orion maritime reconnaissance aircraft, the Caribou short take-off and landing tactical transport, Iroquois helicopters (the ubiquitous 'Huey' of Vietnam war fame), the Macchi MB.326 jet trainer and the ordering of the controversial but highly effective General Dynamics F-111 strike bomber.

The decade witnessed yet another conflict in which Australia would fight – Vietnam – with all three services involved and the RAAF playing a major part. First in and last out were the Caribou transports of the Vietnam Transport Flight, later elevated in status to 35 Squadron. No 9 Squadron's Iroquois helicopters and No 2 Squadron's Canberra bombers followed.

continued p48

A NEW CENTURY DAWNS FOR THE RAAF.

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DASSAULT AVIATION

The RAAF's Enduring Bond

with Dassault Aviation

On 12 December 1959, Flying Officer G.W. Talbot, flying from Istres in the south of France, pushed up the throttle on a Mirage III and hit Mach 2 at 35,000 feet. It was his second of four evaluation flights.

That initiation to France's top fighter launched a close relationship between the RAAF and Dassault Aviation, one that has continued for more than 60 of the RAAF's 100 years.

In the Cold War era of the late 50s, Mach 2 capability was a key requirement for a new interceptor to replace the North American F-86 (the Avon Sabre to the RAAF). A U.S. mainstay in the Korean War, the F-86 could not keep up in an era of supersonic fighters and the advent of air-to-air missiles. Moreover, the RAAF needed to transition from a day fighter to an all-weather interceptor.

It was a tough competition, in which the RAAF toured the U.S. to evaluate the F-104, F-105 and F-106. In Europe, the team considered the British Electric Lightning, the Swedish Draken and the Mirage III.

As Mirage pilot and Wing Commander M. R. Susans, dryly put it in The RAAF Mirage Story, his chronicle of aircraft's near three-decade history with the RAAF: "The team concluded the Mirage III was suitable for the RAAF requirement."

Squadron pilots were known to wax more rhapsodic. One reported:

"The Mirage's strongest feature was its flight control system which gave excellent "feel" throughout the flight envelope... A Mach 2 flight always proved an exhilarating experience. A maximum rate climb in a clean Mirage had you at 36,000 feet and .9 Mach in two and a half to three minutes from brake release."

The early and ongoing relationship between Dassault and the RAAF is as much a story of people as of hardware. A liaison team of Australian officers came with their families to live and work in Paris over three years to manage the adoption of their French import. Those assigned to Paris were concerned about a language barrier (only one officer was fluent in French). But their French counterparts were mostly fluent in English and the communications concerns quickly receded.

Amidst long hours of "boring and tedious work" translating manuals and other liaison tasks, there were also frequent entertainments in "all the best nightclubs

and all the best restaurants," reported Air Vice Marshal Ron Susans, M.T.'s father and the first RAAF air attaché in Paris.

Mirage IIIO No. 1 was handed over to the RAAF in Villaroche, France on 9 April 1963. Subsequently, RAAF Mirage's were built in Australia with 116 entering serviced as interceptors, ground attack aircraft and trainers.

RAAF pilots referred to the Mirage as the "French Lady," meant mostly to be a flattering description. Three-hundred-fifty six pilots flew the Mirage IIIO over its 25-year tenure, many coming to love the aircraft. They accumulated 352,000 hours in total, with seven pilots having more than 3,000 hours in the aircraft. For over 20-years, it was the RAAF's front-line fighter. On several occasions it was reported to have bested F-16's in exercises where the Mirages were able to achieve the element of surprise to claim missile "kills."

Eventually, the Mirage was replaced by the new F/A-18 Hornet. A chapter of The RAAF Mirage Story" concludes with this anecdote:

"In 1986, I felt deep satisfaction that my love of the Mirage was not alone when the final Mirage conversion course was about to commence and the group of young fighter pilot hopefuls were asked whether they wanted to be on the last Mirage course or the first F/A Hornet course – to a man they chose the Mirage!"

The confidence in Dassault aircraft continued with acquisitions on the civil side of the company's product line. In 1967, the RAAF took delivery of three Mystère 20 business jets, soon to be renamed the Falcon 20. The Canberra Times (the aircraft were based in Canberra) called them "flying sports cars."

Whether they were sportsters or pickup trucks, they were certainly durable, providing VIP transport for the RAAF for 22 years before being replaced by five larger Falcon 900 jets in 1989. The 900s had considerably more range—4,000 nautical miles (7,400 km). Their trijet configuration was valued for overwater flights, sometimes permitting more direct routes when backup landing sites mid-ocean were sparse. In the selection process, the Falcon 900 was pitted against the twin-engine Canadair Challenger 601.

The updated Challenger 604 was selected in 2000 to replace the 900s. But Dassault returned to the VIP portfolio when the RAAF upgraded to the long-range Falcon 7X trijet 2019. With the 7X, three of which are now in service in Canberra, the RAAF acquired one of the most capable and advanced jets in business aviation.

The 7X was the first fly-by-wire business jet, its digital flight control system adapted from the Rafale fighter—the successor to the Mirage series. The 7X flight control system, in addition to automatic protections against stalls, overspeeds and overstressing of the airframe, yields an exceptionally smooth ride. Pilots praise the system for its precise, satisfying handling qualities. In that respect, the aircraft harkens back to one of the most prized features of the French Lady.

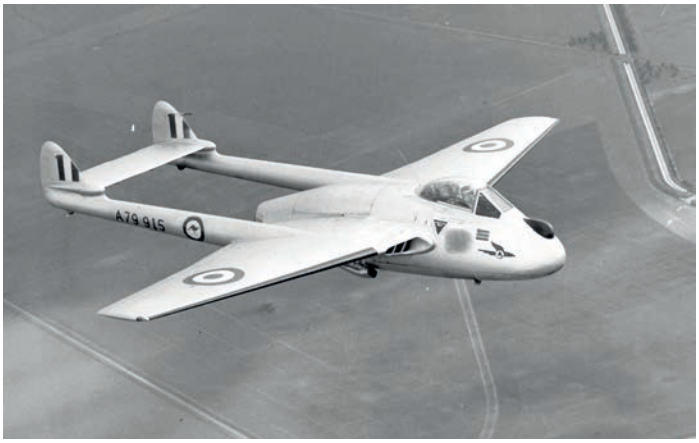
With a range of 5,950 nm (11,016 km) the 7X can fly to any point in Asia nonstop and link Canberra to Washington, D.C. or London with one stop.

Dassault continues to push the envelope in both its military designs (by leading European design efforts on a Next Generation Fighter) and launching two all-new business jets, the Falcon 6X, now flying at the Istres test center, and the Falcon 10X, the largest and most advanced purpose-built business jet.

What will come in the next 100 years? Well, one can't rule out a space-plane for a 90-minute connection to Europe or the US.

Time will tell.

RAAF



RAAF

ABOVE: After WWII there was more conflict, this time in Korea 1950-53. No 77 Squadron was there, initially flying Mustangs and from May 1951 Gloster Meteors.

LEFT: The de Havilland Vampire fighter-bomber was the RAAF's first operational jet (from 1949) and also the first jet aircraft built in Australia.

CHANGING PRIORITIES

With the end of the Vietnam War, the strategic focus switched to defending the Australian continent from possible aggression from its north and north-west. This thinking had its roots in the Japanese advance during WWII (and later the perceived spread of communism throughout South-East Asia) and concentrated on the surveillance and protection of the 'air-sea' gap.

Since then, involvement in the first Gulf War of 1990-91 and the following and ongoing 'Global War on Terror' has further evolved strategy. By the time of its 90th anniversary in 2011 the RAAF was maintaining its traditional homeland defence roles but was also capable of seamless integration into operations with allied air arms.

The world was changing, both politically and in terms of weapons systems technology. The cost of operating single-role aircraft (no matter how superlative) was becoming increasingly prohibitive. The RAAF had first entered the world of modern, high technology multi-role fighters in the mid-1980s with the F/A-18 Hornet and began a journey of change that continues to this day.

The Hornet ushered in the world of the 'electric jet' and began the metamorphosis of the RAAF from the platform-oriented force it had become during the 1960s and 1970s into the interoperable, multi-role service it is today.

The global political balance changed dramatically from the end of the 1980s with the collapse of communist regimes in the Soviet Union and Eastern Europe. This marked the end of the Cold War which had pitted NATO and Soviet forces against each other since the end of World War II.

The so-called 'Peace Dividend' that followed saw reductions in manpower and equipment in most armed forces including the RAAF. Personnel numbers were cut and much of the support work contracted out to industry.

This meant the RAAF could in theory concentrate manpower in operational roles, bringing about an organisational change in the 1990s that saw squadrons become more autonomous and therefore more easily deployable.

The 1990s saw further increases in capability with the launch of upgrade programs for the Hornet, F-111 and P-3C Orion. Airlift capability was also the subject of overhaul with the introduction of the C-130J-30 Hercules to replace the 1960s-era C-130Es.

Projects to acquire new 'force projection' capabilities, such as Airborne Early Warning and Control (AEW&C) and a more capable air-to-air refuelling platform, were also launched during this period.

RESTRUCTURING, NEW TECHNOLOGY

With the arrival of the 21st century, the RAAF started to become fully immersed in this new era of high technology warfare. New platforms and capabilities were introduced and existing assets like the F-111, Hornet and Orion underwent substantial upgrades, reflecting changing times and the move from analogue to digital technology.

The early 2000s saw the first deployment of RAAF fighters to a war zone since Korea when 75 Squadron Hornets were sent to Al Udeid Air Base in Qatar for operations over Iraq. Other assets participating included Boeing 707 tankers, C-130H and J Hercules and AP-3C Orions. A decade later, the Hercules and Orions were still being deployed there on rotation.

Image credit: Australia Department of Defence

Powering the RAAF F/A-18 Hornets and Super Hornets for over 35 years

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GE's F414 engine continues to deliver for the RAAF F/A-18F Super Hornet and EA-18G Growler.

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Recognising the overlap that modern platforms enjoy over their single-role predecessors, the RAAF began a command restructure that saw 'traditional' force elements like the Strike and Reconnaissance Group (F-111) merged with the Tactical Fighter Group (Hornet) to form the Air Combat Group (ACG) in 2002.

With the increased overland surveillance role undertaken by the Orion fleet, the Maritime Patrol Group was merged with the ground-based surveillance and air traffic control radars and the nascent AEW&C squadron (which would later receive Wedgetails) to become the Surveillance and Response Group (SRG).

By now, the value of network-centric operations was becoming apparent, and the 'linking' of platforms with each other and with surface and space-based assets to achieve the 'information edge' was high on the RAAF's agenda. This networking of assets took 'multi-role' to another level with RAAF aircraft able to 'talk' to Navy warships, other aircraft, space-based assets and troops on the ground.

The decade leading up to the RAAF's centenary has seen the entry to service of a number of new aircraft platforms, ranging from front line combat aircraft to trainers.

The list is impressive: F-35A Lightning II fighter (2018); EA-18G Growler electronic warfare aircraft (2017); C-27J Spartan tactical transport (2015); Airbus KC-30A tanker-transport (2011); P-8A Poseidon anti-submarine, anti-shipping, surveillance and intelligence gathering aircraft (2017); and PC-21 trainer (2018).

In the years immediately before that the RAAF also introduced to service the C-17 Globemaster III heavy transport (2006); E-7A Wedgetail airborne early warning and control aircraft (2010); and F/A-18F Super Hornet multi-role strike fighter (2010). A significant addition to the fleet and a pointer to the future occurred in 2010 when the first of three IAI Heron UAVs were leased for operations in Afghanistan.

Significantly, the Super Hornet, Wedgetail, KC-30A and now in its final days of service, Hornet, have proven themselves on combat operations over Iraq and Syria, working seamlessly and highly successfully with Coalition forces.

RAAF

The P-8A Poseidon recorded its first operational deployment in 2019 when a single aircraft was sent to the Middle East for a month to join the US-led international maritime security Construct (IMSC) in the Gulf region to protect shipping passing through the area, following several incidents involving Iran.

Previously, a detachment of RAAF AP-3C Orions was deployed between 2003 and 2012, conducting maritime surveillance patrols over the Persian Gulf and North Arabian Sea in support of coalition warships and boarding parties. They also conducted extensive overland flights of Iraq on ISR missions and supporting counter-piracy operations in Somalia.

Still to come in terms of platforms are more P-8As; the Gulfstream MC-55A Peregrine intelligence, surveillance and electronic warfare aircraft based on the G550 long range corporate jet; and the Northrop Grumman MQ-4C Triton high altitude and long endurance remotely-piloted aircraft (RPA) for intelligence, reconnaissance and surveillance duties. The General Atomics MQ-9B Skyguardian RPA is also to be acquired.

The result of these acquisitions and the operational philosophies which go with them is a Royal Australian Air Force which has equipment that can match any – and surpass the capabilities of most – of the world's air arms. ■

RAAF

ABOVE: Three signifi ant and successful aircraft in RAAF post-war service, between them covering nearly six decades of operation: Canberra (1951-82); Mirage (1954-88); and F-111 (1973-2010).

LEFT: After more than 37 years' service, Australia's most effective deterrent – the F-111 – was retired in late 2010 and replaced by the F/A-18F Super Hornet.

SCAN THIS QR CODE TO LISTEN TO AN *ADM* PODCAST WITH AUTHOR STEWART WILSON.

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Advertorial

RE-EVALUATING THE 'SOVEREIGN' IN SICP

In September this year, Defence announced four new Sovereign Industrial Capability Priorities (SICPs) in response to an evolving strategic environment. Like many in Australia's defence industry, TAE Aerospace welcomes the ongoing iteration of these priorities. It is now equally important to re-evaluate our concept of sovereignty in response to these same global shifts.

By examining what degree of self-reliance Defence needs from its industry partners in a deteriorating strategic environment, defence industry can play its part to manage and mitigate Australia's strategic risk.

In this article, TAE Aerospace shares its view on sovereignty as a continuum, with 'full sovereignty' at the far end. It outlines why it wants to reach this goal and the steps it is taking to get there.

MRO capability for multiple Defence engines.

What does it mean to be 'Sovereign'?

As others in defence industry have noted, Australia takes a broad view of sovereignty in the context of SICP. This extends to the criteria we use to qualify a company as sovereign, and how we assess sovereign capability.

If we view sovereignty as a continuum, then progress can be marked by an increasing level of sovereign control over capability delivery.

At the start of the continuum, we might place overseas-owned companies that establish an Australian entity to support a specific Defence project. They conduct work here, providing jobs, investment, and capability, but sovereign control ultimately resides with their home country.

Further along the line are sovereign Australian companies that meet the more stringent Defence Industry Security Program (DISP) qualification. They are Australian owned, operated and headquartered, but rely on global supply chains for critical components. Limited control over their supply chain gives them only partial control over the delivery of certain capabilities.

At the far end of the continuum are sovereign Australian companies with end-to-end capability in-country, or a high degree of sovereign control over their supply chain. With unrestricted access to components, skills, labour and IP, they can assure priority capabilities are delivered in a timely way for sustained periods. This self-reliant capability, when delivered by a sovereign Australian company, is what TAE Aerospace terms 'full sovereignty'.

The concept of self-reliant capability that underpins full sovereignty seems closely aligned with Government intent. SICP policy defines priority capabilities as those "considered operationally critical because of the essential strategic advantage they provide to the ADF. They must be developed and supported by Australian industry because overseas sources do not provide the required security or assurances of access and supply." *(SICP Industry Plan: Aerospace Platform Deeper Maintenance and Structural Integrity, November 2020, p11).*

Is full sovereignty necessary for Australia?

In times of relative stability, probably not. Companies that operate and invest in Australia are well placed to meet Government and Defence requirements, delivering both jobs and local capability. In uncertain times, however, lack of sovereign control over capability delivery could create an unacceptable level of strategic risk.

When crises threaten global supply chains, national interests take priority. One example is Italy invoking EU regulations to block the export of Covid vaccines to Australia. We have also seen how sovereignty without self-reliance can compound a crisis. Recently, as Brexit-induced labour constraints combined with a Covid-induced escalation in shipping costs, much of Britain was left without fuel.

Some countries, like the US, have regulations in place to prioritise their own defence needs. In times of adversity, directives like the US Defense Priority and Allocation System (DPAS) could easily see Australia placed at the back of the queue.

To be fully prepared for a future where crises and conflict coexist, sovereign Australian companies must aim for the highest possible degree of self-reliance when delivering critical Defence capabilities.

When do we need full sovereignty and how long do we need to sustain it?

Each sovereign Australian company needs to determine this relative to the SICP(s) it contributes to. Some questions to consider are: What aspects of the capability are operationally critical or will deliver a strategic advantage to Defence? Where do gaps exist in the ability to develop and fully support this capability in Australia? How much buffer stock or additional resources are required to sustain this capability for an extended period? What investment is needed to close any capability gaps, is the investment justifiable relative to the benefit, and in what timeframe can we achieve this?

What steps is TAE Aerospace taking?

A 100% Australian owned company, TAE Aerospace has taken significant steps over the last five years to enhance current and future capability in priority areas. It has established *Australia's Centre of Excellence for Defence Propulsion MRO* for multiple Defence engines, designed to scale up capacity and take on new platforms as Defence requires. It is working to integrate Land and Aerospace Platform SICPs and leverage the many synergies between them. Alongside its MRO work, TAE Aerospace is innovating in the area of data analytics, using data captured through HUMS on tank engines to improve engine performance.

TAE Aerospace recognises, however, that in-country capability does not equal full sovereignty. For example, its close relationships with engine OEMs allows access to IP and data for MRO work, but there is a weak link in Australia's supply chain when it comes to manufacturing critical propulsion components. These vital engine parts are only manufactured in a small number of US plants, often with long lead times.

To address the shortfalls in self-reliance, TAE Aerospace is looking at each 'gate' in its propulsion MRO process to determine where it has 100% capability in Australia, where it needs to invest in new capability or stock holding, and where to look for a different solution. One option is to strengthen regional supply chains; another is to explore potential for the AUKUS alliance to share IP beyond submarines to include mission critical aerospace parts. IP transfer could be sought to manufacture these parts in Australia, along with a commitment to train local companies in how to do the work.

For sovereign Australian companies, creating a plan to move toward full sovereignty on priority capabilities is essential. A measurable plan, endorsed by Defence and shared with Government, will help determine Australia's priorities for future investment, and quicken our collective pace toward self-reliance. Only then can we ensure Defence has sustained access to mission critical capabilities in an increasingly uncertain future.

Australia's Centre of Excellence for Defence Propulsion MRO.

AIR FORCE'S ISREW SPECIALISTS

The RAAF's No. 10 Squadron plays a significant part in maintaining Australia's knowledge edge, providing the only airborne ISREW capability in the whole of the ADF.

ROYA GHODSI | SYDNEY

DEFENCE

DEFENCE

BASED at Edinburgh in South Australia, 10 Sqn operates two Lockheed AP-3C(EW) Orion aircraft, the oldest currently serving operational aircraft in the RAAF, albeit with modern mission systems.

The RAAF has been flying the P-3 for more than half of its 100 years, since 1968; with the fleet receiving a number of modifications and upgrades over its service history. 10 Sqn is the last P-3 squadron remaining and continues to make a significant contribution alongside the new suite of technologies, platforms and systems that are being introduced into RAAF service.

Even as platforms and technologies evolve, the unit continues to be recognised for the outstanding outcomes it delivers to the joint force. This year it was awarded the Duke of Gloucester Cup by the Chief of Air Force for the Most Proficient Flying Unit in 2020 – the third time it has received the award since the award's inception in 1947.

"To get the award in the last few years of the life of a capability, when there are all these shiny new platforms around, says a lot about what the squadron does, how it goes about its business, and the high regard in which it is held," 10 Sqn's Commanding Officer Wing Commander Marija Jovanovich said.

Adamant that credit should go where credit is due, she added; "This award was for exceptional performance in 2020. While I was at the squadron and deployed on operations with the team, I was not the Commanding Officer. That honour belonged to WGCDR Colin Smith; it was under his leadership that 10 Sqn distinguished itself above others to win the Duke of Gloucester Cup.

"When I took command of 10 Sqn in December 2020, I took over the best flying unit in the Royal Australian Air Force. We of course continue to go from strength to strength."

MAIN: 10 Sqn is based at RAAF Edinburgh in SA and currently operates two Lockheed AP-3C(EW) Orion aircraft in the ISREW role

ABOVE: Wing Commander Marija Jovanovich in the cockpit of an AP-3C Orion aircraft

A WEALTH OF EXPERIENCE

Prior to assuming command of 10 Sqn, WGCDR Jovanovich had a long and distinguished career as an operational and experimental test pilot.

Upon completing pilot training in 2006, she flew the AP-3C Orion maritime patrol aircraft for four and a half years on a broad array of exercises and operations around the world.

"We're talking looking for pirates off the coast of Somalia, looking for submarines off the coast of Southern California, doing search and rescue in the Southern Ocean, as well as three tours of duty in the Middle East," WGCDR Jovanovich said. "That was an amazing thing to happen to somebody in their twenties."

Following her stint as a P-3 captain, WGCDR Jovanovich became qualified as an experimental test pilot after completing one year of training at the United States Air Force Test Pilot School at Edwards Air Force Base in California.

The privilege of such an opportunity was not lost to an aeroplane enthusiast like WGCDR Jovanovich.

"Even just going to where that school is – Edwards Air Force Base – was a dream come true for me," she said. "Edwards is the home of flight test. That's where Chuck Yeager first went supersonic in 1947, it's where the space shuttle used to land as an alternate landing field, so it was an amazing place to be."

She notes that, while exceptionally rewarding, Test Pilot School was no easy feat. The prestigious institution has graduated less than 3,000 students in more than 70 years of operation – when she graduated in 2014, WGCDR Jovanovich was the first Australian in 25 years to do so. The course involved a two-year Master's degree compressed into one year, along with practical training in flying 23 different types of aircraft.

IT'S ABOUT PEOPLE

Despite such memorable experiences, she says that if she had to choose the single most rewarding part of her 20 years in the Air Force so far; "It's the people that I've worked with, always".

And it's the people to which she attributes the success of 10 Sqn today.

"It's all about the team," WGCDR Jovanovich said. "This version of 10 Sqn – noting that this is my third posting at the squadron – is the closest and most integrated team I have ever worked with. And I mean, across all ranks and specialisations, and including both uniformed personnel and contractors."

"I believe we have, hands-down, the best maintenance workforce in the Air Force," she continued. "They do an absolutely magnificent job of keeping two 40-year-old airframes flying and achieving outstanding serviceability rates that are the envy of much newer aeroplanes."

WGCDR Jovanovich also commends the aircrew – "all of whom are specialists in their own areas, and who all work seamlessly together to deliver world-class ISREW effects" – as well as support sections, including administration, operations, intelligence, IT support and logistics.

"EVERYBODY JUST ACCEPTS THAT WE'RE HERE BECAUSE WE'RE AWESOME AT OUR JOBS, AND WE ARE. SO, WE JUST GET ON WITH IT."

DEFENCE

"Our logistics section is actually a bit of a special highlight because 10 Sqn in the past never used to have a logistics section of its own," she added. "But as our aircraft have aged, sustaining them and maintaining them at the high operational tempo that we need them to be at has become a real exercise in logistics support."

10 Sqn has also broken new ground in 2021 by having both a female Commanding Officer and Executive Officer.

WGCDR Jovanovich is third after only two other women to become the Commanding Officer of an operational flying squadron: WGCDR Linda Corbould between 2006 to 2008, and WGCDR Sarah Stalker between 2018 to 2020. Furthermore, WGCDR Jovanovich, alongside the squadron's Executive Officer, Squadron Leader Jenna Higgins, make the first pair of female aviators to lead an operational flying squadron in 100 years of the Air Force.

"I think that's both a big deal, and not a big deal," WGCDR Jovanovich said. "It's a big deal because we're breaking new ground, and it's not a big deal because at 10 Sqn that's honestly just business as usual. Everybody just accepts that we're here because we're awesome at our jobs, and we are. So, we just get on with it."

While WGCDR Jovanovich does not draw focus to female leadership as a contributing factor to the squadron's success, she observes that "it is reflective of the unit's broader culture of diversity and inclusivity – and that culture certainly does contribute to our success.

"The diversity means that there's always lots of different ideas floating around 10 Sqn, and the inclusivity means that people feel valued and that their ideas are valued. That, to me, is what gives us an edge when it comes to problem solving. I think both military aviation and military operations are basically continuous problem-solving exercises – so that culture of diversity and inclusivity is why we're really good at what we do."

A BUSY SCHEDULE

10 Sqn has sustained an intensive operational flying program throughout 2021, including numerous overseas deployments, despite the ongoing challenges of the COVID-19 pandemic.

"Throughout these operations we continue to receive exemplary feedback from both national and allied agencies, acknowledging the capability that we deliver to the joint force," WGCDR Jovanovich said.

While the squadron delivers most of its ISREW effects on deployed operations, it also contributes to joint collective training, both in Australia and abroad. Most recently, that was Talisman Sabre.

"We participated in Talisman Sabre, where we operated as part of ISR packages with other Air Force assets, and in support of Navy and Army elements, both Australian and those of allies. So, we play well by ourselves, and we play well with others."

As they reach the end of their life, the AP-3C(EW) Orions remain a driver of how ISREW operations will integrate into the future force. As the ADF's only airborne ISREW capability, 10 Sqn leads the way with developing TTPs – tactics, techniques and procedures – for integration with other capabilities, both within the ADF and with allies.

"As we speak, one of our aircraft is getting ready to take off, to go over to the east coast and work with a P-8A Poseidon from 11 Squadron, an E-7A Wedgetail from 2 Squadron and jets from Air Combat Group, on what we call a TACEX (tactical exercise), doing just that kind of TTP development," WGCDR Jovanovich said.

"And while I can't talk in detail to what is happening next for 10 Sqn, I can say that we will certainly continue to be a large part of the effort to develop the big common operating picture, and be fully integrated into the networked way of warfighting." ■

ABOVE: The RAAF has been flying the P-3 for more than half of its 100 years.

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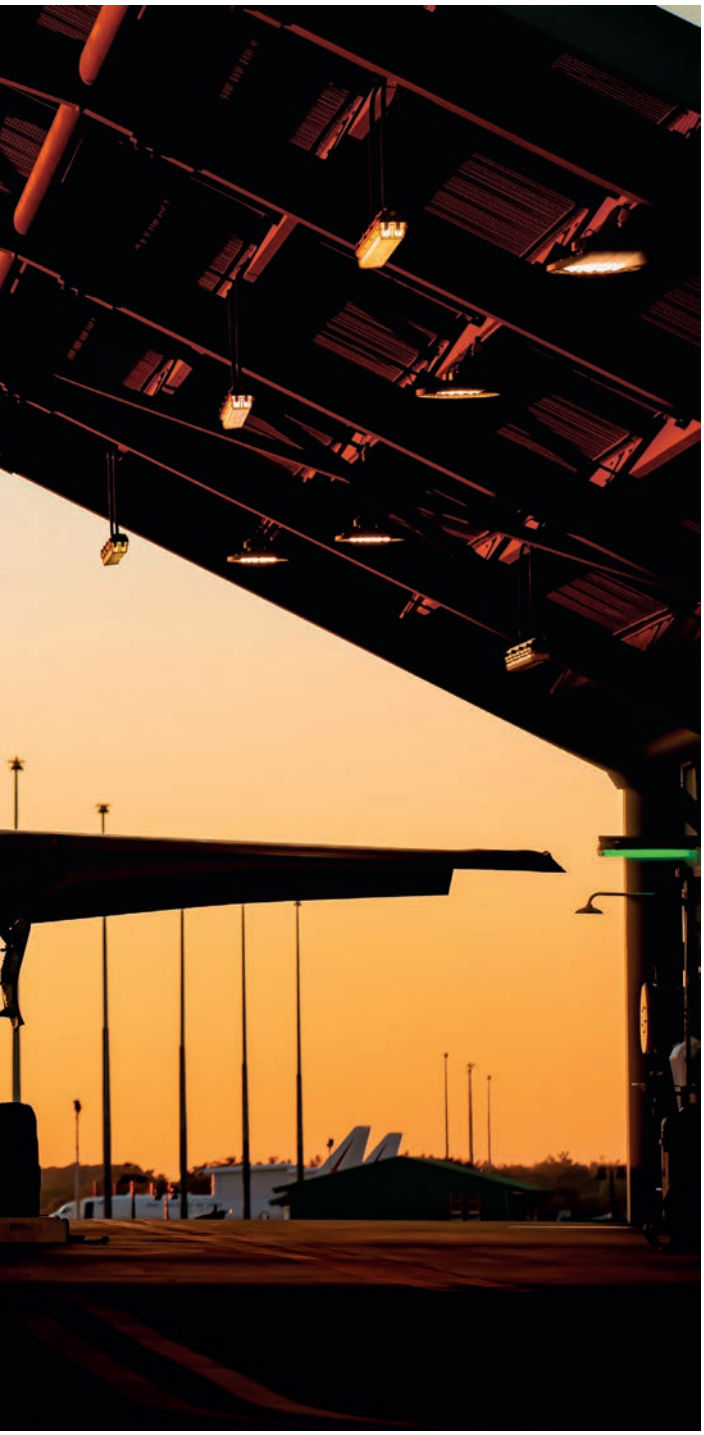
F-35A – A CRITICAL NODE IN THE NETWORK

As the Royal Australian Air Force continues its F-35 journey between Initial and Final Operational Capabilities (IOC & FOC) some important experimentation is underway across the wider F-35 program which promises to revolutionise the way battles are fought.

NIGEL PITTAWAY | MELBOURNE



DEFENCE

DURING the recent Australia-US Talisman Sabre 21 exercise, an RAAF F-35A flying an acceptance flight in the US successfully used its Multi-Function Advanced Data Link (MADL) in conjunction with a Virtual Aegis Weapon System (VAWS) to share real-time sensor data with ADF elements engaged in the exercise.

The demonstration was designed to highlight the F-35's capabilities in support of joint all-domain warfare aspirations represented in the US Pacific Defence Initiative and improve interoperability between the US forces and allies such as Australia.

Meanwhile, the RAAF now has 41 of its 72 F-35A Lightning IIs in service at Williamtown, representing the largest fleet outside the US at the present time. Despite the restrictions on travel imposed by COVID-19, Defence says the program remains on track to achieve FOC on schedule by the end of 2023.

Already the second of the RAAF's three operational F-35A fighter squadrons is working up on their new jets and the third - and the only squadron to be based outside Williamtown - will receive its first aircraft at Tindal by the end of the year. In addition, the first Australian F-35 operational conversion course was successfully completed in July, representing the completion of the process to migrate F-35 pilot and maintenance personnel from the US.

F-35 ENTERPRISE WRIT LARGE

Looking at the wider F-35 program, Lockheed Martin has recently delivered its 700th production aircraft from its Final Assembly and Check Out (FACO) facilities in Fort Worth Texas, Cameri in Italy and at Nagoya in Japan.

According to Lockheed Martin data, F-35s are operating from 21 different air bases around the world, in excess of 1,460 pilots and 11,025 maintenance personnel have been trained, and the global fleet has now surpassed 430,000 flight hours. Of the total flying time, the 41 Australian F-35As have contributed around 12,000 flying hours.

The F-35 has also achieved further sales success in recent months, with Switzerland selecting the F-35A in June as its next fighter aircraft, with a proposed order for 36 jets to replace its ageing F/A-18A/B Hornets. A little further back in time, the US State Department approved the sale of up to 12 F-35B Short Take-Off and Vertical Landing (STOVL) variants to Singapore in January 2020 and Lockheed Martin has several actives sales campaigns underway, including in Finland, where Helsinki is expected to make a decision on its own F/A-18C/D Hornet replacement program in the near term.

The F-35 has attracted a great deal of criticism from operators for its high unit purchase price and unacceptably high sustainment costs, but Lockheed Martin's Director of

LEFT: An F-35A Lightning II in the ordnance loading area at RAAF Base Darwin, during Exercise Rogue Ambush

ABOVE LEFT: A Royal Australian Air Force F-35A Lightning II aircraft, off the coast of Newcastle, New South Wales

DEFENCE

LEFT: Exercise Red Flag Alaska 21-3 was the first time that Royal Australian Air Force F-35A Lightning II aircraft deployed overseas from Australia

F-35 International Business Development Steve Over says there is good news on both fronts.

Again, according to Lockheed Martin's data, the purchase price of a Conventional Take Off and Landing (CTOL) F-35A variant, without engine, is a little more than US$77 million. "In 2013 or 2014 it's fair to say that many customers were sceptical, when we had a $140 million aircraft, that we were ever going to get the acquisition cost down below $80 million," Over said. "But here we sit today and a Lot 14 aeroplane (the current production lot) is about $77 million. We've been working to improve the loss in our supply chain, we continue reliability improvements, helping to demonstrate greater manpower efficiencies and product support solutions."

Over also revealed that Lockheed Martin has struck a deal with the Pentagon for a 30 percent reduction per flying hour in F-35A annualised sustainment contracts covering the US 2021-2023 fiscal years, compared with the previous year. He added that this also represents a reduction in sustainment costs in excess of 44 per cent over the last five years. "These are huge wins for our customers and something we're proud of today," he stated. "We're committed to driving cost out of our portion of the sustainment cost in partnership with our customer, the US Air Force and Pratt & Whitney (manufacturer of the F-35's F135 engine). We're focussing on what we can do to lower the overall sustainment cost and I'm very pleased to tell you with demonstrable evidence, we're doing our part."

Over said the new contracts also provide a pathway to a longer-term Performance-Based Logistics (PBL) agreement across the F-35 program.

JOINT ALL-DOMAIN WARFARE

The joint all domain warfare experimentation during TS21 involved the RAAF F-35A (with a US Air Force pilot) acting as an airborne sensor platform to provide weapons' quality targeting data to the VAWS facility in Fort Worth via MADL. The data was then relayed to a US Battle Management Centre in Oahu, Hawaii, and on to RAAF Williamtown via a bilateral communications network and finally to an artillery battery on the ground in the exercise area. The data was received at Williamtown inside one of the RAAF's next-generation deployable facilities that are manufactured by Varley Group at Tomago.

At Williamtown, Lockheed Martin had associated its Surveillance and Operational Awareness and Response (SOAR) software with a passive radar system developed by Daronmont Technologies and also had a direct feed from RAAF tactical radars. "So, despite being distributed halfway across the world, all of the data was being aggregated into a single surveillance picture," explained Lockheed Martin Australia Business Development Director Rotary Wing Systems Neale Prescott.

"DESPITE BEING DISTRIBUTED HALFWAY ACROSS THE WORLD, ALL OF THE DATA WAS BEING AGGREGATED INTO A SINGLE SURVEILLANCE PICTURE"

"That's one of the elements of this Joint All-Domain operation, you need to be able to extend the surveillance horizon and connect air platforms with things like destroyers and frigates (which are) carrying specialist weapons. No longer are you doing this to some predetermined plan, you're feeding all of the sensor data into a picture (and) assigning weapons based on who has the greatest chance of performing the intercept and you're getting the data out in real-time."

Importantly, the RAAF aircraft was in standard

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LEFT: Australia's F-35A program is on track to achieve Final Operational Capability (FOC) at the end of 2023

BELOW: RAAF F-35 and EA-18G Growler aircraft fly alongside a United States Air Force B-52H Stratofortress during Exercise Talisman Sabre 2021

production configuration and was not modified in any way for the trial - which represented the first ever live sharing of F-35 MADL data with a non-US participant.

The perhaps circuitous routing of the data was because it was a proof-of-concept demonstration rather than an evaluation under operational conditions, but it isn't the first time Lockheed Martin and US forces have experimented with MADL's capability to support Joint All-Domain Operations.

"Back in September 2016 an unmodified F-35 participated in what we call an 'engage on remote' scenario, in which it provided all sensor cueing via MADL to a ground station. The MADL ground station then provided all that information to an Aegis weapons system at the White Sands Missile Range in New Mexico. That Aegis system then engaged a low-altitude representative target and fired an SM-6 missile utilising only F-35 data, none of its own targeting capabilities," explained F-35 Combat Air, Australia Business Development Lead, Chris Widerstrom.

"IMPORTANTLY, THE RAAF AIRCRAFT WAS IN STANDARD PRODUCTION CONFIGURATION AND WAS NOT MODIFIED IN ANY WAY FOR THE TRIAL"

"A further demonstration occurred in December 2019, when two F-35s provided initial cueing for the US Army's Integrated Battle Command System (IBCS), which controlled a PAC-2 Patriot missile battery. Two manoeuvring low-altitude cruise missile surrogates were then launched, detected and tracked by the F-35s."

Widerstrom said MADL provided a secure, low probability of detection 'broadband' data capability when compared with older data sharing systems such as Link 16, which he compared with 'dial-up internet' connection speeds. This means however that a coalition partner does not need an F-35 – or a MADL receiver – to participate in joint all-domain operations.

DEFENCE

"There's a lot of tactics and procedures being developed for that today," Widerstrom added. "We have Link 16 on F-35 as well and we've developed procedures that allow us to have F-35s that remain out of the hostile environment such that they can broker (data) back utilising other waveforms – link 16 or otherwise."

The demonstration has obvious relevance to Defence's Air 6500 Joint Air Battle Management System program and perhaps it's not a coincidence that Lockheed Martin is also one of two short-listed companies (the other being Northrop Grumman) for the project.

AUSTRALIAN PROGRAM MILESTONES

Since achieving IOC in December 2020, the RAAF's F-35 program has achieved several significant milestones, as it looks towards the declaration of FOC in a little more than a year's time.

The first four F-35A pilots to complete their operational conversion course with No.2 OCU at Williamtown graduated in early July, at the conclusion of Exercise Rogue Ambush 21-1 in Darwin.

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SHAPING, DETERRENCE AND RESPONSE:
THE CONTRIBUTION OF DISTRIBUTED LETHALITY

Neale Prescott, Director of Business Development, Lockheed Martin Australia Rotary and Mission Systems

This year's centenary of the Royal Australian Air Force (RAAF) is reason to acknowledge the contribution and sacrifice of those who served and the freedoms we enjoy today.

Since 1921 the RAAF has answered the call wherever Australia's interests and those of our allies needed defending by human endeavour, evolving tactics and applying new technology.

Maintaining stability and security in the Indo-Pacific requires "credible deterrence" as detailed in the Strategic Update; a vital contributor is distributed lethality.

A fundamental pillar of Australia's security posture in the region over the past 70 years has been the ANZUS Alliance, the closeness and success of this deep partnership has sharper focus with the announcement of Australia's alliance with the US and the UK.

While a foundation stone of that alliance is sharing state-of-the-art defence technologies, the fundamentals of our collective defence requirements are reasonably orthodox.

To protect the interests of Australia and our allies, we need to detect, identify and monitor threats at the greatest possible range to maximise decision making and response time.

The contemporary challenge we face, and must surmount, is the rapid reduction in the time to detect and counter advanced threat technologies.

An appropriate and necessary response to address these new technologies are strengthened alliances to integrate Australia's technologically advanced capabilities and interoperate with our allied forces to the point they are interchangeable.

Deemed "distributed lethality" by the US Navy's VADM Rowden, RADMs Gumataotao and Fanta, that "by distributing power across a larger number of more geographically spaced units, adversary targeting is complicated and attack density is diluted".

The strength of Australia's defence is not size, the Australian Defence Force (ADF) has consciously structured itself to be first and foremost an integrated joint force with technological superiority.

Australia has developed our air force, army and navy capabilities to adapt quickly to threats. Defence industry partners including Lockheed Martin Australia work alongside the ADF to develop innovative technologies in pursuit of this objective.

Australia has acquired the most advanced individual platforms as demonstrated by its choice of surface vessels, aircraft and satellites – achieving integration of these systems is the logical next step.

With its Integrated Air and Missile Defence (IAMD) Program, the leaders of the RAAF identified that integrating those platforms to become a collective rather than a collection would be critical to maintaining their technological superiority in the region.

Australian platforms equipped with advanced sensors, networked communications to assure the passage of friendly force, with battlespace awareness are on the cusp achieving distributed lethality.

Nowhere was that more on display than Exercise Talisman Sabre 2021 (TS21). TS21 was a training activity between the ADF and United States military, designed to test Combined and Joint Task Force operations, improve combat readiness and interoperability.

During TS21 Lockheed Martin and the ADF demonstrated for the first time outside of the US the ability to exchange real-time F-35 sensor data with the Virtualised Aegis, via the F-35's multifunction advanced data link.

The ability to exchange real-time F-35 sensor data halfway around the globe – from Fort Worth, Texas, to Honolulu, Hawaii – and on to Australia represents a new benchmark in joint all-domain information sharing. It confirms the F-35 as the most advanced node in the 21st century warfare network-centric architecture.

Put simply, the best IAMD command and control system, in combination with the best aerospace combat system, provides even greater deterrence and distributed lethality.

It should also be acknowledged that this was the first such demonstration by a non-U.S. F-35 operator and reinforces the ADF's emergence as an interoperable, fifth-generation force.

The final dimension to achieving a sustained, resilient deterrence in the Indo Pacific is the realisation of allied platform interchangeability.

Consider that by 2035 there will be more than 300 F-35s operating in the Indo-Pacific from allied land bases, carriers and amphibious assault ships.

Meanwhile, dozens of Aegis-enabled allied surface vessels will likely be stationed across the region.

These air and maritime capabilities integrated with surveillance satellites, gathering and fusing data provide Australian and allies unprecedented situational awareness.

This is important because, to deal effectively with the complex threats that are emerging, we must be able to rapidly share information between allied platforms.

Interchangeability is the point at which, in the event a threat is detected, command and control of the response is determined objectively and assigned to the most appropriate element of the force, whether it is Australian or one of our allies'.

The implications for commanders of this degree of all-domain connectivity will represent a gamechanger in their ability to make time critical decisions to apply effects from a distributed force.

As the designer of platforms critical to our allies realising regional deterrence, including the F35, Aegis and space-based infrared systems, Lockheed Martin's differentiator is our ability to examine new and emerging threats and connect capabilities across all domains to deliver maximum effect.

Lockheed Martin Australia is proud to be the capability partner of choice to the RAAF for over 70 years and supporting Australia's security environment through the strengthening of sovereign self-reliance and platform interchangeability.

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Rogue Ambush was held in Darwin between June 15 and July 2 and, besides the F-35As, almost 30 RAAF aircraft and 300 personnel participated - including KC-30A multi-role tanker transports, E-7A Wedgetail airborne early warning and control (AEW&C) aircraft, Hawk Mk.127 lead-in fighter trainers and F/A-18A/B Hornets. The exercise also marked the first time 2 OCU has deployed aircraft domestically since transitioning to the F-35A in 2020.

Prior to Rogue Ambush, Exercise Arnhem Thunder was undertaken in the Northern Territory between 17 May and 15 June, with participants including the F-35As of 3 Sqn, the first operational fighter squadron to transition to the 5th generation aircraft. Arnhem Thunder was the first major domestic deployment of F-35As and also the largest domestic air combat exercise for the year. During the exercise period, two F-35As took off from Darwin with a full weapons load (internal and external), marking the first time the so-called 'beast mode' has been demonstrated in Australia.

"This design feature allows F-35s to be adapted to suit the threat environment and operational requirements," commented 3 Sqn Commanding Officer, Wing Commander Matthew Harper, during the exercise. "This mode would most likely be used in less contested environments where rapid employment of ordnance is prioritised over maximising the F-35A's stealth capabilities."

More than 50 inert GBU-12 laser-guided munitions were reportedly dropped on the Delamere Air Weapons Range and during the exercise period, one jet was deployed to Tindal, representing the first visit to the future F-35A operating base.

Most recently 3 Sqn conducted the first ever RAAF F-35A international deployment when it participated in Exercise Red Flag Alaska held at Joint Base Elmendorf-Richardson in Anchorage in August.

ABOVE: Fully loaded with inert GBU-12 laser guided ordnance for the first time, an F-35A is pictured enroute to the Delamere Air Weapons Range during Exercise Arnhem Thunder 21

"THE FIRST FOUR F-35A PILOTS TO COMPLETE THEIR OPERATIONAL CONVERSION COURSE WITH NO.2 OCU AT WILLIAMTOWN GRADUATED IN EARLY JULY"

AUSTRALIAN INDUSTRIAL CAPABILITY

No in-depth analysis of Australia's F-35 program would be complete without a look at how an Australian Industry Capability (AIC) has grown around the enterprise. Lockheed Martin figures suggest that, at last count, Australian companies have won contracts worth a total of $2.7 billion.

In the early days of the program, industry primes like BAE Systems and smaller enterprises such as Marand Engineering, together with numerous others, were focussed on aircraft production – supplying parts to the assembly line at Fort Worth and thence into Lockheed Martin's global supply chain. While this work is still going on – with only 700 of a projected final total of around 3,100 F-35s now completed – the exponentially-increasing global fleet (and flying rate) is now seeing attention turn towards sustainment.

"We have a significant role in leading the Australian industry team in sustaining the F-35 both for the RAAF and laying the foundation in Australia for industry to participate in Asia-Pacific regional support," detailed Lockheed Martin Australia Aeronautics Lead, Andy Doyle. "Another key set of achievements this year has been the establishment of an airframe depot at Williamtown, through our subcontractor BAE Systems."

The first RAAF aircraft was inducted into the BAE Systems facility in February for modifications. In terms of potential work, it is perhaps worth noting that Japan, Singapore and the Republic of Korea have committed to the F-35 and there is also the potential to support US aircraft forward-deployed in the region.

From a powerplant perspective, TAE Aerospace announced in July that it has achieved Initial Depot Capability (IDC) requirements for the repair of the Pratt & Whiney F135 engine's fan and power modules. The work is being undertaken at TAE's F135 Maintenance, Repair, Overhaul and Upgrade (MRO&U) facility near Amberley. The MRO&U is the first operational F135 depot in the Asia-Pacific region and had previously achieved qualification from the engine manufacturer to perform fan module repairs in 2020.

Finally, despite the impact of COVID-19, Defence says the F-35 program is on track to achieve the FOC milestone as planned. "The project is delivering to the 2014 government-approved budget and schedule for the acquisition of 72 F-35A Lightning II aircraft, reaching IOC in December 2020. While the COVID-19 pandemic has increased the complexity of delivery of the F-35A program, a mature capability is expected on schedule by end of 2023," a Defence spokesperson said.

"The F-35A – along with the F/A-18F Super Hornet and EA-18G Growler – will ensure Australia maintains its potent and lethal air combat edge." ■


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RAAF F/A-18A Hornets from 77 Squadron fly in formation with JASDF F-15J and F-2A fighters during Exercise Bushido Guardian 19 conducted from Chitose Air Base in Japan.

REGIONAL ENGAGEMENT – STRENGTH THROUGH PARTNERSHIPS

The transformation of the RAAF into a 'fifth generation' force and the acquisition of those same capabilities by other Indo Pacific nations has given Air Force a unique opportunity to boost capabilities and engage with its partners by enhancing interoperability with like-minded countries.

MIKE YEO | MELBOURNE

THIS engagement would be in effect an extension of what the RAAF has been doing all along, with Australia's involvement in operations like Operation Gateway to ensure maritime security in the South China Sea and Indian Ocean, using P-3 Orions and now P-8A Poseidon maritime patrol aircraft over the past decades.

The RAAF is also continuing engagement with regional nations via training activities, with numerous bilateral and multilateral training under the auspices of organisations like the Five Power Defence Arrangement with Malaysia, Singapore, the UK and New Zealand, and setting up the Pitch Black series of multilateral high-end air combat exercises.

These efforts have extended to other countries as well – Australia has also conducted bilateral training with the air forces of Indonesia, Malaysia, and Thailand. The refurbishment and donation of the RAAF's C-130H Hercules airlifters to Indonesia after their retirement in 2012 was also a sensible move and is perhaps one of the key indicators of Australia's commitment to regional security.

This has expanded in recent years with RAAF P-8As joining in efforts to monitor North Korean sanctions-busting activities in waters surrounding the secretive Stalinist state; the regular low-key deployment of AP-3C(EW) Intelligence, Surveillance, Reconnaissance and Electronic

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Photographic record made during the unpaved runway test campaign.

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INTERVIEW with President and CEO of Embraer Defence & Security

Please introduce Embraer for our readers?

JMS: Embraer is a leading aerospace company with a proud 52-year history serving the defence, commercial, and executive aviation industry segments. It has achieved notable recognition as global market leader manufacturing the C-390 Millennium multi-mission transport aircraft, the A-29 Super Tucano light air attack, armed reconnaissance and tactical training aircraft and jets including the ERJ 145 and the E-Jets family of commercial aircraft. Embraer has a strong presence in the global Defence market, with more than 1400 aircraft delivered in more than 60 countries. With broader solutions for air, land, sea, space and cyber domains, in the last decade, the Company has invested in a diversified product portfolio, which includes a full line of integrated solutions and applications such as Command and Control Center, radars and ISR (Intelligence, Surveillance & Reconnaissance).

The KC-390 is proving itself now that it is operating with the Brazilian Air Force, please tell us more about it?

JMS: The C-390 Millennium aircraft, and the KC-390 refuelling version, is the result of a partnership between the Brazilian Ministry of Defence and Embraer, with an initial target to design and build the new generation medium sized military aircraft to replace their fleet of 31 Lockheed Martin C-130H aircraft operated by the Brazilian Air Force (FAB), setting new standards in its category.

Some of the aircraft's strengths are its unrivalled mobility and operational flexibility in a single platform. This provides air forces with optimal fleet performance generated by a cost-effective combination of high availability and productivity. The C-390 Millennium flies faster and carries more cargo than other military airlifters of the same size and features a robust design, flexibility, proven state-of-the-art installed technologies and easier maintenance. The aircraft needs fewer on-demand inspections and maintenance actions which reduces overall operating costs, contributing to excellent availability levels and low life-cycle costs.

The Brazilian Air Force current fleet of the Embraer KC-390s, the air-to-air configuration of the C-390 Millennium, stand at four and these aircraft have exceeded 3,650 flight hours in operation, including its extensive use to transport equipment and medical supplies across the country urgently needed to address the COVID-19 situation in Brazil. In addition to the Brazilian Air Force, the Hungarian Defence Force and the Portuguese Armed Forces have signed for the C-390 Millennium's multi-mission aircraft with air-to-air refueling (AAR) configuration, the KC-390.

Sgt Bianca / Força Aérea Brasileira

Which do you believe are the strong selling points of the aircraft

JMS: Some of the aircraft's strengths are its unrivalled mobility and operational flexibility in a single platform. This provides air forces with optimal fleet performance generated by a cost-effective combination of high availability and productivity. The C-390 Millennium flies faster and carries more cargo than other military airlifters of the same size and features a robust design, flexibility, proven state-of-the-art installed technologies and easier maintenance. The aircraft needs fewer on-demand inspections and maintenance actions which reduces overall operating costs, contributing to excellent availability levels and low life-cycle costs.

The built-in, rapidly reconfigurable multi-mission design of the aircraft allows it to efficiently perform a variety of missions such as cargo and troop transport, cargo airdrop, paratrooper operations, air-to-air refuelling (as a receiver and tanker) for both jets and helicopters, aeromedical evacuation, search and rescue, aerial firefighting, special force's missions, and tactical VIP transport missions. The aircraft can carry up to 26 metric tons of cargo at a maximum speed of 470 knots (870 km/h), and can operate in austere environments, including maximum effort operations to and from unpaved or damaged runways.

Proving its interoperability capabilities, in 2021 one of FAB's KC-390 aircraft dropped paratroopers in joint flights with U.S. Air Force C-17 and C-130 aircraft during Operation Culminating, in Alexandria, Louisiana, USA. The exercise missions delivered high levels of interoperability with US Forces and other transport aircraft. In addition to the KC-390, nine USAF C-17 and four C-130 aircraft participated in the exercise. Some 1,600 paratroopers and 22 heavy equipment platforms were successfully delivered to the drop zone of Joint Readiness Training Centre, a U.S. Army installation that specializes in receiving this type of joint training.

What other projects is Embraer developing for the international military market?

JMS: Looking forward to future projects, we have signed two Memorandums of Understanding (MoU) with the Brazilian Air Force (FAB). The first was established for a study of the potential development of a short take-off utility transport (STOUT) powered by hybrid-electric propulsion. The second is a cooperation for the study of the necessary capabilities for the conceptual design and development of advanced unmanned combat aerial vehicle (UCAV). Embraer has also signed an agreement with ELTA Systems Ltd (ELTA) to introduce a new Airborne Early Warning & Control aircraft using the super-midsize Praetor 600 business jet.

What is Embraer doing to address global concerns around sustainability within the aviation sector?

JMS: Embraer's goal is to decarbonise our direct and indirect operations focusing on carbon reduction and efficiency. With the introduction into service of our electric and hybrid aircraft, we are committed to achieving carbon neutral operations by 2040. Our priority is to join with strategic partners and invest in R&D for solutions such as electrification and sustainable aviation innovations. Embraer is advancing the following initiatives: First the eVTOL, 100% electric, planned for 2026. In August, Embraer also had the first test flight of the electric demonstrator. Embraer already has executive aircraft using sustainable aviation fuels (SAF) in Florida and is working to expand this solution. Additionally, Embraer is also looking at modern turboprop solutions and hydrogen propulsion.

DEFENCE

Warfare aircraft to Singapore for what Defence says are 'maritime domain awareness' missions that it stresses are conducted in 'international airspace'.

In addition to these operational taskings, the RAAF has also increased its interactions with the Japan Air Self-Defense Force, whether within the framework of the US alliance at exercises like Cope North in Guam, or at bilateral exercises like Bushido Guardian.

As China's assertiveness in the region and military capabilities continue to grow, US allies and partner nations in the region are likely to increasingly move closer in an effort to balance against burgeoning Chinese power.

As such, their increasingly aligned capabilities in the air domain and their similar assessments of the geopolitical situation represent an opportunity to further the relationships the RAAF has with these nations – in areas like networking, training or mutual support in mid-air refuelling operations to improve interoperability.

"THE RAAF IS ALSO CONTINUING ENGAGEMENT WITH REGIONAL NATIONS VIA TRAINING ACTIVITIES"

NETWORKING

One of the biggest game-changers in the air domain in recent times has been the proliferation of networked systems. The most widespread of these is the Link 16 datalink, which is the standardised communications system used by US, NATO, and coalition forces for transmitting and exchanging real time tactical data using links between allied military network participants.

It uses Time Division Multiple Access (TDMA) to provide multiple, simultaneous communication paths through different nets. Considered the standard by which other systems are measured for secure, airborne situational awareness, Link 16 has increased situational awareness by providing users with an improved tactical picture and reducing the need to exchange information using less reliable voice communications.

Link 16 improves security, jam resistance, and situational awareness compared to other equivalents, while also increasing data throughput and the capacity of information exchanged. It also provides secure voice capability, relative navigation capability, and precise participant location and identification.

Data is transmitted via Link 16 terminals found in a range of platforms, including aircraft, surface ships, ground vehicles, missile defence systems, networked weapons, and command and control networks. These terminals can operate Link 16 capabilities exclusively or can combine Link 16 functions with other advanced military waveforms.

Several regional countries use Link 16 on their air platforms, including Japan, Malaysia, Singapore, and South Korea. However, to this writer's knowledge there is yet to be an occasion where these countries have shared infor-

ABOVE: Australia has supplied a number of former RAAF C-130H Hercules aircraft to the Indonesian Air Force (TNI-AU)

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mation with RAAF assets or vice versa using Link 16. Depending on who you talk to, this either due to US export regulations or a lack of desire on the part of individual users to share information using Link 16 during exercises.

Going forward, the improved networking in the Lockheed-Martin F-35 Lightning II Joint Strike Fighter offers improved networking capability – via its fleet-wide, secure Multifunction Advanced Datalink (MADL). The datalink, which further improves on the security and jam resistance of Link 16, also enables the real-time sharing of targeting data between aircraft in warfare.

"IT MUST BE REMEMBERED THAT AUSTRALIA CAN STILL BE SEEN POLITICALLY AS AN OUTSIDER BY SOME IN THE REGION"

It essentially provides yet another opportunity for allied and partner nations to take cooperation one step further, giving multinational F-35s an opportunity to conduct synchronised operations. It is designed to achieve the much sought-after goal of sharing threat data and helping find and destroy enemy targets from ranges where the F-35 remains undetected, when operated in conjunction with other F-35 sensors.

It will enable global F-35 users to take networked operations one step further during future coalition operations given Japan, Singapore and South Korea are also operating – or are due to operate – the F-35 alongside US forces in the region.

The ability of their platforms and systems to be networked is an opportunity to build closer ties with these nations, particularly that of Japan, which is probably the closest peer fighting force to Australia – and the wariest of China's rise.

COOPERATIVE ENGAGEMENT CAPABILITY

Cooperative Engagement Capability (CEC) is another potential area where Australia and Japan can potentially work together. CEC is a sensor network with integrated fire control capability that combines data from multiple battle force air search sensors on CEC-equipped units into a single, real-time, composite track picture, enhancing the capability of the fleet.

This allows targets detected by one ship, and potentially those detected by aircraft like the F-35, to be identified by another ship and engaged with long-range missiles without that vessel having to use its own sensors.

This potentially means a shorter sensor-to-shooter loop for the ship doing the shooting, and allows for targets to be engaged from longer ranges and from an unexpected direction (as the shooter will not be emitting with its own sensors). This enables a whole fleet to intercept threats like high-speed cruise missiles once a single ship has detected them.

The key improvement of CEC over the Link 11 or Link 16 datalink-based network previously is that it is no longer constrained by the latency inherent in the latter, which has often meant reliable fire control solutions could not be developed when sensor data is shared via datalink.

CEC uses an organic "sensor-agnostic" network which shares raw data, not tracks, and builds a composite track from a number of airborne and surface sensors. Any vessel or aircraft that has a CEC capability is able to become a

ABOVE: RAAF and JASDF fighters on the flightline at Chitose Air Base Japan during Exercise Bushido Guardian 19.

node in the network, while other platforms with integrated sensors such as the F-35, EA-18G Growler or the MH-60R helicopter can feed their sensor data into the nodes and thus the wider CEC network, but cannot carry the cabinet-style 'boxes' required to act as a node themselves.

Australia is the first nation outside the US to receive the CEC with the capability fitted onto the Royal Australian Navy's Hobart-class destroyers. The RAAF's E-7A Wedgetail is also set to receive the CEC capability, which turns it into a node that will form a part of the Australian Joint Integrated Fires Capability being implemented in the ADF.

There are also plans for CEC to be fitted and integrated with the CEA radars that will go on the RAN's Hunter-class frigate, and Australia's land-based sensors being acquired under AIR 6500.

The installation of CEC will also be a significant step to improve the interoperability of RAAF and RAN with Australia's allies and partners. CEC is already in the process of being deployed on US Navy ships, Northrop-Grumman E-2D Hawkeye early warning aircraft and the US Marine Corps' network systems. This will provide the ships and aircraft of both countries the ability to potentially share targeting data and solutions in the event of a conflict.

In addition, Japan is also equipping its own Aegis destroyers and E-2Ds with CEC, potentially further


NIGEL PITTAWAY

LEFT: A Republic of Singapore Air Force F-16D over a hazy Australian outback during a recent multi-lateral Pitch Black exercise

enhancing the efficacy of the system regionally. There is also the possibility that other airborne assets, for example the P-8A Poseidon, can also become a future CEC node.

What this means is that in the event of a conflict, ADF air and naval assets plugged into the CEC, either as a node or a sensor, can feed data into the wider CEC network to work to engage a hostile target, vastly improving interoperability with allies and partners.

TANKERS

The RAAF has made a considerable effort to partner with friendly nations to expand its mid-air refuelling interoperability – both as a refueller and a receiver – and these include several regional nations. The effort began even before the KC-30A's boom system was declared operational, when RAAF aircraft in the Middle East supporting Operation Okra began refuelling coalition aircraft with the hose-and-drogue method in 2014.

The first non-Australian receiver aircraft to be cleared were French Rafales and American Classic and Super Hornets and, soon after the boom became operational, the RAAF started clearing coalition aircraft for boom refuelling. The first regional type to obtain clearance was the Lockheed-Martin F-16D+ of the Republic of Singapore Air Force (RSAF) in October 2016, followed by Indian Sukhoi Su-30MKIs and Malaysian F/A-18D Classic Hornets at Exercise Pitch Black 2018.

The RAAF also had plans to conduct refuelling trials with RSAF F-15s and Japanese Mitsubishi F-2s although this has been delayed due to COVID-19. Airbus had developed boom control software specifically for refuelling the F-15 in conjunction with Singapore's Defence Science and Technology Agency and released it to all MRTT users as Update III Loop 6.1 after certification in 2018.

It was the RAAF that had in fact discovered issues be-

tween the KC-30A and F-15, when it conducted refuelling trials with USAF F-15s in the United States in 2015. It uncovered a tendency for the F-15's canopy to drift towards the boom in some flight parameters, due to the receiver's receptacle being mounted above its port air intake.

With a number of other regional nations selecting the MRTT, the RAAF has also worked with the tankers of these nations. Chief among these is Singapore, who operates six MRTTs, which replaced its fleet of four ex-USAF Boeing KC-135R Stratotankers withdrawn in 2019.

The mid-air refuelling partnership between both countries preceded the MRTT/KC-30A though: Singapore had used its KC-135Rs to refuel RAAF F-111s and Classic Hornets at Exercise Pitch Black and Five Power Defence Arrangement exercises, as well as conducting refuelling trials with the RAAF's Boeing C-17A Globemaster airlifters in 2016.

The refuelling partnership has continued to advance since the RSAF took deliveries of its own MRTTs from 2018 and since then the RAAF and RSAF's MRTT/KC-30s have refuelled from each other.

In late September another RSAF MRTT flew with four RAAF F/A-18E/F Super Hornets in tow from Darwin to Singapore for an FPDA exercise, after supporting a flight of RSAF Lockheed-Martin F-16s in the other direction for an RSAF exercise in the Northern Territory.

The Republic of Korea Air Force (ROKAF) has also sent its MRTT crews to observe and study RAAF KC-30 operations as it awaited delivery of its own four aircraft. There were ROKAF personnel on board some KC-30A flights during Exercise Pitch Black 2018, although further details about the program are not known.

STILL MISTRUST

Despite the potential for Australia to broaden and deepen its engagement with regional air forces in the air domain – and its efforts to do so are for the most part welcomed by regional militaries – it must be remembered that Australia can still be seen politically as an outsider by some in the region.

The cool reaction to the recent AUKUS partnership and Australia's decision to go with nuclear-powered submarines from the political leadership in places like Indonesia and Malaysia is a timely reminder of this, with regional nations having to walk a fine line between the two increasingly confrontational regional powers given the economic and security stakes.

However, this is actually a sign that Australia would be best served by continuing its efforts to engage, and not withdraw, from the region, as there is nothing to gain from alienating regional countries. ■

AFGHANISTAN TO ANTARCTICA – THE RAAF ON OPERATIONS AND EXERCISES

Since its involvement in East Timor in 1999 and 2000, the Royal Australian Air Force has experienced a sustained period of increased operational tempo.

NIGEL PITTAWAY | MELBOURNE

AFTER a decade or more of operations in the Middle East Area of Operations (MEAO), the RAAF formed an organic Air Task Group in September 2014 for further operations over Iraq and later Syria in support of coalition efforts to defeat ISIL forces.

Under the banner of Operation Okra, RAAF Super Hornet, Hornet, Wedgetail and KC-30A aircraft supported coalition airstrikes over a five-year period, until the final rotational deployment in 2019.

That the RAAF was capable of raising an organic task group and then sustaining it over a long distance for an extended period of time demonstrated a depth of capability arguably not seen since the Vietnam War.

Even during this period, a full series of domestic exercises were maintained, including deployments throughout the region and across the Pacific. Exercises such as Pitch Black and Talisman Sabre here in Australia; the Bersama series in Malaysia; Ausindo with TNI forces; Red Flag and Cope North in the US and, most recently, Bushido Guardian with the Japan Air Self Defense Force, has seen the RAAF's air combat and ISR assets regularly engaged with its partners.

While the RAAF's air combat capabilities capture the headlines, it is the Air Mobility Group which has arguably been the busiest over this period. As well as supporting Okra and the wider ADF's exercises and deployments and the Australian Antarctic Division (AAD) under Operations Southern Discovery; AMG has provided extensive support for disaster relief operations at home and abroad. These include Operation Bushfire Assist in Australia, COVID Assist throughout the Indo-Pacific region and most recently, the evacuation of Kabul.

Maritime surveillance Orions and (more recently) Poseidons have also experienced a constant series of operations and deployments and today are still actively engaged in Operations Gateway (South China Sea), Resolute (Australia's EEZ) and Argos, the latter supporting UN sanctions against North Korea.

The following gallery of images is a tribute to the men and women of the RAAF who have tirelessly supported these efforts, from Afghanistan to Antarctica.

MAIN: A C-17A Globemaster III taxis towards the bomb replenishment area at RAAF Base Amberley

CLOCKWISE FROM TOP RIGHT: Afghanistan evacuees disembark an RAAF C-130J Hercules aircraft at Australia's main operating base in the Middle East region, after their flight from Kabul

A E-7A Wedgetail closes on a KC-30A Multi Role Tanker Transport as part of an air-to-air refuelling serial during Operation Okra

A C-130J Hercules air drops rations into the Shoalwater Bay Training Area during Exercise Talisman Sabre 2019

A 37 Squadron C-130J-30 Hercules is marshalled into a parking position at RAAF Base Darwin after a sortie during exercise Diamond Storm

A 75 Squadron Aircraft Technician preparing for the start of an F/A-18A Classic Hornet during Exercise Talisman Sabre 2021

A 36 Squadron C-17A Globemaster takes off from RAAF Base Richmond

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BARRY BECKER/AAD

COUNTERCLOCKWISE FROM ABOVE:

A 36 Squadron C-17A Globemaster sits at Wilkins Aerodrome in Antarctica

C-17A airdrop at Davis research station, Antarctica

A 77 Squadron F/A-18A Hornet landing at Andersen Air Force Base, Guam during Exercise Cope North 20

Air to Air photo of P-8A Poseidon from 11 Squadron with Harpoon Missiles

An F-35A Lightning II A35-017, in the ordnance loading area at RAAF Base Darwin, during Exercise Rogue Ambush 21-1

An RAAF F/A-18A Hornet fires a flare and banks away in the skies over Iraq

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CLOCKWISE FROM ABOVE:
An RAAF C-17A Globemaster III at Wilkins Aerodrome in Antarctica for Operation Southern Discovery 20/21

A KC-30A and F/A-18F Super Hornet transit to the main air operating base in the Middle East following a mission in support of Operation Okra

Pilatus PC-21A aircraft from 4 Squadron in formation on return from Sydney in support of an Air Force 2021 commemorative service in Hyde Park

An F/A-18F Super Hornet ignites its afterburners at dusk over Iraq

An RAAF KC-30A multi-role tanker transport aircraft from 33 Squadron refuels a P-8A Poseidon from 11 Squadron for the first time in the airspace off the coast of Queensland

Two RAAF C-17As arrived at Australia's main operating base in the Middle East on 18 August 2021, joining C-130J Hercules and a KC-30A aircraft supporting evacuation operations from Kabul

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COUNTERCLOCKWISE FROM LEFT: The sun sets behind a row of F/A-18F Super Hornets at RAAF Base Darwin, Northern Territory during Exercise Arnhem Thunder 21

Two F-35A Lightning II aircraft from 2 Operational Conversion Unit, fly over the Northern Territory during Exercise Rogue Ambush 21-1

A 33 Squadron KC-30A extends refuelling hoses prior to refuelling of a 6 Squadron EA-18G Growler aircraft during Exercise Talisman Sabre 2021

A 10 Squadron AP-3C(EW) Orion and 2 Squadron E-7A Wedgetail on the tarmac at Nellis Air Force Base during Exercise Red Flag 19-1

Four RAAF F/A-18F Super Hornets briefly share the Middle Eastern airspace with a RAAF E-7A Wedgetail Airborne Early Warning and Control aircraft

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IAI's leading Harop Loitering Munition

As a global leader in developing defence technologies for over four decades, IAI has extensive experience and knowhow which it seeks to share with its partners. Addressing the interest in defensive capabilities all over the world and specifically in the Asia Pacific region, IAI is introducing its ground-breaking, state-of-the-art capabilities and combat-proven technologies to Australia through cooperation with local industry. Through transfer of technology and local industry support, IAI is committed to providing Australia with the best defence solutions.

A family of advanced mobile radars, the Multi-Mission Radar (MMR) operate in S or C-Band and perform multiple missions: air surveillance, counter rocket artillery and mortar (C-RAM), and fire control. The MMR detects high and low flying targets, tracks, classifies and generates a real-time Air Situation Picture of all aerial targets, and its innovative design delivers high accuracy and rapid update rates. Combat proven, the MMR is operational in Israel and across the world, and is used as the key sensor in leading air & missile defence systems, including Iron Dome, David's Sling and Barak MX. Meanwhile, passive radars, like the COMINT ELK 70-71, intercept, analyze, identify, locate and monitor communication networks and datalinks in dense and complex communication environments - creating a real time Electronic Order of Battle (EOB), allowing it to monitor communication of emitting aerial targets.

Another one of IAI's world leading air defence solutions, the BARAK MX Air & Missile Defence System provides a single integrated solution for multiple simultaneous aerial threats from different sources and different ranges. The BARAK MX has vertical launch capabilities supporting 360° coverage, quick reactions, short minimal ranges and an active high-end RF seeker for targets with low radar cross-sections and high maneuverability. The BARAK interceptors can be medium range (up to 35km), long range (70km) or extended range (150km), and are capable of both land and naval configuration. IAI utilizes local defence companies, providing transfer of knowledge to the local industry, to build the BARAK MX family Air & Missile Defence System worldwide.

IAI's innovative solutions are ground-breaking – IAI's Loitering Munitions (LM) family is the ideal match for the time-critical, elusive, and evasive enemy targets of the modern battlefield. The LM family, which includes the Harop and Mini-Harpy, can quickly deploy, launch, fly and strike in adverse weather, and operate in complex arenas while detecting moving targets. Ground forces can operate loitering munitions from a distance, using portable tablet-based controls. LM can stay in the relevant area of combat operations for an extended time, and use sensitive electro-optic or anti-radiation sensors to cover and acquire an entire area in which enemy activity is known to be happening

Alongside developing cutting-edge air defence solutions, IAI strives to bring an impact to its customers and provide the local defence ecosystem with the tools to support and develop itself, in every location around the world. As such, IAI's commitment to local productivity – beginning with transfer of knowledge – is a crucial core value that every IAI partner can attest to. IAI's recent partnership with Hensoldt to supply new radars to the German Armed Forces is a testament to the importance IAI places on local development.

IAI-ELTA's MMR Radar

BARAK MX during trial

Similarly, IAI, alongside British company MCL, has been awarded a contract for unmanned ground vehicles by the British MoD. In further testament to IAI's deep commitment to "making in" its partner countries, the Indian DRDO has recently inducted the jointly-developed and locally built MRSAM Air & Missile Defence System. Partnering with local defence companies to provide the best solutions to every country's defence needs, while supporting the local defence ecosystem, is at the heart of IAI's solution.

IAI's air defence solutions join its other versatile state-of-the-art systems in providing Australia with the proper solutions to its security defence needs. Designed to defeat all types of aerial threats with efficient and versatile capabilities, IAI provides the tools to establish comprehensive network-centric, multi-layered air defences. IAI's expertise in delivering game-changing, high-end, combat-proven technologies to customers worldwide is a key factor in IAI's ability to offer world-class leading solutions – innovating for the needs of the future battlefield, together with our partners.

COUNTERCLOCKWISE FROM ABOVE: A 10 Squadron AP-3C (Electronic Warfare) Orion aircraft starts engines for a night mission during Exercise Red Flag 19-1 at Nellis Air Force Base, Nevada

An RAAF F/A-18F Super Hornet manoeuvres over Rawah, Iraq, during an Operation Okra sortie

P-8A Poseidon with Harpoon Missiles

Alaskan based US Army paratroopers conduct a static line jump from an RAAF C-17A Globemaster III near Charters Towers during Exercise Talisman Sabre 2021

A trio of F-35A Lightning II aircraft in formation over the Pacific with a KC-30A Multi-Role Tanker Transport during Exercise Lightning Ferry 21-1

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CLOCKWISE FROM ABOVE: C-130J Hercules aircraft from 37 Squadron taxi in preparation for a formation flight out of RAAF Base Richmond

A forklift moves into position behind a RAAF C-17A Globemaster at Wilkins Aerodrome in Antarctica

Combat Controllers from No.4 Squadron conduct parachute operations out of a C-130J-30 Hercules during Exercise Havoc Drop conducted near RAAF Base Wagga

RAAF personnel wave goodbye to a C-17A Globemaster loaded with fellow personnel and Super Hornet equipment from the main air operating base in the MEAO

An RAAF E-7A Wedgetail in formation with Hawaii Air National Guard F-22 Raptors near Oahu, Hawaii on 21 April 2021

An RAAF C-27J Spartan lands at Benning Airfield, Queensland, during Exercise Talisman Sabre 2021

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Joining forces to transform training and critical operations support

CAE recently completed the acquisition of L3Harris' Military Training business, which included iconic names in simulation and training – Link and Doss Aviation.

CAE is now the leading pure play, platform-agnostic company focused on simulation, training and operational support. We are ideally positioned to help our defence customers train and operate across air, land, maritime, space and cyber -- the multi-domain environment.

Explore our expanded breadth of capabilities and experience with the integration of Link Simulation and Training and Doss Aviation into CAE's Defence & Security business. And learn how our digitally immersive training and operational support solutions support your preparation for multi-domain operations.

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CAE

Training support for the RAAF

With a long history in Australia and an eye to the future, CAE's strategic acquisitions and ongoing investments in training technologies closely support the RAAF's evolving role

As the Royal Australian Air Force (RAAF) continues its Centenary celebration and 100 years of service to Australia, CAE is proud to have played a small role in supporting the training of RAAF aircrews past and present. Importantly, CAE also has an eye to the future as the RAAF continues to evolve as a fifth-generation air force needing to operate in a multi-domain environment – an environment that will demand an increasing use of digital technologies and synthetic environments to prepare for complex, near-peer threats.

With the billion-dollar-plus acquisition of L3Harris Technologies' Military Training business now complete – a business that includes iconic names such as Link Simulation & Training – CAE is continuing its long history of successful growth serving the RAAF.

"We have broadened CAE's expertise and experience as a training systems integrator across multiple platforms and enhanced our ability to offer digitally immersive solutions across multi-domain operations – air, land, sea, space and cyber," said Matthew Sibree, Managing Director for the Indo-Pacific region at CAE. "The Australian Defence Force as a whole face an evolving defence and security environment with new threats and challenges. We are positioning CAE as an industry partner who can help Australia, its allies and the RAAF in particular prepare for this environment. The combination of L3Harris Military Training with CAE's Defence and Security business is highly complementary to our core military training business and creates a platform-agnostic leader in training, simulation and operational support."

CAE was founded in 1947 and, though younger than the RAAF, next year will celebrate its own 75-year anniversary. The company has grown into a world-class training and mission support provider at the leading edge of digital immersion and counts Australia as one of its home markets. In fact, CAE Australia Pty Ltd is home to more than 300 employees.

Some current and ongoing activity for the RAAF

In Australia, CAE remains the Commonwealth's primary provider for support services on their aerospace simulators, such as the Hawk Mk127 lead-in fighter, C-130J transport, KC-30A tanker, MH-60R maritime helicopter, AP-3C maritime patrol aircraft and MRH-90 battlefield helicopter. CAE Australia delivers the RAAF's B350 King Air training at a company-owned and operated training facility in East Sale. CAE also built the RAAF's P-8A operational flight trainers at RAAF Edinburgh in collaboration with Boeing and following the Link acquisition is now the original equipment manufacturer of the RAAF's F/A-18 simulators. In a number of these training sites, the company has broadened its scope of services in recent years to become more of a training systems integrator and deliver the management of facilities, courseware, instructional delivery and in-flight training. A perfect example is the recently announced collaboration with Seeing Machines that will upgrade the Hawk Mk127 full-mission simulators at RAAF Williamtown and RAAF Pearce to incorporate biometric data and eye-tracking into the lead-in fighter training program.

Future complex systems for the RAAF

CAE's strategic relationship with General Atomics positions the company as General Atomics training partner for their family of Medium Altitude Long Endurance (MALE) remotely piloted aircraft platforms. CAE has worked closely with General Atomics on the training programs delivered to Italy and the UAE and are currently developing the Protector synthetic training system for the Royal Air Force in the UK. CAE Australia is an integral part of Team SkyGuardian Australia and will leverage this experience to support the RAAF which has selected the General Atomics MQ-9B for its RPAS requirement.

The RAAF has an upcoming training requirement for an Air Mission Training System, which trains Electronic Warfare Officers, Maritime Patrol and Response Officers, Operations Officers, and Weapons System Officers – in other words, not the pilots in aircraft like the P-8, E-7, or E/A-18, but the other crew. CAE has a range of experience and training solutions in this area. For example, the requirements for the Air Mission Training System are very similar to the training CAE supports for the U.S. Navy naval flight officers (NFOs) in Pensacola, Florida, where CAE instructors deliver training and make extensive use of the CAE-built Multi-Crew Simulator.

Investing for the future

CAE continuously invests in innovative technologies to help produce qualified aircrew more efficiently – for example, the CAE Trax Academy that helps train pilots faster and better. Elements of the CAE Trax Academy make up part of the U.S. Air Force's Pilot Training Transformation initiative as well as being used in trials by the Royal Air Force in the UK to transform fast-jet pilot training.

CAE Rise (Real-time Insights and Standardized Evaluations) is part of the CAE Trax Academy continuum and indicative of CAE's emphasis on leveraging digital technologies and big data analytics for self-paced, adaptive learning. Another new technology initiative originating from the company is the CAE Medallion MR e-Series Visual System — a complete visual solution designed to help revolutionize fast-jet pilot training in the virtual world.

A proven, trusted partner for the RAAF

The ADF and the RAAF in particular recognize it is no longer just individual platform proficiency in the air domain for which operators need to conduct training. Increasingly, the training requirement is for a coordinated effort across the multi-domain environment – air, land, sea, space and cyber -- and synthetic training is crucial to the preparation and readiness for multi-domain operations.

The close relationship between CAE and the RAAF promises to continue as the RAAF evolves in its second century. "It is our continued mission to earn the RAAF's trust and confidence to be their partner of choice for training and mission support solutions that help enhance safety, efficiency and readiness," summed Sibree.

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CAE

TRAINING FOR THE 21ST CENTURY

After more than 20 years as the primary provider of support services for the ADF's aerospace simulators, CAE Australia now seems likely to extend these and integrated training capabilities into a future in which advanced digital immersion technologies will play a vital role.

JULIAN KERR | SYDNEY

CAE'S two main umbrella contracts for simulator sustainment are due to expire this year and at the time of writing the company was preparing to enter negotiations with the Commonwealth on the construct of a future single umbrella contract.

Any new contract is likely to encompass simulator support to the Hawk Mk.127 lead-in-fighter at RAAF Williamtown and RAAF Pearce, C-130J-30 tactical airlifter at RAAF Richmond, KC-30A multi-role tanker transport at RAAF Amberley, MRH 90 Taipan battlefield helicopter at Army's Oakey Aviation Training Centre and the 5th Aviation Regiment at Townsville, and the AP-3C(EW) at RAAF Edinburgh.

In addition, CAE Australia supports the RAN MH-60R naval combat helicopter training academy at HMAS Albatross, the King Air 350 simulator at RAAF East Sale, and the Toll Aeromedical Centre of Excellence at Bankstown under separate agreements.

At a number of these sites CAE has become more of a training systems integrator, delivering the management of facilities, courseware, instructional delivery and in-flight training with the simulators as an integral part of the training curriculum.

"The training outcomes required by the Commonwealth across our centres is quite diverse," explained Matthew

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LEFT: CAE and Seeing Machines recently collaborated to install and integrate a crew training system that features precision eye-tracking technology on the three CAE-built Hawk Mk.127 full-mission simulators

OPPOSITE PAGE: Training in the CAE KC-30A simulator at Amberley, 33 Squadron pilots approach a simulated USAF KC-135 tanker

Sibree, Brisbane-based Managing Director of CAE Indo-Pacific Defence and Security.

"The KC-30A training is for both pilots and air refuelling officers (AROs); at RAAF Richmond we deliver C-130J training in aircraft and simulators together with a fuselage trainer, the pilot and loadmaster training environments and the maintenance training environment.

"At Nowra we have instructors as well as device maintainers. The work is subcontracted to CAE USA who then interface with the US Navy because of some of the sensitivities around the MH-60R.

"At Williamtown and Pearce our Hawk simulator instructors generally double up as RAAF Reserve pilots, which allows us to attract a very high calibre of instructors who remain current across operating procedures and take that back to the sim. On the C-130J, CAE delivers training both in the live aircraft and the simulators.

"At Townsville we subcontract the device sustainment scope of work to Thales. Across the MRH 90 the Commonwealth retains uniformed instructors."

The Army's CAE-manufactured Black Hawk simulator, commissioned at Oakey in 2008 and described at the time as the world's most advanced helicopter simulator, was retired earlier this year after 27,000 hours usage. By contrast, the heaviest-flown Black Hawk notched less than 6,000 flight hours.

CUTTING EDGE TECHNOLOGY

As an example of how government and industry can partner to deliver cutting-edge technologies, CAE Australia and technology company Seeing Machines recently collaborated to install and integrate a crew training system that features precision eye-tracking technology on the three CAE-built Hawk Mk.127 full-mission simulators used as part of the RAAF's lead-in fighter training program at RAAF Bases Williamtown and Pearce.

The eye-tracking technology improves aircrew training by providing objective insights and detailed data on where pilots are looking during training sessions in the simulator.

"We believe with further research we can understand through the analysis of a student's biometric data we can assess cognitive capacity and where they sit on the learning curve," Sibree said.

"Through a combination of Artificial Intelligence and adaptive training scenarios, simulated missions can be tailored to a student's learning capacity to optimise both training outcomes and reduce the time taken to train.

"In historical training, every pilot either passed or failed in a certain period of time and everyone went through the same training curriculum. With tailoring, if you've got a really good student, you can accelerate them through the curriculum whereas if you've got someone who just takes a little longer to learn, you can adjust the scenarios accordingly."

COVID-19 had initiated new approaches such as off-board instructor operator stations, virtual instructor-led classroom training and remote acceptance testing on training devices, Sibree noted.

However, it had also accelerated trends to which defence forces were moving already – digital immersion technologies like virtual reality; leveraging synthetic environments for not just training, but also planning, analysis and decision support; and looking more holistically at multi-domain operations and the integration of air, land, maritime, space and cyber.

"We need to prepare for a future that is contested in a multi-domain environment with a peer or near-peer adversary, and a secure virtual world will be the only way to do so because of time, cost and the prying eyes of adversaries," Sibree stated.

"The challenges for all air forces going forward are that aircraft and live flight are not getting any cheaper, but aircraft are so capable that they cannot not be used in a training area to their full capacity.

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LEFT: RAAF pilots fly a mission in the C-130J Full-Flight Mission Simulator during a Coalition Virtual Flag Exercise

BELOW LEFT: RAAF instructors conduct a Hawk Training Evolution at RAAF Base Pearce in Western Australia

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"Training was moving more around mission rehearsal in a large force employment exercise. So, getting that distributed mission training environment set up where people or operators can plug and play into a common synthetic environment is the challenge going forward.

"When you think about the cross-domain security of various devices, Hawk for example is an unclassified device whereas the F-35 is incredibly classified, and when you start mixing those ones and zeroes you need some smart operators to be able to implement the cross-domain security protocols."

Nevertheless, operators were getting greater value for money from live flight, concentrating on high end aspects with lower end aspects relegated to simulator time.

EMERGING TRENDS

One apparent trend however, was a move away from expensive full motion simulators to lower cost devices that still provided high immersion but were less expensive and more transportable.

Emerging technologies such as cloud computing, big data analytics, and artificial intelligence have the potential to transform training and mission support for multi-domain operations, Sibree commented.

CAE was involved in the Mission Command Systems Common Operation Picture for the US Special Operations Command and the Single Synthetic Environment for the UK Strategic Command where cloud-based synthetic environments offer decision support, what-if course of action analysis, and faster than real-time simulation.

The company was also contracted to develop a cloud-based adaptive learning management system for the US Air Force Pilot Training Transformation initiative. This will leverage data analytics, artificial intelligence and machine learning to streamline pilot training and create a training process that is continually adapting and improving.

"What we're seeing, and we're not the only defence industry to do so, is the Commonwealth starting to take what they traditionally call a below-the-line defence contractor further up into the above-the-line space, acknowledging there are some areas of capability in which they don't need to have a deep technical understanding," Sibree said.

"There they will leverage their partners to provide them with impartial advice and this is where the trusted nature of the relationship comes in."

FUTURE OPPORTUNITIES

Meanwhile CAE Australia is a training partner in the General Atomics-led Team SkyGuardian Australia selected in November 2019 to deliver the MQ-9B SkyGuardian as Australia's first armed medium altitude long endurance (MALE) remotely piloted aircraft system (RPAS). The $1.3 billion MQ-9B acquisition proposal is scheduled for government consideration in 2021-22.

CAE has delivered MQ-9A training to the USAF for several years and has worked closely with General Atomics on MQ-9B programmes for the UAE and the Italian Air Force, the latter with what is believed to be the highest fidelity RPAS simulator ever designed. This has been formally

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LEFT: The C-130J Hercules Fuselage Trainer at Richmond for training is an accurate and dedicated cargo compartment training device

BELOW: A CAE instructor supervises a KC-30A Air Refuelling Officer (ARO) during training at Amberley

qualified to Level D equivalent standard and provides the option to fully qualify both pilots and sensor operators in the simulator with zero live flight time.

The Italian simulator is also the baseline for the mission trainers under development by CAE for the Royal Air Force' s MQ-9B-based Protector RG.1 RPAS.

In terms of other opportunities, Sibree pointed out that the C-27J Spartan lacked an in-country training system, with COVID presenting challenges for pilots still travelling to Italy to utilise the synthetic devices at the original equipment manufacturer Leonardo in Pisa.

As agreed with the Commonwealth, the CAE-owned and operated King Air 350 full motion simulator at East Sale can also be accessed by third parties – in this instance numerous civilian customers and the RNZAF – providing a rebate back to the Commonwealth for every hour sold and demonstrating a model that could be extended, for example to other platforms with regional operators.

Yet to be disclosed is any training requirement for the MC-55A Peregrine electronic warfare support system capability based on four modified Gulfstream G550 airframes, the first of which will be delivered to the RAAF in 2023.

"We see a potential opportunity here because the flight model and operations will be different from a standard civil G550," Sibree commented.

Of more immediate interest is the upcoming RAAF requirement under Project Air 5428 Phase 3 for an Air Mission Training System to be located at RAAF Base East Sale. This will train Air Battle Managers, Air Mobility Officers, Air Traffic Controllers, Electronic Warfare Officers, Maritime Patrol and Response officers, Operations Officers and Weapons Systems Officers.

The requirements are similar to the training supported by CAE for non-pilot US Naval Flight Officers (NFOs) at US Naval Air Station Pensacola who are selected for the six-month Advanced Maritime Command and Control course. In parallel, the company is pursuing a major contract with the Canadian government for the RCAF Future Aircrew Training System (FAcTS).

This involves a CAE-designed multicrew simulator

CAE

(MCS) incorporating crew stations with interactive software running a series of instructor-programmed scenarios designed to facilitate the training of basic NFO skillsets.

Perhaps coincidentally, CAE Australia is now seriously examining taking the experience it has gained in the air domain and also delivering it in the naval space.

This aspiration will benefit from the recent US$1 billion acquisition by CAE of the L3Harris Technologies' military training business. Among a broad range of capabilities, this brings with it experience in the development and delivery of training systems for submarines.

"There's a concept coined by Navy called Ship Zero whereby training, sustainment, design engineering, experimentation and test would be undertaken under one roof," Sibree states.

"Ideally, for each of the new classes of ship there would be a Ship Zero facility that would enable some onshore training to occur.

"We can see CAE playing a part in Ship Zero and we have been in discussions with various elements of Navy to better understand their requirement and where we could add value.

"We currently deliver to the UAE Navy their naval training centre and that integrates several classes of ships in a synthetic environment. That centre also has the capability to then bring ships that are either alongside or at sea into a live, virtual and constructive environment so it's not new to CAE, it is new to us in Australia, and we see a path we could play there." ■

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At BAE Systems Australia, we are immensely proud to support the RAAF and proud of the role we play to help ensure our Air Force has the best capability, always.

Every day at work in Williamtown, one of the biggest RAAF bases in the nation, I only have to look skyward to see some of Australia's elite pilots put their aircraft through their paces overhead.

It's a sight I never tire of and a reminder of our purpose, our promise and our community.

I have been privileged to support the RAAF for many years, beginning my career on the Hawk design team. Today, I lead more than 590 employees at Williamtown, Wagga and RAAF Base Pearce as Director of Aircraft Sustainment & Training at BAE Systems Australia.

For me, it's so much more than a job.

It's a purpose that unites our team, from some of the longest serving, who were instrumental in the first Australian-built Hawk's maiden flight in May 2000, to our newest technicians supporting the fifth generation fighter, the F-35.

Over many decades, we have worked together with the RAAF, changing and evolving our business to reach a place of shared ambitions and alignment. We work side-by-side on many levels, as engineers, technicians and as trainers, supporting our nation's sovereign air capability.

Today, there is a significant focus on Hawk and F-35, though our partnership spans several decades, with our teams supporting rotary

> "A centrepiece of the RAAF's capability is the fifth generation F-35 Joint Strike Fighter – the most modern and lethal aircraft in the world."

and fixed wing aircraft, advanced military training services and training hundreds of pilots and technicians.

Over 30 years, our team of highly skilled trainers in Tamworth – many of them ex-RAAF pilots, helped graduate more than 2000 Australian Defence Force students with Basic Flying Training. In that time they completed more than 280,000 flight hours with an exemplary air safety record and more than 60,000 ground school lectures.

Nearly 700 kilometres south of Tamworth, our team in Wagga Wagga provide specialised aviation technical training to ADF aircraft

The First F-35 in for scheduled maintenance at BAE Systems Australia - Williamtown Facility

Andrew Chapman

technicians. This facility provides students with access to aircraft and state of the art simulators, and is recognised for delivering highly skilled technicians.

Today, the new era of air power is upon us, with the fifth generation F-35 Joint Strike Fighter – the most modern and lethal aircraft in the world today and a centrepiece of the RAAF's capability.

BAE Systems Australia is a sustainment partner for F-35 aircraft across the Asia-Pacific region and has been assigned the Asia Pacific Regional Warehouse provider for the aircraft where key F-35 components will be maintained for the next three decades.

In early 2021, we declared our Southern Pacific Regional Airframe Depot operational and welcomed the first F-35 for scheduled maintenance, a huge milestone for the region, state and the nation.

Work has begun on the second aircraft and over time we will grow our capacity to support the entire Australian F-35 fleet, as well as 300 aircraft in the Asia Pacific region.

The size, scale and complexity of the program provides an exciting future. Already we have more than 60 F-35 maintenance technicians supporting the fleet across the BAE Systems Depot and Operational Maintenance at RAAF Williamtown. With such longevity, the

technicians sustaining the F-35 fleet in the final years of this program are yet to be born.

F-35 sustainment at Williamtown will generate hundreds of highly skilled jobs but the impact of the program will be felt far and wide, from our supply chain, economic contribution, export opportunities and our growing sovereign capability.

Some 750 direct and indirect jobs will be created nationally, contributing $70 million in GDP to the Australia economy by 2025. While some 360 new, direct jobs in our business will be created over the next 10 years.

And the impact of the program doesn't stop there. To keep our programs delivering for the RAAF we rely on our network of trusted suppliers, and industrial capability is set to grow with the program. By 2025, we will have developed a specialist supply chain of around 76 SMEs to support us – in the Hunter Valley and across the nation.

For the past 100 years, the RAAF has played a vital role for our nation and we are immensely proud to play our part in supporting their service men and women.

Thank you to the RAAF for your unwavering service to Australia and for taking us with you on the journey so far and the decades to come.

F-35 Technicians at BAE Systems Australia - Williamtown Facility

Messages from our people:

Derren
F-35 Program Manager, Williamtown.

Congratulations to the RAAF on 100 years of service to Australia. It is a huge privilege to support the RAAF and to be on this journey with the F-35 fleet. Working from our Williamtown facility, I feel privileged to look up and see the RAAF flying the F-35 knowing the part we play in its success. It is particularly special to see apprentices coming through the program who are at the start of their careers and very excited to be working in the early stages of such a significant program.

Stephanie
Graduate Aerospace Engineer, Williamtown.

Happy 100th birthday to the RAAF! I often feel humbled by the size and importance of the Hawk LIF Program. To begin my career working on a platform of such significance leaves me excited for the future and brings purpose to my role every day.

Adam
Project Manager, Wagga Wagga.

Supporting the RAAF is at the heart of what we do and I am thrilled to join in congratulating the RAAF on their 100 years of service to Australia. Our team, past and present, pride themselves on delivering the highest quality aviation technical training to ADF aircraft technicians and are incredibly proud to support the RAAF.

AN AIRDROP LIKE NO OTHER

In late August, after months and months of planning, an RAAF C-17A Globemaster undertook a 15-hour round trip to airdrop supplies to Mawson Station in Antarctica, which had been isolated from maritime resupply due to thick sea ice last year.

EWEN LEVICK | MELBOURNE

THE mission was an impressive whole-of-government effort to plan, coordinate and execute. The RAAF effort (under Operation Southern Discovery, the ADF's Antarctic support operation) was led by Flight Lieutenant Matthew Huber, a C-17A pilot with No. 36 Squadron, who told *ADM* that planning started up to a year ahead of time in order to grapple with multiple challenges.

"Planning was conducted about six to twelve months prior," FLTLT Huber said. "There was engagement between multiple government agencies such as the ADF and Australian Antarctic Division (AAD), as well as environmental, meteorological, and logistics considerations that all needed coordination to get the job done.

"BIOSECURITY WAS A BIG CHALLENGE, INCLUDING COVID, WHICH IMPACTED HOW WE WERE GOING TO COORDINATE THE EFFECT WITH ALL THE AGENCIES INVOLVED"

"Biosecurity was a big challenge, including COVID, which impacted how we were going to coordinate the effect with all the agencies involved. We went forward from there to plan a mission that would depart from Perth International Airport and conduct the 15-hour sortie."

In a release, Defence said that biocontrol measures included washing parachutes to prevent unwanted organisms from entering Antarctica, which was undertaken by 176 Air Dispatch Squadron in Tasmania after a mandatory two weeks of quarantine.

Meanwhile, the RAAF had to provide guidance to the AAD on how to develop a drop zone to military requirements.

"The planning crew, which was myself and a few other pilots, we coordinated with the AAD to develop the drop zone that we needed to execute the mission," FLTLT Huber said. "Obviously they're not a military agency, so we provided the guidance on how to lay out the drop zone and they did the work on the ground down there to ensure that it met the minimum requirements."

For FLTLT Huber and the crew aboard the C-17A, the scale of the operation was less of a concern than the unpredictability of Antarctic weather.

"We very rarely, I would say, enact a mission that is an actual 15.2-hour sortie requiring an 80,000-pound upload of fuel using air-to-air refuelling capabilities, although we train to it," FLTLT Huber said. "That wasn't really a huge issue for us. The biggest complexity was understanding the weather at that time of the year and the daylight hours. Being flexible and resilient to the changing weather patterns is probably the most critical point of doing any Antarctic mission, whether that be landing or airdrop.

"There are flexible and rapidly changing weather systems that move through Antarctica, which can change every 6-12 hours, so there was a very small window for the drop – and meteorological forecasting models all like to tell us different stories."

For the RAAF and the AAD, the main meteorological concern was the strength of the prevailing wind, which

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would prevent the ground crew from acquiring the cargo and potentially even blow the supplies right across the ice. The AAD set a 25 knot wind limit, which forecast a one to three hour window available to drop and secure the supplies.

"First, we had to be close enough to execution to analyse the met forecast – so lining up with the rough window – and then, with 12-24 hours from execution, making a decision on the exact time to execute the mission and drop," FLTLT Huber explained. "And when I talk weather conditions I mean weather fronts causing blizzards so the crew on the ground can't actually grab the cargo. The biggest obstacle really was the wind blowing the cargo across the ice.

"There was a lot of back and forth with Bureau of Meteorology and AAD to essentially build a picture and then make a coordinated decision on the time of drop."

Given the distances involved the contingency plan was simple: if the winds were too high, the C-17A would simply have to turn around and come home.

"We essentially carry the fuel reserves to get us safely back to Australia. So, in the worst case we would have flown down there, the wind was too high and we'd turn around and come home," FLTLT Huber said. "Best case, we take a little bit of extra fuel if we can, orbit down there and wait for the wind to decrease so that we can drop."

Once everything was in place, the C-17A took off from Perth International Airport just before midnight for the 11,000-kilometre journey with additional crew members on-board to share the burden of a long flight.

Somewhere over the Southern Ocean the Globemaster met a KC-30A tanker for a lengthy 15-minute air-to-air refuelling. The exact location was decided by a balance between the C-17A's fuel burned and the diversion range of the KC-30A.

ABOVE: A C-17A airdrop at Davis research station, taken in 2017.


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"We need to burn enough fuel to be able to take on more because we departed Perth with full tanks," FLTLT Huber said. "The KC-30A is a twin-engine aircraft and has other regulations and limitations around how far they can actually travel from an airfield. So, it's a balance between risk mitigation for the tanker aircraft against how much fuel we can on-load at that point in the flight."

As captain, FLTLT Huber was responsible for manually flying the C-17A for 15 minutes in line with the boom movement of the tanker aircraft, which he describes as the most taxing part of the operation.

"It was planned at 22 minutes but it took 15 minutes," FLTLT Huber said. "But in training we don't normally sit there plugged for 15 minutes. We can take a lot of gas very quickly, in the order of 7000 pounds per minute, however it was definitely one of the longer air refuelling missions we would enact.

"It's fatiguing. We're hand flying, it's night time, we're out of sleep cycle, it's a little bit bumpy, a little bit of weather around, all those sort of things. So, it's quite fatiguing, but our training prepares us for that."

The drop was made successfully in the dull Antarctic light, and the AAD expeditioners recovered the cargo from the drop zone in temperatures of -25 degrees centigrade and strong winds while the Globemaster returned to Australia.

The complex and successful airdrop is valuable experience as the AAD prepares for the Million Year Ice Core project: a plan for an Australian team to traverse the White Continent for the first time in decades, departing from Casey research station and travelling 1,100 kilometres to Little Dome C in east Antarctica, which is more than 3,200 metres above sea level. According to the AAD, the journey is expected to take two weeks at an assumed rate of 90 kilometres per day. The AAD will then construct a mobile inland station to allow scientists to drill more than three kilometres down into the Antarctic ice sheet.

"THE AIRDROP IS VALUABLE EXPERIENCE AS THE AAD PREPARES FOR THE MILLION YEAR ICE CORE PROJECT"

Tasmanian company Elphinstone Engineering – which is teamed with Hanwha Defense Australia to manufacture vehicle hulls for the Redback infantry fighting vehicle under Land 400 Phase 3 – is building five 12.5 metre and 23 7.5 metre sleds for the expedition.

Whilst the traverse has been delayed by the AAD, the RAAF is ready to help deliver supplies to the expedition when it eventually moves across Antarctica.

"I was involved with the proof of concept and that airdrop would be very much the same," FLTLT Huber said. "The delivery of cargo is via a method or via a system called the container delivery system – that's just packed bundles with parachutes that fall out of the back of the aircraft on a pre-calculated point to land on the drop zone that has been communicated by the ground team."

Although there are numerous challenges in organising an airdrop to the most remote places on earth, the RAAF crews flying south are rewarded with a view most people will never see: acres of sea ice, soaring rock features, and a long white coastline.

"It's pretty surreal, how far away from civilisation you actually are," FLTLT Huber said. "I was lucky enough that it was clear weather when I went down there last time. An hour out of Antarctica, you start to make out the ice, the ice cracks, the rock formations. At first it's actually a lot less white than you think it is, with all those rock formations, depending on the time of the year.

"Then when you're over the continent itself, it becomes white, as far as the eye can see. It's awesome." ■

ABOVE: The air-to-air refuelling required FLTLT Huber to fly manually for 15 minutes.

ABOVE LEFT: Supplies on the ground at Wilkins Aerodrome, taken in 2020.

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AIR FORCE'S HEAVY LIFTERS

From Afghanistan to Antarctica, RAAF's medium and heavy airlifters have been in the news in recent times, as Air Mobility Group supports military operations, civilian agencies and disaster relief efforts around the globe.

NIGEL PITTAWAY | MELBOURNE

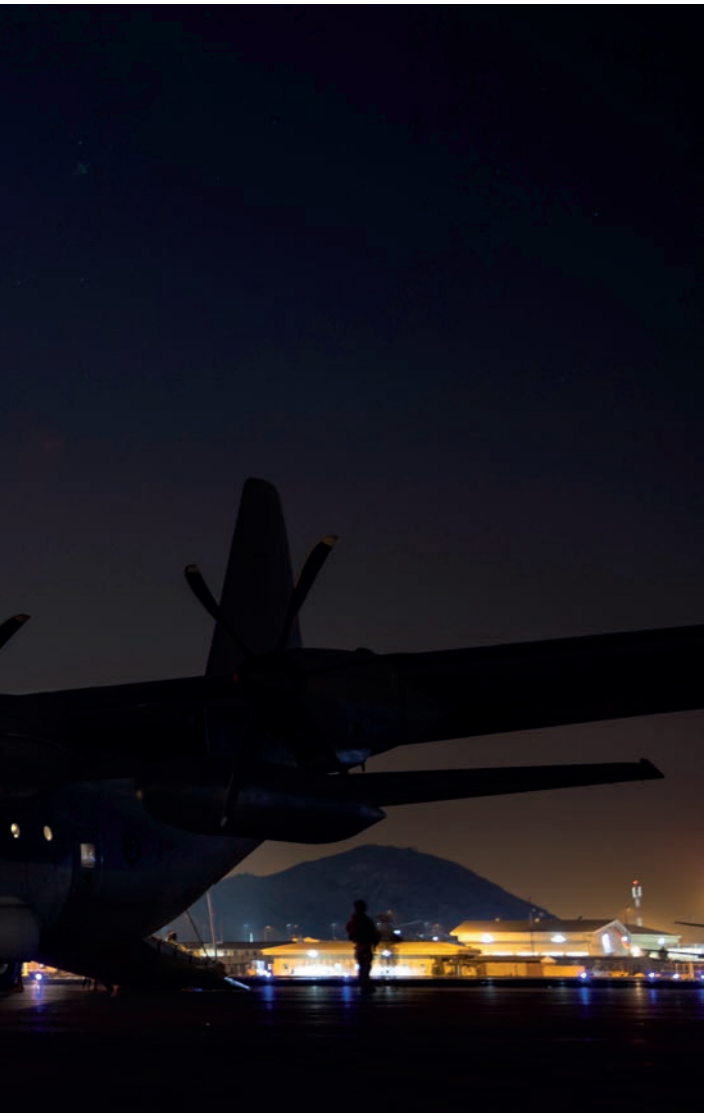
THERE'S a military maxim that goes something along the lines of, you never have enough airlift assets when the chips are down. This truism has been so since the capability was first developed in the years after the First World War: from the first evacuation of Kabul to the Burma Hump; from the Normandy landings to the Berlin Airlift; and from the war in Vietnam back full-circle to the recent evacuation of Kabul.

In times such as these, the great work done by the aircraft, crews and support personnel is highlighted for the world to see, but the capability comes at a cost and Defence budgets are often skewed towards glamorous big ticket acquisition programs such as fighter jets and submarines. Airlift assets are often acquired in penny packets as and when funding can be made available and, when they are needed, they are often spread thinly – with consequences for both concentration of the effort required and the fatigue of aircraft and their crews.

This is so even in modern times, as evidenced by the airlift operations to evacuate civilians from Kabul. Assets from the US Air Force and its allies had to be hurriedly brought into theatre and sustained through what was to become an intense period of operations. This meant aircraft and personnel had to be redirected at short notice from other tasks and has reportedly resulted in a forced 'reset' period, while maintenance and crew fatigue is addressed and deferred tasking completed.

Australia contributed five aircraft and personnel to the airlift, made up of two Boeing C-17A Globemaster III strategic airlifters, two Lockheed Martin C-130J-30 Hercules medium airlifters and a single Airbus KC-30A Multi-Role Tanker Transport (MRTT) – almost one-fifth of all the RAAF's assets in this class. Over the period of the Kabul evacuation, other time-critical tasks had to be undertaken simultaneously, including a resupply airdrop over Antarctica.

Details of the RAAF's efforts to airlift civilians from Kabul have unfortunately been suppressed by Defence, so it is difficult to determine how much strain – if any – the operation placed on the ADF. With tensions in the Indo-Pacific region increasing and the impacts of climate-change being attributed for more (and more severe) natural disasters in the future, any review of Air Force's heavy airlift capability must also ask if there is actually enough capability to support simultaneous high-intensity operations. Furthermore, it must ask if the recent Defence Strategic Update



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(DSU2020) and Force Structure Plan (FSP2020) have allocated enough importance to airlift capability to cope with rapidly-changing events.

KABUL AIRLIFT

While *ADM*'s questions to Defence concerning the impact of the Kabul Airlift on short and long-term fleet planning have so far gone unanswered, ADF sources have provided some details of the operation.

The RAAF's first flight into Kabul's Hamid Karzai International Airport was operated by a C-130J-30 Hercules from 37 Sqn on the night of 17 August, evacuating an initial load of 26 people including Australian citizens and Afghan nationals.

Over a nine-day period between August 18 – 26 the five RAAF Air Mobility Group aircraft and personnel performed more than 30 flights and, in co-ordination with the Department of Foreign Affairs and Trade (DFAT), evacuated a total of 4,100 people from Kabul.

While the C-17As and C-130J-30s flew into Kabul to complete the airlift operations, the single KC-30A flew eight air-to-air refuelling (AAR) missions in support of coalition

NIGEL PITTAWAY

fighter aircraft that were providing cover. Over the course of the eight missions, the force-enabling KC-30A delivered around 375,000 pounds (170 tonnes) of fuel to patrolling fighter jets. For a more detailed look at the KC-30As capabilities, see the separate story in this issue of *ADM*.

AIR MOBILITY GROUP AT A GLANCE

Headquartered at Richmond, the RAAF's Air Mobility Group (AMG) currently has five operational flying squadrons, split between 84 and 86 Wings at Richmond and Amberley respectively. Aside from the C-130J-30, C-17A and KC-30A, the AMG is responsible for the RAAF's ten Leonardo C-27J Spartan light tactical airlifters and a squadron of Special Purpose Aircraft, made up of two Boeing 737-BBJs and three Dassault Falcon 7X aircraft, for the VIP transportation role.

C-17A GLOBEMASTER III

Eight C-17As are operated by 36 Sqn at Amberley and have provided the ADF's strategic airlift capability since the first entered service in late 2006.

Only four aircraft were initially acquired, but the large transport's versatility soon proved indispensable and has meant that a further four have subsequently been acquired, in batches of one, one and two aircraft each. The final pair are among the last handful of C-17As to be built by Boeing and had been in storage in the US since rolling off the production line in Long Beach, California in 2014. The two aircraft were in a batch of ten 'white tail' aircraft built in anticipation of further contracts and others in this batch were later acquired by Canada, India and Qatar.

The eight RAAF aircraft are in high demand and the fleet supported the ADF air bridge operations to the Middle East for many years as well as Humanitarian Aid and Disaster Relief (HADR) missions across Australia and the region.

The C-17A fleet flew domestic operations in support of Operation Bushfire Assist in 2019 and 2020 and so far in 2021

LEFT: The first RAAF C-130J-30 Hercules landed at Hamid Karzai International Airport overnight and departed at around 0100 local time on 18 August 2021

ABOVE: The RAAF has 12 C-130J-30 Hercules medium airlifters with 37 Sqn, based at Richmond

NIGEL PITTAWAY

ABOVE: A 37 Sqn C-130J-30 Hercules over Sydney

it has supported cyclone relief efforts in WA in the wake of tropical cyclone Seroja and undertaken HADR and COVID-19 relief operations throughout the Indo-Pacific, including East Timor, Fiji, India, Nepal, Sri Lanka and Vanuatu.

In addition, 36 Sqn provides support to the AAD in Antarctica each year under Operation Southern Delivery, either by operating into the ice runway at Wilkins Aerodrome (known as Air-Land missions), or by aerial delivery of supplies when Antarctic weather does not permit, or resupply of deployed personnel is required. These latter missions are known as Air-Drop missions and the most recent example, flown concurrently with the beginning of the Kabul Airlift effort, was conducted from Perth on 19 August (for further details see Ewen Levick's story on page 100).

"FROM A MILITARY OPERATION STANDPOINT, THE C-17A FLEET ROUTINELY SUPPORTS RAAF EXERCISES AND DEPLOYMENTS ACROSS AUSTRALIA AND AROUND THE PACIFIC"

From a military operation standpoint, the C-17A fleet routinely supports RAAF exercises and deployments across Australia and around the Pacific and made news in July, when one aircraft was used to provide a targeting solution for a US Army Lockheed Martin High Mobility Artillery Rocket System (HIMARS) during Exercise Talisman Sabre.

Although such a capability is not an operational requirement for the ADF, as Defence has not purchased HIMARS to date, Australia becomes the first nation outside the US to provide rapid air mobility for the system.

The trials were conducted at Amberley on 23 July and follow a similar series of testing performed by the US Air Force as part of its Advanced Battle Management System, which is exploring how systems across the four US services can be networked together to enable Joint Force operations.

"The HIMARS targeting trial has demonstrated yet another way that mobility aircraft directly enable the Joint Force in the fight," explained Officer Commanding 86 Wing Group Captain Anthony Bull at the successful completion of the RAAF trial.

"The advanced navigation and communication equipment in the C-17A can be used to pass targeting information to the artillery system in flight. This means the HIMARS is 'on' the entire time and using the data to observe and orient itself, so when the aircraft lands, the HIMARS system rolls off ready to fire in a fraction of the time it would normally take."

GPCAPT Bull said the typical time previously taken to offload HIMARS, fire the weapon and reload it back into the C-17A could take upwards of 45 minutes, but the new tactic reduces the chances of successful counter battery fire.

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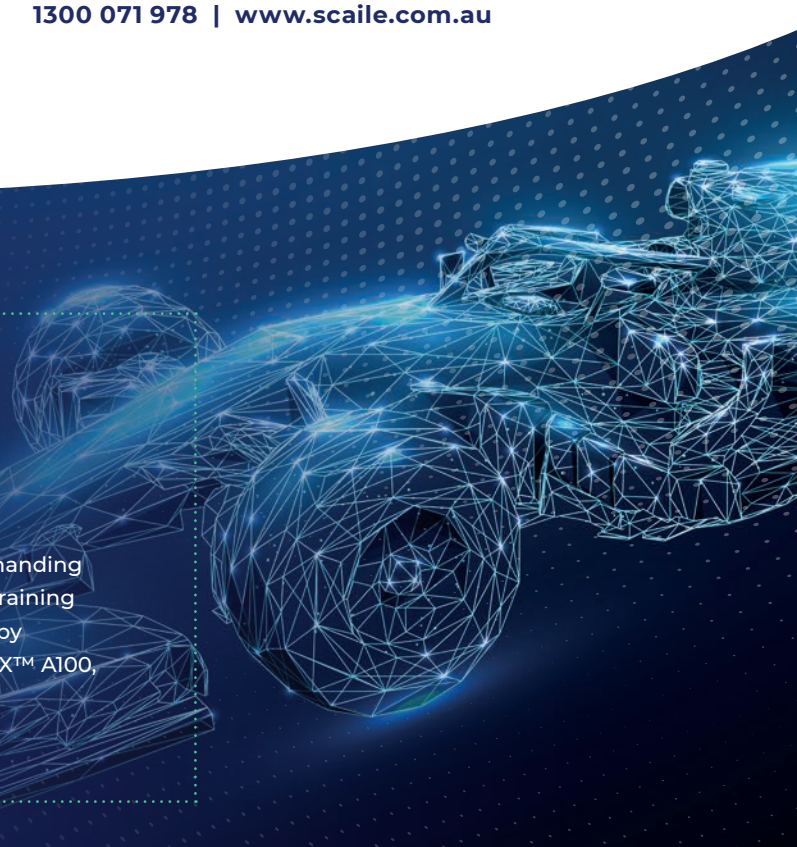


NIGEL PITTAWAY

LEFT: Eight C-17A Globemaster III strategic airlifters are operated by 36 Sqn RAAF at Amberley

THE LABOURS OF HERCULES

The C-130J-30 Hercules has been a stalwart of ADF airlift capability since entering service in 1999 and the twelve-strong fleet is receiving enhanced capabilities that will keep it relevant in the RAAF's future vision for a fully-networked force.

Like the Globemaster, the Hercules fleet continues to support ADF operations at home and abroad and has also enjoyed a high operational tempo throughout 2021.

As mentioned earlier, two aircraft supported the evacuation efforts in Afghanistan in August and also explored new tactics, techniques and procedures during the recent multi-lateral Talisman Sabre 21 exercise. As part of the latter exercise, one 37 Sqn C-130J-30 was refuelled on the ground at RAAF Base Tindal from a US Air Force MC-130J Commando II special operations aircraft.

The refuelling operation was conducted as part of a Forward Arming and Refuelling Point (FARP) training scenario and marked the first time an RAAF Hercules has been refuelled from a US Air Force MC-130J under FARP conditions.

"THE C-130J-30 HERCULES HAS BEEN A STALWART OF ADF AIRLIFT CAPABILITY SINCE ENTERING SERVICE IN 1999"

The RAAF has previously trialled FARP procedures with Australian Army battlefield helicopters (and even an Abram M1A1 Main Battle Tank) and has acquired a number of underwing fuel tanks similar to those used by the now-retired C-130H variant to enable higher fuel offload in remote locations.

"In recent years we've conducted FARP trials and training with the ADF, as well as with US Marine Corps aviation units," explained 37 Sqn Commanding Officer Wing Commander Anthony Kay in a story for Air Force News. "Exercise Talisman Sabre 21 allowed us to build valuable FARP experience with a fellow C-130 operator (and) will be valuable in future exercises and operations."

WGCDR Kay said that the ability to establish a FARP at a remote airfield in Australia, or throughout the Indo-Pacific region, would add "flexibility and range" to force projection and will become an important element of Joint operations.

Leading up to Talisman Sabre 21, 37 Sqn worked with the MC-130Js of the US Air Force's 353rd Special Operations Group at RAAF Richmond as part of Exercise Teak Action 2021. During this exercise, the two units conducted joint medical evacuation, air-drop and FARP training scenarios, as well as experimentation with augmenting RAAF Hercules flight crews with a Combat Systems Operator (CSO).

The CSO forms part of the MC-130's standard crew, but up until now the role has not been trialled by the RAAF. "At this stage there are no C-130J roles that require a CSO and this concept (was) a trial only," a Defence spokesperson commented.

THE FUTURE OF RAAF MEDIUM AND HEAVY AIRLIFT

To return to the maxim of an air force never having enough airlift capability when needed, and whether the RAAF was indeed stretched by recent events: Defence unfortunately declined *ADM*'s request for an interview and had not responded to written questions by the time closed for press. However, Chief of Air Force Air Marshal Mel Hupfeld notes in our From the Source interview this month that FSP2020 has identified a future need for more airlift and more air-to-air refuelling capability and has "subsequently allocated future projects to deliver these capacity increases."

The FSP2020 document includes a $13.2 billion provision for a Medium Air Mobility (C-130J-30) Replacement program, with funding to begin in 2029.

While it does not specify requirements for the new capability beyond the fact that it will be a medium airlift capability, given the assumption the new platform will have a cargo bay of a similar volume to the current C-130J-30, there are currently only two platforms on the market. These are the C-130J itself, which is still in production in the US, or Embraer's KC-390 Millennium turbofan-powered airlifter.

If a larger capacity is required, then the number of alternatives narrows to just one: the Airbus A400M, known in RAF service as the Atlas. The A400M is larger than the C-130J but smaller than the C-17 but, in the absence of any US program in the meantime, it is the only game in town if additional heavy airlift capability is required. As noted, the C-17A has now been out of production for more than five years and so far it would appear that there's nothing on the horizon.

Similarly, the recent announcement by Defence that the C-27J has been re-roled from battlefield airlift (for which it was originally required) to light fixed-wing transport and HADR duties will leave a gap in intra-theatre airlift that has been only partially addressed by the purchase of four more CH-47F Chinooks for Army.

Even before Kabul, future fleet planners had a lot to take into consideration and it would appear that their task has now become even more complicated. ■

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Leonardo is a market leader in the development and production of jet training aircraft and associated integrated training systems. Leonardo proudly has over 60 years' experience in military pilot training, 2,000 trainer aircraft delivered, 20,000 military and civilian pilots trained for more than 40 customers globally with touch points on every continent. Leonardo leverages this vast experience and couples it with the most advanced technologies in the delivery of combat pilot training systems.

Historically, RAAF fighter pilots earned their wings flying the Aermacchi MB-326, tomorrow's pilots could fly the Aermacchi M-346 Integrated Training System. The Aermacchi M-346 is a 5th generation LIFT solution which allows aviators to hone their skills in both air-to-air and air-to-surface tactical operations along with the critical skill of cockpit data management. The Aermacchi M-346 provides a fundamental input to capability enabling pilots to subsequently exploit the full potential of F-35 and other latest-generation fighters'.

The Aermacchi M-346 was born with specific focus on providing an effective eco system to meet contemporary platform and battlespace demands. The Aermacchi M-346 seeks to deliver combat pilot training for front-line operations in evolved multi-dimensional scenarios, whereby the pilot faces the challenges relating to performance of modern fighter aircraft as well as situational awareness, complex dataset management and compressed decision making timeframes. "The fundamental parameter to be managed in today's training is the optimal balance between real high performance aircraft and appropriately linked simulation, in order to reduce costs without compromising quality." synthesizes Emanuele Merlo, SVP Line of Business Trainers at Leonardo Aircraft Division.
Through its advanced integrated training solutions, the Leonardo LIFT solution enables a transition to the latest generation fighter aircraft for new combat pilots. The Leonardo LIFT training solution comprises a high performance training aircraft like the Aermacchi M-346, and, a complete Ground Based Training System (GBTS) which includes full mission simulators, other instructional devices and logistic services ensuring optimal aircraft availability. The Aermacchi M-346 Advanced / Lead-In Fighter Trainer (LIFT) was conceived from the beginning as a new generation solution seeking to maximize the teaching effectiveness whilst reducing costs.

"The M-346 targets extensive "downloading" of flight hours from the more expensive training phases traditionally carried out on the twin-seat version of front line fighters: this provides huge savings and optimization in the fighter fleet exploitation, allowing their highest deployment to combat tasks only. This approach maximizes - at the same time – the quality of training with particular focus on developing cadet's necessary skills to manage the most complex operational net-centric scenarios", continues Emanuele Merlo.

Today the M-346 is the most modern LIFT trainer on the market, combining high level of performance and maneuverability. Thanks to its two Honeywell F124-GA-200 turbofans engines reaches a maximum level speed of 590 KTAS and can expose the pilot to supersonic flight reaching 1.2 Mach in shallow dive, with a service ceiling of 45,000 ft and limit load factor of +8/-3g. The twin-engine solution, together with a four channel Fly-By-Wire Flight Control System, highly redundant main systems and advanced in-flight safety features like PARS (Pilot

Activated Attitude Recovery System), combine to ensure the Aermacchi M-346 is a very safe aircraft.

The Aermacchi M-346's Embedded Tactical Training Simulation (ETTS) allows the aircraft to emulate on-board sensors and an impressive range of weapons. The Aermacchi M-346 has the latest generation human-machine interface (including Helmet Mounted Display), as well as in-flight refueling probe and five hard-points for different external loads for both air-to-air and air-to-ground. Combined, these features provide the trainee pilot with a training eco-system which is truly representative of the latest generation fighter aircraft.

The Aermacchi M-346 is at the core of the Leonardo Integrated Training System, which includes a complete Ground Based Training System (GBTS) of simulators, academic modules, mission planning system and a computer-based training management system. The system allows the simultaneous integration of in-flight aircraft, Full Mission Simulator and Computer Generated Forces (CGF) which enables the trainee pilot to interact in real time with a virtual tactical scenario: the so-called "Live Virtual Constructive capability" (LVC). The LVC reproduces the most complex net-centric operational scenarios, further enhancing the effectiveness of the Leonardo LIFT solution for training the new generation of combat pilots.

Leonardo responded last year to the Commonwealth's Air 6002 Request for Information, committing to deliver to the Royal Australian Air Force an immediately available and effective solution for training its pilots destined to latest generation fighters, centered on the M-346 advanced jet trainer.

The M-346 training system is at the forefront of technology and represents a proven, non-developmental LIFT solution. In addition to the Aermacchi M-346 central role to the Italian combat pilot training system, (inclusive of fully developed and operational LVC (Live, Virtual, Constructive) capability), the Aermacchi M-346 is currently delivering fundamental inputs to fighter pilot capability for the Israeli, Polish and Singaporean Air Forces.
All of them current or future F-35 operators.

Recently the Aermacchi M-346 has been chosen by the Hellenic Air Force in the frame of a wider agreement between Greece and Israel and by an undisclosed customer. It has also been delivered to its international launch customer in its radar equipped Fighter Attack version.

The Aermacchi M-346 aircraft is the core of above mentioned IFTS - the International Flight Training School - operated by the Italian Air Force with Leonardo and the collaboration of CAE - to reinforce their training offer for NATO and allied Countries. The IFTS is aimed at the establishment of an advanced flight training centre, an international benchmark for military pilots' training, particularly in the Phase IV (Advanced/Lead-In to Fighter Training), capable of satisfying the growing demand of partner Countries for the training of their pilots.

The project brings together two national excellences: the expertise and tradition of the Italian Air Force and Leonardo's capabilities in the training sector. The Qatar Emiri Air Force's and German Air Force's - and now the Japan Air Self-Defense Force (JASDF)'s - decisions to send their pilots to train in Italy at the IFTS provides clear evidence of the recognition of the Italian training system and testifies the potential of this ambitious international project.

The Aermacchi M-346 is a technologically advanced comprehensive LIFT solution with unparalleled program maturity and operational readiness, able to deliver next generation fighter pilots through an eco-system that is both operationally outstanding and cost effective.

Finally, yet importantly, thanks to its performance the Aermacchi M-346 can become also an effective "aggressor" platform - the aircraft already acted as "enemy" versus fighters in several NATO exercises - or a companion trainer for front-line squadrons, actually covering the range of additional roles envisaged by ADF Combat Support requirements.

NIGEL PITTAWAY

KC-30A & WEDGETAIL – THE GREAT ENABLERS

The Royal Australian Air Force's Boeing E-7A Wedgetail Airborne Early Warning & Control (AEW&C) and Airbus KC-30A Multi-Role Tanker Transport (MRTT) share several commonalities, not least of which is their critical importance to ADF force projection.

NIGEL PITTAWAY | MELBOURNE

ALTHOUGH very different capabilities, the both are derived from commercial airliners, both were immature platforms when selected and both subsequently experienced long development periods and a hesitant introduction to service. However, both are reportedly now regarded as the 'platform of choice' by the ADF and coalition partners in exercises and on operations.

The RAAF was the lead customer for Wedgetail and one of the early customers for the KC-30A (referred to as the MRTT by Airbus) and is a world-leader in their employment. This has recently been evidenced by five years of operations in the Middle East supporting RAAF and coalition strikes in Iraq and Syria as part of an organic Australian Air Task Group (ATG).

The ATG deployed to the Middle East Area of Operations (MEAO) in September 2014 and included single examples of the Wedgetail and KC-30A. Their performance over the next five years not only dispelled lingering doubts of some within Defence of their suitability in their respective roles, but earned the respect of allies and partners as the 'go to' capabilities.

The Wedgetail celebrated a decade of service with the RAAF in May 2020 and the KC-30A followed suit in June this year. Today both look forward to a range of incremental upgrades to keep them at the cutting edge of their respective capabilities until replacement, sometime in the 2030s.

WEDGETAIL'S VIGIL

The E-7A Wedgetail is based on the commercial 737-700IGW (Increased Gross Weight) airframe, albeit with significant structural modifications to support the equipment and sensors required for the AEW&C mission. Not least of these is the dorsal-mounted pedestal for the aircraft's primary sensor, the Northrop Grumman Multi-Role Electronically Scanned Array (MESA) surveillance radar.

Six Wedgetails are service with 2 Sqn RAAF at Williamtown and a similar solution has subsequently been selected by Turkey, the Republic of Korea and the United Kingdom. The first two Australian aircraft were modified for

ABOVE: The Wedgetail's primary sensor is the Northrop Grumman Multi-Role Electronically Scanned Array (MESA) surveillance radar

the AEW&C role by Boeing in the US, but the remaining four were completed by Boeing Defence Australia (BDA) at RAAF Amberley.

Since returning from the Middle East in 2019, the fleet has provided AEW&C support for major air combat exercises such as the biennial Pitch Black series in the Northern Territory and the Red Flag exercises in the US.

Most recently, two Wedgetails participated in the multilateral Talisman Sabre 21 exercise held in eastern Australia in July and August, providing battlespace management – including both air and maritime tracks – for force commanders as well as allowing air and ground crews to upgrade training competencies.

"Talisman Sabre 21 has exposed 2 Squadron airborne personnel, including pilots, air battle managers and airborne electronics analysts to a complex battlespace environment, providing them with familiarity in monitoring and controlling a range of aircraft types and missions," commented the squadron's Commanding Officer, Wing Commander Warren Haynes.

"Fundamentally, TS21 is a highly complex exercise and allows personnel to engage in real-time training scenarios to ensure the squadron maintains the highest level of operational capability and readiness."

WGCDR Haynes noted the Wedgetail is capable of covering an area in excess of four million square kilometres – roughly equivalent to the Northern Territory and Western Australia combined – during a single ten-hour sortie.

"With its ability to survey, command, control and co-ordinate a Joint air, sea and land battle in real time, the E-7A is a significant force multiplier for the ADF and our coalition partners," he added. "The opportunity to participate in TS21 has been vital to maintain our strong interoperability and lethality, to effectively respond to threats when called upon and achieve mission success."

"THE RAAF WAS THE LEAD CUSTOMER FOR WEDGETAIL AND ONE OF THE EARLY CUSTOMERS FOR THE KC-30A"

The aircraft were original acquired under the Air 5077 project and subsequent phases of the overarching program are seeking to enhance capability over the Wedgetail's remaining lifespan, currently expected to stretch beyond 2030.

A series of incremental upgrades is being carried out under Air 5077 Phase 5A to address a range of obsolescence and compliance issues and improve interoperability with Australia's allies and partners. These include the addition of a Traffic Collision Avoidance System (TCAS), Identification Friend Foe (IFF) Mode 5, a wideband satellite communications (SATCOM) system and an upgrade of the MESA radar software.


DEFENCE

LEFT: A 33 Sqn KC-30A refuelling 6 Squadron EA-18G Growlers during the ferry from Australia to the US for Exercise Distant Frontier 21 ahead of Exercise Red Flag 21-3

BELOW: A US Air Force E-3B Sentry and RAAF E-7A Wedgetail and AP-3C(EW) Orion aircraft on the flightline at Nellis Air Force Base, Nevada, USA

A future Air 5077 Phase 6 project will also oversee a comprehensive mid-life upgrade of the Wedgetail's capabilities in the 2025-2026 timeframe, which will see the aircraft out to its planned life of type.

The RAAF is also providing support to the Royal Air Force, as it introduces the Wedgetail as a replacement for its dwindling Boeing E-3D Sentry AEW.1 fleet in coming years. The UK announced it would acquire five Wedgetail platforms in 2019, but this has since been reduced to just three under its Strategic Defence and Security Review 2021 (SDSR21) process. RAF crews have been converting from the Sentry to the E-7A with 2 Sqn at Williamtown as part of this process and, from an industry perspective, BDA is also closely engaged with its UK counterpart on development and sustainment work.

Perhaps more exciting for the near-term future of the Wedgetail in RAAF service are recent US media reports that the US Air Force is close to selecting the type as a replacement for its even older E-3 fleet, which has suffered from declining serviceability rates in recent years.

MULTI-ROLE TANKER

The Airbus KC-30A is based on the civil A330-200 wide-body airliner and was selected to replace the RAAF's four Boeing 707 tankers in 2004 under Defence's Air 5402 program.

Today the RAAF has seven KC-30As in service with 33 Sqn at Amberley and, like the Wedgetail, it has served with distinction in the MEAO. Airbus brochure figures suggest the baseline MRTT is capable of uplifting 111 tonnes of fuel – all of which is available for offload, as the design utilises the A330's wing and centre fuselage tanks and has no need for dedicated tanks.

Fuel can be transferred using either the hose and drogue method, utilising a Cobham 905E pod under each outer wing, or the boom and receptacle system, via an Airbus-developed fly-by-wire Advanced Refuelling Boom System (ARBS) under the aft fuselage. The KC-30A can also carry a normal complement of passengers on the main deck and the same amount of cargo as the civilian version in the underfloor cargo holds. For the air mobility mission, six of the RAAF's aircraft are configured with a 270-seat airline interior while the seventh has a VIP interior forward of the wing and is used for long-range Special Purpose Aircraft (SPA) missions.

The RAAF has previously stated that five KC-30As can concurrently transport over one thousand passengers or ferry more than 40 F/A-18A/B Hornets across Australia. Alternatively, it has said five aircraft could fly 1,800 km from their base and offload 250 tonnes of fuel to receivers over a four-hour period.

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LEFT: The Wedgetail celebrated ten years of operational service with the RAAF in May 2020

BELOW LEFT: The KC-30A is a regular participant in regional air combat exercises, such as Pitch Black

NIGEL PITTAWAY

The combination of passenger and freight capacity, air-to-air refuelling (AAR) flexibility and relatively large fuel offload capability has made the baseline MRTT very popular with export customers. Besides Australia it has so far been selected by the UK, the United Arab Emirates, Singapore, Saudi Arabia, the Republic of Korea, France and the Multinational Multi-Role Tanker Transport Unit (MMU) which comprises ten European Defence Agency nations. To date, 60 aircraft have been ordered, of which 48 have been delivered.

Airbus Defence and Space is offering a range of enhancements to the MRTT customer base under its SmartTanker program, including the world's first (and so far, only) Automatic air-to-air refuelling (A3R) capability. Other features of the SmartTanker project include initiatives to transform the MRTT into a Command and Control (C2) node, enhanced communications systems utilising Airbus' Space Data Highway program and a 'Big Data' reductive maintenance computer system to reduce sustainment costs.

Of these options, the Republic of Singapore Air Force became the first customer for the A3R capability with an announcement during the 2020 Singapore Air Show, but the RAAF has participated in trials of the system and has previously expressed an interest. Singapore's aircraft are also among the first of what Airbus terms it's 'Second Wave' of MRTTs, which leverage structural and avionics upgrades from the civil A330 program, including an increase in maximum take off weight (MTOW) from the baseline 232 tonnes to 242 tonnes. The new configuration also features wideband SATCOM communications, AAR software upgrades, IFF Mode 5, Link 16 tactical data link and Airbus' Tanker Integrated Mission System (TIMS), which allows in-flight mission replanning.

In November 2020 the Commonwealth selected Airbus to develop a Communications and Mission Systems modernisation upgrade for the RAAF's KC-30A fleet as a retrofit package, which will bring it up to the latest MRTT standard.

Under Phase 1 of the program, Airbus will carry out systems design and development activities ahead of a Critical Design Review (CDR) of maturity. Under Phase 2, Airbus will install and deliver a prototype aircraft for the certification and qualification process, prior to fleet-wide modifications. This work will also see the KC-30A Full Flight Mission Simulator (FFS), the Integrated Procedures Trainer (IPT) and Remote Air Refuelling Operator (RARO) console part-task trainer upgraded at Amberley.

In January, the RAAF further announced that Airbus has signed a contract for a digital focus on ARBS maintenance under the original equipment manufacturer's SmartForce digital services program. The digital focus will aim to reduce maintenance costs and fleet availability by optimising fault diagnosis and troubleshooting of the complex boom system. The service will leverage the existing Central Data System program to include flight data recorded by the KC-30A's Mission Recording System. The CDS is a joint development between the Commonwealth, Airbus and Through Life Support provider Northrop Grumman Australia.

"The Central Data System delivers a significant capability benefit for the KC-30A aircraft and demonstrates the strong commitment within the KC-30A enterprise to innovation and improvement," commented Officer Commanding Heavy Air Lift Systems Program Office (HALSPO) Group Captain Scott Parry.

A GLIMPSE INTO THE CRYSTAL BALL

Enhancements and upgrades aside, the future of both the

Wedgetail and KC-30A will be decided around the turn of the decade – at least according to the Defence Force Structure Plan 2020 (FSP2020).

The FSP2020 document forecasts up to $21.1 billion will be spent on a Wedgetail replacement program, to be delivered in the second half of the next decade under Air 7002 Phase 1. What this will look like is open to conjecture this far out, but it may be worth noting the aforementioned reports of the US Air Force seriously considering acquisition of an E-7 capability in the near-term.

In the longer-term the US is seeking a space-based AEW&C capability but media reports in September suggest this may be some considerable way off into the future. Speaking at the Air Force Association's annual Air, Space and Cyber conference in Maryland, US Air Force Chief of Staff General Charles Brown reportedly told US-based media outlets that Washington was "looking seriously" at the E-7 as a "path" towards future space-based capabilities and revealed he has already held discussions with both the RAAF and RAF.

With respect to the KC-30A, the FSP2020 document allocates up to $20.2 billion of investment for a replacement, beginning in 2032. "The KC-30A replacement project is scheduled for the mid to late 2030s and has funding for an expanded fleet size," Head Air Force Capability Air-Vice Marshal Cath Roberts told *ADM* shortly after the document's release. "The project is pre-Gate Zero and options have not yet been determined or evaluated."

Again, it may be interesting to note that the US Air Force's KC-Y 'bridging air tanker' program is set to occur in the near-term, which seeks between 140 and 160 additional tankers from 2029. While one contender is likely to be the incumbent Boeing KC-46A Pegasus – which is smaller than the RAAF's current KC-30A – Lockheed Martin unveiled its LMXT, based on the A330 MRTT, in September.

"THE RAAF HAS PREVIOUSLY STATED THAT FIVE KC-30AS CAN CONCURRENTLY TRANSPORT OVER ONE THOUSAND PASSENGERS OR FERRY MORE THAN 40 F/A-18A/B HORNETS ACROSS AUSTRALIA"

The LMXT will feature the increased MTOW of the 'Next Wave' Airbus tankers, coupled with an increase in fuel capacity of around 12 tonnes, taking the total to more than 123 tonnes.

With the US Air Force looking to buy E-7As and possibly the MRTT-based LMXT before Australia's respective replacement programs kick off in earnest, it may just come to pass that the replacements for the Wedgetail and KC-30A may well be enhanced variants of the Wedgetail and KC-30A! ■

An RAAF P-8A Poseidon supports sea trials for the HMAS *Hobart* in the Gulf St Vincent off the coast of Adelaide

DEFENCE

RAAF ISR – MAINTAINING THE INFORMATION EDGE

In airpower terms, Intelligence, Surveillance and Reconnaissance (ISR) enables battlespace awareness, information superiority and decision superiority, and thus is critical to the successful conduct of all ADF operations.

JULIAN KERR | SYDNEY

GENERAL ATOMICS

OR, AS perceptively foreshadowed in the 5th Century BC by Chinese military strategist Sun Tzu: "If you know the enemy and know yourself, you need not fear the result of a hundred battles."

Within the RAAF, responsibility for this crucial ISR capability is held by the Surveillance and Response Group (SRG) - motto 'Foremost Sentinel' - formed in 2004 from the merger of the Surveillance and Control and Maritime Patrol Groups and headquartered at RAAF Williamtown.

More than 2,400 SRG personnel are working across Australia in Air Defence (No 41 Wing, RAAF Williamtown); Airborne Early Warning and Control (No 42 Wing, RAAF Williamtown); Air Traffic Control (No 44 Wing, RAAF Williamtown); and Maritime Operations (No 92 Wing, RAAF Edinburgh). All contribute to the ADF's early warning and response capability.

"BOTH THE SKYGUARDIAN AND THE SEAGUARDIAN VARIANTS OF THE MQ-9B ARE CERTIFIED TO OPERATE IN CIVILIAN AIRSPACE"

In terms of airborne large area ISR, the RAAF currently benefits from the multi-tasking capabilities of its 12 P-8A Poseidon maritime patrol aircraft together with the air defence input of its six E-7A Wedgetail Airborne Early Warning and Control (AEW&C) aircraft.

Also contributing are the specialised capabilities of two AP-3C(EW) Orions dedicated to the Signals Intelligence (SIGINT) role, along with the JORN over-the-horizon radar network and air-traffic control radar systems linked with the EASTROC operations centre at RAAF Williamtown and NORTHROC at RAAF Tindal in the Northern Territory.

At the tactical level, the F-35A Joint Strike Fighter, F/A-18F Super Hornet, EA-18G Growler electronic attack aircraft, P-8A, the RAN's air warfare destroyers and MH-60R naval combat helicopters, are increasingly adding to the air picture.

SURVEILLANCE IN THE MARITIME DOMAIN

The Poseidon fleet completed a series of modifications in July that included wiring upgrades to expand and enhance the mission systems fitted to the aircraft and improve interoperability, as well as networking for air to air, air to ship, and air to ground communications in support of the joint force.

Further upcoming modifications will upgrade systems hardware, software and firmware components.

Two more P-8As are being acquired through the existing cooperative program with the US Navy that allows Australia to share USN technical expertise and divide development costs, and will be delivered in 2022.

This mix of airborne capabilities is now set to be boosted by three new platforms that will further enhance the take of ISR strategic and tactical information.

ABOVE: An artist's impression of a GA-ASI MQ-9B SkyGuardian remotely piloted aircraft system in RAAF markings

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GENERAL ATOMICS AERONAUTICAL

Acceptance by the RAAF of the first of up to seven MQ-4C Triton high altitude, long-endurance (HALE) remotely piloted aircraft system (RPAS) is expected in 2023. However, arrival in-country may not take place until 2024 due to delays in infrastructure works at RAAF Edinburgh – the Tritons' main operating base for the ground segment – and forward operating facilities at RAAF Tindal.

Options under consideration for the initial employment of the aircraft until infrastructure completion include operating alongside two US Navy Tritons currently deployed to Andersen USAF base in Guam to further develop the Triton's concept of operations.

Meanwhile manufacturer Northrop Grumman disclosed in September the delivery to Australia of the Triton Network Integration Test Environment (NITE). This will support the Chief Information Officer Group in configuring and testing the array of Triton network interfaces and systems on Defence's wide area networks.

L3 HARRIS

The 2016 Defence White Paper forecasts a requirement for seven Tritons under Project Air 7000 Phase 1B; sufficient to establish two simultaneous, persistent orbits on a 24/7 basis (three aircraft each – one aircraft observing, one being prepared, one in post-mission turnaround) leaving one in maintenance/reserve.

Sustainment funding for the current approved fleet of three MQ-4Cs was announced in January 2021. Defence said in April that the acquisition of further aircraft was subject to further government consideration "and continued review of the future balance between the Triton and Poseidon".

The Tritons will work in conjunction with and complement the P-8As, whose mission requirements in addition to maritime ISR include anti-surface and anti-submarine warfare, and search and rescue. The Tritons could also be tasked with missions over hostile areas with degrees of risk that are more acceptable than those for manned platforms.

From an altitude of more than 50,000 feet, a Triton will be able to observe more than 2.5 million square kilometres in a single 24-hour mission, relaying near real-time data to the Distributed Ground Station - Australia (DGS-AUS) at RAAF Edinburgh.

LEFT: The RAAF will receive four Gulfstream G550-based MC-55A Peregrine ISREW aircraft from 2023

BELOW: A P-8A Poseidon aircraft from 11 Sqn prepares for the Air Force Centenary flypast in Canberra on 31 March 2021

DEFENCE

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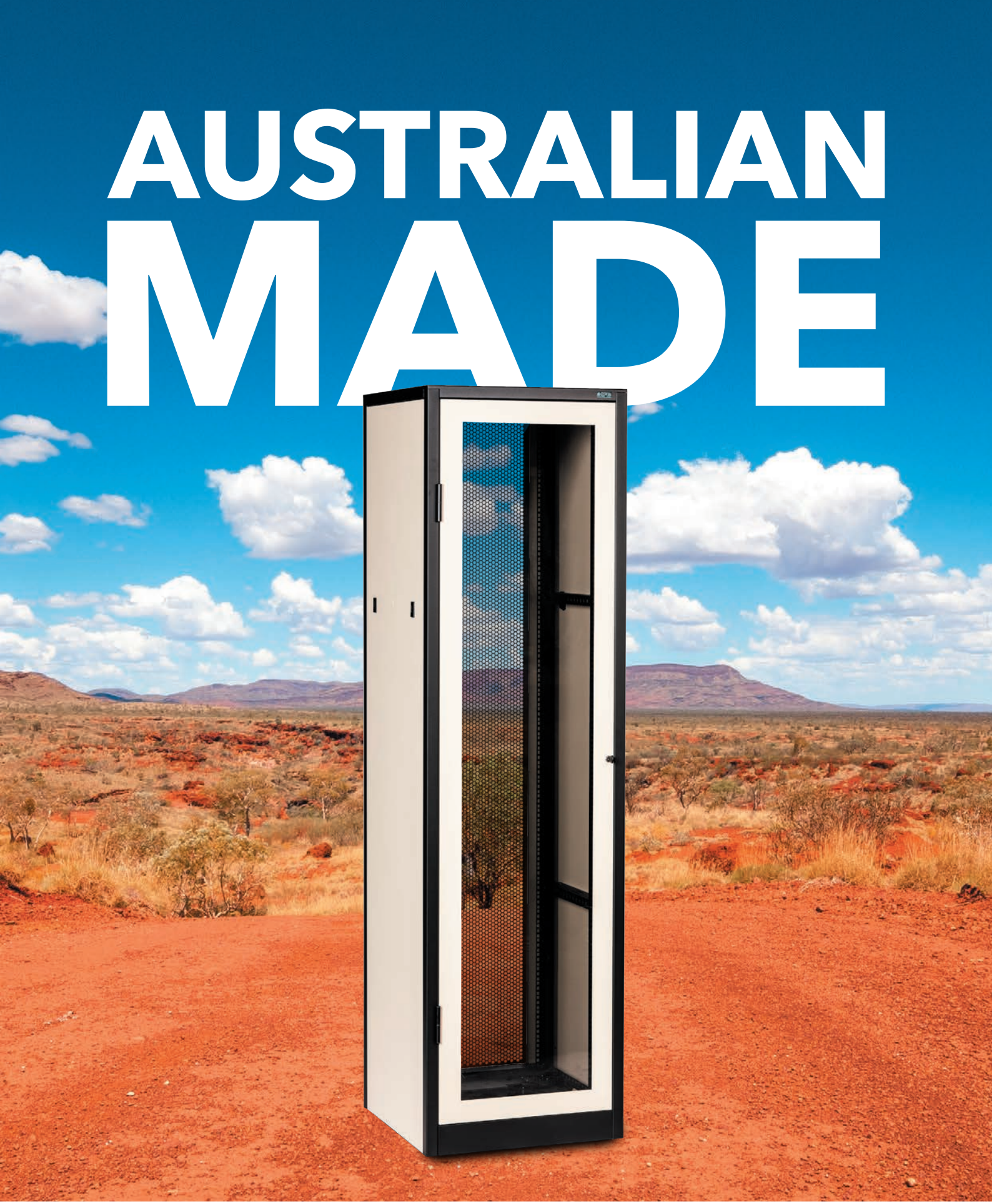

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ABOVE: The RAAF's Poseidons also have an important search and rescue role and are able to carry air-droppable air-sea rescue kits in their weapons bay

LEFT: 11 Squadron Airborne Electronic Analysts on-board the P-8A Poseidon during a mission as part of Operation Resolute

De-icing and lightning protection systems allow the Triton, if required, to descend through cloud layers and gain a closer view of ships and other maritime targets.

The MQ-4C's standard operating crew comprises an air vehicle operator, a tactical coordinator, two mission payload operators and a signals intelligence coordinator. Assuming a crew operates the system for eight hours, a 24-hour Triton mission will require 15 personnel – and a single tank of fuel.

As pointed out by Northrop Grumman, the Triton's mission radius of 2,000 nautical miles (3,700 km) and a maximum speed of 331 knots will allow the aircraft to undertake a surveillance mission from RAAF Tindal over Australia's northeast approaches, reaching one of the world's busiest shipping lanes in the Indian Ocean approaching the Malacca Strait.

Its ability to detect suspicious activity far in advance would give commanders time to conduct a thorough situational analysis and determine the most appropriate course of action to meet an apparent threat.

Commanders would also be able to make critical decisions to conduct specific missions against identified targets of interest, such as tasking a P-8A to search a specific area where Triton had detected an anomaly.

The RAAF's Tritons will be delivered in the US Navy's IFC-4 Multi-Intelligence (Multi-INT) configuration, supporting a 360-degree active, electronically scanned array maritime radar; full motion electro-optical/infrared video streaming; full-spectrum signals intelligence provided by low band and high band sensor suites; automatic identification system; and the ability to transmit multiple data types to ships, aircraft and defence ground stations.

The Multi-INT configuration will provide the RAAF with a pathway to retirement for the two AP-3C(EW) Orion platforms flown by 10 Squadron from RAAF Edinburgh, as it is for the US Navy's ageing fleet of EP-3E Aeries II multi-intelligence reconnaissance aircraft.

Fielding the MQ-4C via a development, production and sustainment cooperative program with the USN has given the RAAF input into system and sensor operating modes

HENSOLDT Australia advances space domain awareness

Building sovereign industry capability

Tasmania's position as a leader in Space Domain Awareness (SDA) continues to grow, as capability is further defined in object tracking. HENSOLDT Australia & New Zealand are working together with the University of Tasmania to assess and further develop radar detection of objects in space. The technology under development has the potential to enable an 'always on' piggyback – combined SDA/radio astronomy – system. This will enable the identification and tracking of orbiting objects and their relativity to space assets, like satellites, space stations and active space missions.

There are many thousands of objects in orbit around the Earth, all of them travelling at significant orbital velocity. Not only do they pose a significant risk to the safety of space assets, but collision between these objects can instigate a chain reaction, if the density of objects is sufficient. Knowing object location, through SDA technologies, helps to reduce that risk.

HENSOLDT Australia & New Zealand, the Tasmanian Department of State Growth and the University of Tasmania announced a Memorandum of Understanding (MOU) on SDA in July this year. The MOU supports the development of sovereign SDA capability through the Southern Guardian project, building on Tasmania's significant advantages of southern location, research and Australia wide space-radar assets. Each partner brings a unique advantage; HENSOLDT Australia is a global leader in space radar and C4ISREW technology, while the University of Tasmania manages an array of space radar infrastructure across Australia combined with significant expertise in space observation and tracking. Though every state and territory is keen to grow space capabilities, Tasmania alone has the geographic advantage that allows it to observe and track objects in multiple orbit tracks in all of the key space operating bands including LEO, MEO, GEO and beyond. One of the unique benefits is that Tasmania can view objects sooner and before their angular dispersion spreads them across the sky. SDA data can then be rapidly processed and used for direct observations and tracking as well as cueing of next-sensor-in-chain and sensor fusion. With these advantages, the Tasmanian Government is seeking to attract domestic and international investment, a skilled workforce, start-ups and national and international expertise to the State.

The team is building a sovereign capability to address the challenges of detecting and tracking objects in space and how to classify them. The enormous amount of data generated will be delivered as timely information, appropriate for decision making by Space Command or commercial operators keen to protect their assets.

For further information, contact Mick Burgess, Head of Space, HENSOLDT Australia – michael.burgess@hensoldt.com.au

and development that will lend itself to synergies for operations, training, and support.

While the USN program expects to achieve Initial Operational Capability (IOC) in 2023 for what will ultimately be a 68-aircraft fleet, the RAAF seems unlikely to achieve the same with its initial airframe until late 2024.

PERSISTENT OVERLAND AND LITTORAL ISR

US approval for Australia to buy up to 12 weapons-ready General Atomics Aeronautical Systems Inc (GA-ASI) MQ-9B SkyGuardian RPAS air vehicles and associated equipment at an estimated cost of US1.6 billion was announced in April.

This represented the latest step in Project Air 7003 Phase 1, aimed at acquiring an armed medium altitude, long endurance RPAS capability under Air 7003 Phase 1. Should second pass approval be achieved in mid-2022 as expected, deliveries are anticipated in the 2023/2024 timeframe with IOC to follow 12 months later.

Surprisingly, considering that the MQ-9B will be the ADF's first armed RPAS, Defence chose on its program website to emphasise the SkyGuardian's persistent ISR and electronic warfare capabilities over its precision strike attributes for the land and littoral environments.

DEFENCE

For its part, the US Defense Security Cooperation Agency (DSCA) said the proposed sale was designed to enhance the RAAF's capabilities not only in ISR, but also in target acquisition, submarine location, and counter-land and counter- surface sea operations.

Approved equipment includes the Leonardo/Selex Seaspray 7500E V2 multi-mode maritime radar, carried in a pod on the centreline station together with the automatic Identification ship-tracking system, confirming an enhanced mar-

LEFT: Three P-8A Poseidon aircraft from 11 Sqn in formation with an AP-3C(EW) Orion from 10 Sqn practice formation flying ahead of the Air Force Centenary flypast in Canberra on 31 March 2021

itime ISR role. The Seaspray radar uses AESA technology to detect, track, and classify hundreds of maritime contacts. The radar's patented small target detection capability enables it to spot extremely difficult targets such as submarine periscopes at long range and in rough seas.

Other major equipment included in the approval included Raytheon multi-spectral targeting systems, electro-optic infra-red (EO/IR) sensors, synthetic aperture radars with ground moving target Indicator capability, COMINT systems, embedded GPS/INS systems with selective availability anti-spoofing modules, SATCOM antennas, Sierra Nevada electronic intelligence systems, and Leonardo's SAGE electronic support measures (ESM) systems.

The SAGE 750 unit will provide intelligence information on maritime and terrestrial radar emitters over a wide area, delivering instantaneous detection and ELINT analysis.

Also included is a small package of training, telemetry, and other enabling systems for 250lb and 500lb Joint Direct Attack Munition and Paveway guided bombs and AGM-114 Hellfire air-to-ground missiles, as well as an MQ-9B simulator, test and ground support equipment, an initial spares package, technical publications, and an initial training support package.

According to *Janes* the strike-capable MQ-9B features nine external stores/stations, is 11.7 metres long with a wingspan of 24 metres, and has a maximum operating altitude of 40,000 ft, a maximum endurance of about 40 hours, and a maximum air speed of 210 knots.

Both the SkyGuardian and the SeaGuardian variants of the MQ-9B are certified to operate in civilian airspace.

The future armed RPAS capability will be co-located at RAAF Edinburgh in a de facto ISR hub along with the P-8A, the MQ-4C Triton, the MC-55A Peregrine electronic warfare support aircraft, and the Distributed Ground Station intelligence unit, which is responsible for the dissemination of data collected from RAAF ISR platforms.

NORTHROP GRUMMAN

LEFT: A rendition of a Northrop Grumman MQ-4C Triton in RAAF markings

PEREGRINE'S VIGIL

Formally revealed in the 2016 Defence White Paper, Project Air 555 is part of a wider requirement to improve electronic support capabilities across all domains. The associated Defence Integrated Investment Program included $2billion - $3billion over 2017-24 for the acquisition of up to five long-range electronic warfare support aircraft.

In June 2017 the US State Department approved the potential sale to Australia of five Gulfstream G550 business jets. In July 2018 the US Department of Defence awarded L3 Technologies a US$83 million contract for the upgrade through the US Air Force's secretive 645th Aeronautical Systems Group, also known as 'Big Safari', of two RAAF G550s to the MC-55A Peregrine electronic support configuration– although no official confirmation of the aircraft's acquisition had yet to emerge from Canberra.

And finally, in March 2019, the Commonwealth announced that four G550s would be acquired for $2.46 billion under Air 555, describing Peregrine as a new airborne EW capability that would provide a critical link between ADF platforms.

While the Peregrine's mission capabilities are closely guarded, the aircraft is likely to be able to monitor, record and classify a wide portion of the microwave and radio wave end of the electromagnetic spectrum, from mobile phone and Wi-Fi networks to large integrated air defence systems.

External modifications to accommodate mission equipment feature a 'canoe' fairing under the forward fuselage, an upper fuselage satellite communications antenna, a rear tailcone fairing housing an integrated electro-magnetic/infrared turret, and an antenna fairing on the top of the vertical stabiliser.

The MC-55A has two pilots. The number of onboard mission operators has not been disclosed, although it is reportedly sufficient to handle a significant portion of any operation while airborne (The Israeli Air Force's Eitam G550-based airborne early warning and control aircraft is understood to accommodate six operator consoles).

The aircraft itself has a range of 12,000 km, a long-range cruise speed of 553 knots and a maximum cruise altitude of 51,000 ft, ensuring an excellent perspective for its sensors. Endurance is around 12 hours.

Delivery of the first Peregrine to the RAAF after a comprehensive test campaign is anticipated in early 2023 and final delivery in late 2025. A target for Final Operating Capability (FOC) has not been disclosed.

Group Captain Jason Lind, Director of ISR at RAAF Headquarters, told *ADM* that rather than separating ISR and EW capabilities as often happened, the intention was to be more rather than less flexible and the MC-55A would be mixing and merging information from other platforms and its own sensors to produce a 5th generation effect.

"This translates into providing an enhanced network force with sophisticated cooperative engagement and situational awareness so we can bring to bear joint effects as precisely and as accurately as possible," he explained. "Peregrine is a force multiplier in a kind of similar but different way to Wedgetail – it's got lots of brain power and it has the ability to orchestrate the fight, conventional or otherwise, in a contested and congested EW environment.

"We'll have operators on the aircraft who will be able to make rapid decisions, we'll also have operators on the ground. We'll also be able to tap into other resources and capabilities across the Joint Force, and the Distributed Ground Station - Australia (DGS-AUS) as an intelligence node will be in the thick of that as well."

"PEREGRINE IS A FORCE MULTIPLIER IN A KIND OF SIMILAR BUT DIFFERENT WAY TO WEDGETAIL – IT'S GOT LOTS OF BRAIN POWER AND IT HAS THE ABILITY TO ORCHESTRATE THE FIGHT"

THE COMPLETE PICTURE

Formed at RAAF Edinburgh in 2014, DGS-AUS is staffed by air intelligence officers working alongside geospatial and SIGINT specialists.

The facility is intended to ingest information from numerous Australian and allied imagery and SIGINT assets and combine it with strategic reference material from the Australian intelligence community to improve commanders' situational awareness.

DGS-AUS was formally established as an RAAF unit in January 2020 as part of the Information Warfare Directorate under the Air Warfare Centre at RAAF Edinburgh.

"Certainly, we're moving into a different age where we need to augment as much of our capability as we can with systems on the ground by remotely processing some of that information but that won't take from the ability to do things on board the aircraft," GPCAPT Lind commented.

"The MC-55A can be a conductor depending on what it's doing at the time. At other times it's more likely to be the drum that beats with a relentless flow of information that goes to all parts of the Joint Force." ■

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DEFENCE

THE SKY-HIGH AMBITIONS OF AIR 6500

EWEN LEVICK | MELBOURNE

Of all the big projects in Defence, there are only a few that tend to make it into wider public discussion. These are invariably the projects people can 'see' – submarines, combat reconnaissance vehicles, F-35s, infantry fi hting vehicles. These projects are all important in their own right. But one of the largest and most ambitious projects in Defence is often overlooked: Air 6500, the Joint Air Battle Management System for the ADF and what Defence calls the 'core' of the future Integrated Air and Missile Defence capability.

AIR 6500 is the keystone in the RAAF's fifth-generation archway. Its purpose is to connect all platforms and sensors across all warfighting domains into a single interface that can track threats, coordinate a joint response, and direct that response onto the target. It is 'all sensor, best shooter' writ large.

Initially four companies were bidding for the program – Lockheed Martin, Raytheon, Northrop Grumman, and Boeing – on the understanding that the successful bidder would be required to work with the other three to provide best-of-breed solutions to the ADF. This understanding was laid down on the basis that no single company is capable of meeting the ambition of Air 6500 alone.

In early August, Defence down-selected Lockheed Martin Australia (LMA) and Northrop Grumman Australia (NGA) to continue to the final stage of the competitive evaluation process (known as CEP Stage 2, which is a risk reduction activity). Minister for Defence Industry Melissa Price said those two companies had 'demonstrated the best understanding of [Defence's] capability requirements' and 'a strong

DEFENCE

commitment to developing Australian industry capability.'

ADM spoke to both companies about the program following the down-select decision and how they intend to provide the ADF's fifth-generation ambitions.

NORTHROP GRUMMAN AUSTRALIA

"Certainly Air 6500 is the cornerstone of the integrated air and missile defence capability," Christine Zeitz, General Manager Asia Pacific for Northrop Grumman, said. "It will be used to provide the ADF with theatre wide missile defence".

"We just signed the risk reduction activity which will progress for 12 months and we're talking to Boeing and Raytheon around their capabilities as we go forward. And I think that's the spirit the Commonwealth wants us to enhance: this is about collaboration and bringing together the best of breed industry and capability outcomes."

To facilitate NGA's commitment to developing Australian industry, the company is utilising its recent investment in Parallax Labs, which is a means of focusing priorities in-country and creating a collaborative environment for Air 6500.

While the official launch of the lab has been delayed due to Covid-19 lockdowns in Canberra, it's certainly no secret. The aim is to connect Northrop Grumman Australia and SMEs with technology transferred from NGA's parent company in the US.

"In our risk reduction activity we have a large number of SMEs involved, which we know is very important to transfer technology to Australian industry," Zeitz said. "Northrop Grumman Australia is leading this program and we're doing it through the infrastructure that we built and invested in, which we call Parallax Labs.

OPPOSITE PAGE: A missile is fired from HMAS *Hobart* off the US coast in 2018.

ABOVE: A US Marine Corps M142 High Mobility Artillery Rocket System (HIMARS) fires a guided rocket against targets on Bradshaw Field Training Area.

LOCKHEED MARTIN AUSTRALIA

ABOVE: Air 6500 will connect all platforms and sensors across all warfighting domains into a single interface.

"It's a distributed lab. It's secure, so we can not only transfer technology from the US to Australia and have Northrop Grumman Australia engineers work and modify the software but it's also distributed around Australia. So of our 22 Air 6500 Australian SMEs, 12 Australian SMEs will be participating directly in our CEP2 risk reduction activity and will be connected into our Parallax Labs."

The technology being transferred to Australia derives from what Zeitz refers to as the 'architecture' that NGA is using for its bid for Air 6500: the US Army's Integrated Air Missile Defence Battle Command System, which is at the core of the US Army's next-generation air and missile defence capability. In other words, another 'all sensor, best shooter' model.

"AIR 6500 IS THE CORNERSTONE OF THE INTEGRATED AIR AND MISSILE DEFENCE CAPABILITY"

"The US Army approved Milestone C, which was very exciting, at the beginning of 2020 which provides the ability to move forward with low grade initial production," Christine Harbison, VP and GM Combat Systems and Mission Readiness for Northrop Grumman in the US, said. "We're about to enter into the Army's Integrated Operational Testing and Evaluation.

"We will then go to producing and fielding the systems. The architecture is really the basis for our offering for Air 6500 and leverages a lot of what the US Army is doing."

Recently, Northrop Grumman undertook a flight test that connected a US Marine Corps radar with sensors onboard an F-35 to create a common operating picture, which allowed a Lockheed Martin PAC-3 missile to intercept a surrogate cruise missile. Now that both companies have been down-selected for the Australian program, the test can perhaps be seen as a preview of what Air 6500 will deliver to the ADF.

"Flight Test Six really demonstrated the ability to connect multiple disparate systems that typically would have been in a silo," Harbison explained. "We leveraged the Marine Corps radar and the F-35 as sensors on the network within the architecture and created a single integrated operations picture.

"That allowed the user to take action and shoot down the target using a missile that is normally connected only to the Patriot radar. So that was a great demonstration. It really showed the capability of the architecture that we will then add on to for the purposes of Air 6500."

Flight Test Six could also be a preview of Air 6502, previously referred to as Air 6500 Phase 2, which is the ADF's future medium range ground-based air defence system. However, given the 'best-of-breed' requirement handed down by the Commonwealth, the down-select for Air 6500 does not necessarily indicate which companies will be successful for 6502.

"The architecture gives tremendous choices to countries to determine what is the best for their capability," Harbison said.

The bid for Air 6500 comes at an interesting time for NGA. Following her appointment as General Manager Asia

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LMA

RIGHT: Lockheed Martin's demonstration centre at the Endeavour Centre in Canberra.

Pacific last year, Zeitz undertook an internal restructure to bring project execution expertise, as well as profit and loss accountability, into the local company.

"It makes no sense to me as to how you can effectively manage a program from the United States," Zeitz explained. "My American colleagues are very good at managing US programs for the US customer, but we have particular requirements here that Australians understand deeply.

"So when I was appointed last July I came with a delegation of profit and loss, and with the authority to manage the programs from Australia."

"YOU NEED PROFIT AND LOSS AND YOU NEED AUSTRALIANS THAT KNOW HOW TO DELIVER AUSTRALIAN PROJECTS"

This, in her view, is at the foundation of successful program bids in Australia.

"The program management office, program management scheduling, risk management, most importantly SIET (Systems Integration Engineering and Test): when those aren't managed from Australia, I think you'll find a direct correlation to programs that get off course and go red," Zeitz said.

"You need profit and loss and you need Australians that know how to deliver Australian projects."

When asked how NGA intends to handle the maxim that no one company can deliver the entirety of Air 6500 alone, Zeitz explains that conversations are already underway.

"No one company can provide the full capability by themselves," Zeitz said. "The US trials show how easy it is to integrate to different effectors and sensors. That's a real strength of how we're going to approach this."

On the surface, the proposed acquisition model for Air 6500 – which is likely to see one company appointed as a prime systems integrator – could run into issues about sharing IP. But Zeitz is optimistic.

"There's something different between IP and integration data; they're two different things," Zeitz explains. "To integrate across two platforms or our system into a platform, as we're talking with Raytheon, you work on the interface control documents as government furnished equipment (GFE). When we do work directly with Boeing and Raytheon, sometimes we'll work as GFE through the Commonwealth and sometimes we'll work directly."

"In the US we talk about an A-kit and a B-kit," Harbison adds. "We've integrated into capabilities that haven't typically been open. The Patriot missile is a perfect example – we don't know the guts of that."

And in NGA's view, what are the top three risks facing the successful delivery of Air 6500?

"One of the risks could be that the Commonwealth don't look forward enough to growth in the environment, but this risk plays into our solution through the modular architecture it has," Zeitz says. "Also, we want to ensure the importance of this program to Australia's future Force Posture is continually reinforced, as it is a systems of systems solution rather than an air, sea or land platform, it is less visible to key stakeholders."

LOCKHEED MARTIN AUSTRALIA

"Lockheed Martin have been a part of this Air 6500 journey for six years," Steve Froelich, LMA program executive for Air 6500, said. "It was something that we took seriously from the beginning and so we started making investments in 2016."

According to Froelich, LMA began organising for Air 6500 by looking at SMEs active in the Australian marketplace and with DST Group. As momentum grew the company built a demonstration centre at the Endeavour Centre in Canberra and teams in Adelaide and the US.

"We started small and looked at some of the promising SMEs that were actively doing work with DST and in the marketplace," Froelich said. "We've continued to mature

the solution. We've brought in more and more thinking. We've looked at various architectures, we've built a number of models. The core engineering team is primarily in Adelaide but it is also distributed in the US."

LMA held a roadshow around Australia and virtual session with New Zealand's defence industry, from which it identified 130 SMEs that could eventually contribute to the Air 6500 solution.

Since the roadshow LMA has formally partnered with five Australian SMEs for Air 6500: Consilium Technology, Consunet, Shoal, Silentium Defence and Ultra. These companies will focus their efforts on electronic warfare battle management, contested communications, cyber protection, advanced systems engineering and passive sensing.

"We've been able to integrate with their capability and then demonstrate that integrated capability in real time," Froelich said. "We stimulate the input and get live reactions out of these systems, even though they weren't designed to work together."

Like NGA, Lockheed is transferring technology and drawing on experience from teams based in the US to build the Australian capability. So far the company has had 'well over a dozen' Technical Assistance Agreements approved to allow the transfer of US technology over to Australia for co-development.

"There's a large number of people who are actively working on Air 6500 today and the majority of them are in Australia," Froelich said. "The US and Australian teams share information every day, but all of the work today that we're under contract for is primarily being done in Australia. We have seven risk reduction areas that we're going through – which is just a maturation of the program."

LMA is considering a wide array of technologies from across industry for its Air 6500 test system. One of the candidates is a 'Virtualised Aegis Weapons System', which uses a tactical cloud to – as Froelich describes – 'package Aegis into a virtual, expeditionary form.'

Yet Froelich also emphasises the centrality of open systems thinking to LMA's bid for Air 6500, confirming that the company is in conversations with Raytheon, Boeing and others to look for best-of-breed solutions.

"We looked at other US based systems, we have looked at various display systems

and we went outside of the company," Froelich said. "Vigilare for instance, uses a Raytheon product, so we've started to talk to Raytheon. With Boeing we talk about Wedgetail aircraft – what do they have today, where are they headed.

"Both of those companies have systems that are deployed today, so we've asked, what are the areas where you would like to lean in and go forward?"

Those conversations even extend to research and development programs: "We also wanted to understand was there anything that they were bringing to the table in terms of research and development that they wanted to put on the table," Froelich confirmed.

When asked how LMA identifies 'best-of-breed' in a truly agnostic manner – i.e. without favouring its own products – Froelich laughs: "When you are building command and control systems, you have to look at products as nodes. You must be willing to be agnostic. I've been in programs where we had to integrate old Soviet radars in the early 2000s, when we were trying to give an air sovereignty capability to some of the old Soviet bloc nations," he said.

"You make selections based on requirements. So there is a set of requirements that the RAAF has flowed down to us. Anything that we would do has to be measured against those requirements, and so that's what we're doing. Any final selections will be made in consultation with the Commonwealth and the industry team, so there is a natural check and balance against any one company simply advocating for its products. At the end of the day Air 6500 is not about Lockheed Martin, and we never lose sight of that."

Like Zeitz, Froelich is not concerned about the acquisition model creating IP issues.

"In a command and control integration IP is almost always preserved," he said. "There is a standard for communications, and the interface design specs and the design of the actual system itself will meet those. You don't have to pierce that IP bubble."

"That's where the open mission system is particularly important," Neale Prescott, Director of Rotary and Mission Systems Business Development for Australia, added. "Vitally important is that technical set of boundaries and interfaces. That's where we can then publish a method by which data is streamed backwards and forwards, and whether the product is from Raytheon, Northrop Grumman, CEA, or Silentium, we've now got the capacity to many companies contributing to the collective picture."

"THERE'S A CULTURAL SHIFT REQUIRED TO EXECUTE AN AGILE CONTINUOUS INTEGRATION AND CONTINUOUS DELIVERY MODEL"

And the same question again: in LMA's view, what are the top three risks facing the program?

"The ADF has a very diverse set of capabilities," Prescott said. "That is going to require a lot of care and interface management. Ensuring that is done methodically and in a prioritised way so that the system evolves is one of the key areas that requires focus.

"Air 6500 is a vitally important program. Australia really has advanced this requirement faster than any other country. Now what's necessary to give Australia that security advantage is being able to network these capabilities together."

For Froelich, the main area of focus is undertaking the cultural shift required to create and deliver a truly evolving and open capability.

"For programs to stay relevant in the 21st century threat environment, they need to be able to continuously evolve as threats and technologies change. There's a cultural shift required to execute an agile continuous integration and continuous delivery model. We hope to earn the Commonwealth's trust to take that journey together." ■

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LEFT: A US Army M901 Launching Station is in position in the Shoalwater Bay Training Area.

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A CONVERSATION ABOUT THE FUTURE

EWEN LEVICK | MELBOURNE

The centenary of the Royal Australian Air Force is an end and a beginning: the closure of the first century of operations, as covered elsewhere in this magazine, and the beginning of the next century – one which, if the current geopolitical winds continue, will undoubtedly see Australian airpower expand in reach and importance.

THE RAAF is set to contend with significant changes to technology over the coming decades. The advent of hypersonic flight and the rise of artificial intelligence (AI) and machine learning will force changes to the RAAF's concept of operations and to its own culture. It will find some of these changes easier to adapt to than others.

I spoke to Andrew Davies, an ASPI Senior Fellow and former Director of the Defence and Strategy Program, about what the RAAF's future might look like.

"There's a couple of big questions," Davies said. "First, what is the impact of new long-range strike capability, including hypersonic weapons? Second, what's the role of uncrewed aircraft in the future and what does that do to our force structure?"

The impact of long-range strike is perhaps the most pressing. The speed and range of latest-generation missile systems has increased the vulnerability of northern bases. The response, according to Davies, should be a combination of defensive and offensive measures.

"Hardening and greater resilience is at a minimum what's required," Davies said. "There's also a need for diversification – more operating areas, more runways, more hardened facilities.

"The other alternative is thinking about response-in-kind. We could be looking at our own long-range strike missile systems. You don't need a crewed aircraft to do that."

That answer hints at a deeper question. As technological advances like long-range strike erode the security of airfields in northern Australia over the coming decades, perhaps it is worth revisiting the core purpose of airpower: what it needs to achieve, and how.

"Airpower is a remedy for sea power," Davies said. "An adversary's control of the sea can be made marginal by a decent maritime strike capability. So the future of RAAF may be increasingly counter-maritime – and in fact it is already with the stand-off weapons on the Super Hornets and the P-8A Poseidons.

"Yet the fact that the F-35 doesn't yet have a dedicated anti-ship missile tells you something about our priorities. To some extent that was due to slippage in development, and a suitable weapon is now in test, but it remains a significant shortfall in a region where maritime power is moving ahead in leaps and bounds. Our ability to do something about that has to keep pace."

"WE COULD BE LOOKING AT OUR OWN LONG-RANGE STRIKE MISSILE SYSTEMS. YOU DON'T NEED A CREWED AIRCRAFT TO DO THAT"

For Davies, the purpose of this counter-maritime priority for RAAF within Australia's larger strategic picture is to prevent an adversary from reaching south.

"As north Asia becomes more dangerous, raising the cost of hostile action against Australia to the point where the costs outweigh benefits, is an attractive strategy," he said.

Is this just a new version of the 1987 Defence of Australia policy set out in that year's White Paper, which has long been criticised for depriving the ADF of the capabilities required to shape the geopolitical picture overseas?

"I don't think so," Davies replied. "Continental defence lets the adversary get a bit too close. This is oceanic defence. The conflict we're worried about in the western Pacific is the US and China. So the question becomes, is it possible for Australian airpower to tip the balance?

"As Chinese power increases and US power declines, there will be a short window where Australia's contribution will make a difference. But it will be a short period.

BOEING AUSTRALIA

LEFT: The potential advantages offered by a mix of crewed and uncrewed platforms may address the RAAF's numerical disadvantage.

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ABOVE: The speed and range of latest-generation missile systems has increased the vulnerability of northern bases.

LEFT: How will autonomous systems impact the delivery of air power?

RIGHT: A RAAF C-130J Hercules arrives in Port Moresby, Papua New Guinea.

"So how do we protect our own interests? We prevent adversaries from establishing sea control, at least within the range of our air power."

Then there is the consideration of uncrewed technology, and how that will impact the means by which RAAF wins the air battle in the coming decades.

"Military forces do not exist as ends in themselves," Davies said. "They exist to deliver effects. The question for RAAF is whether those effects can be better delivered by other means in the future. Will it be better to use land-based anti-shipping missiles to counter maritime power rather than put a P-8A at risk?

"These arguments have been had before. The UK went through this in the 1960s, when they thought missiles were making crewed aircraft obsolete. That turned out to be far from true at the time.

"Yet I don't think it's something you can rule out entirely."

I make the point that there are plenty of other mission types required of RAAF. Heavy lift, as covered by Nigel Pittaway elsewhere in this edition, is a perennial requirement, as demonstrated by the evacuation of Kabul.

"That's fair," Davies agreed. "Crewed aircraft will also continue to play a role in maritime search and interdiction. But strike is the area where there's the biggest question over the role of the RAAF as it is structured now."

According to Davies, airlift and HADR-type missions are likely to become more frequent as climate change takes hold in the Pacific.

"Climate change is the most significant risk we're facing," he said. "A significant disruption to the ability of Asian countries to feed themselves could be profoundly destabilising. The response and mitigation roles are where the military would come in, but what exactly that scenario would mean for RAAF, I don't know."

I put it to Davies that the future for RAAF appears to involve a reduced role in strike capabilities, as hypersonic missiles and uncrewed aircraft mature, but an increased role in airlift and other non-combat effects.

"I think that's a fair statement," he agreed. "Crewed strike is inherently short-ranged with the kit we have now. But our existing lift capabilities look good for that future. The C-17s and the C-130Js are all capable aircraft."

"CLIMATE CHANGE IS THE MOST SIGNIFICANT RISK WE'RE FACING"

Yet there are also issues – not least the failure of the C-27J Spartan aircraft to meet the battlefield airlift requirements for which it was originally bought, as *ADM* reported in July.

"Given the roles that RAAF might be called upon to fill – deploying to airstrips in Papua New Guinea and other Pacific islands – there probably is a capability gap now," Davies said. "It's a shame the C-27J hasn't delivered that."

I suggest that if this vision of the future is accurate, RAAF could start looking more like a 'navy in the sky', with a greater diplomatic role to play in the Pacific than it has had in its first century.

"I don't know how much you can trade off that combat capability for more diplomatic or humanitarian work," Davies replied. "I said there's a role for land-based counter-maritime capabilities, but when you think about the targeting chain that has to support that, there's more points of

failure. Whereas an F-35 is both a sensor and a shooter."

So perhaps the future is more nuanced: strike and combat capabilities become a joint effort between RAAF and other services, as well as between crewed and uncrewed platforms and long-range missile systems, and the demand for HADR and airlift increases simultaneously.

"That's probably right," Davies answered. "And there's a role for Army in the land-based counter-maritime capability as well."

In terms of challenges facing RAAF, Davies believes that a cultural preference for crewed aircraft could prevent sufficient uptake of new technologies. In other words, RAAF's force structure could change slowly – partially because of 'investment inertia', or the difficulty of changing course when financial costs are so high, and also because it fundamentally has a love of flying.

"There's a famous RAND study on the organisational cultures of the military," Davies said. "It predicted that air forces are going to be slower to take up uncrewed aircraft than the technology would warrant."

There are two ways to overcome this sort of inertia. The first – best avoided – would be to lose a war. The second, according to Davies, is to encourage an environment of experimentation and innovation – something RAAF has arguably pioneered in the ADF through the fifth-gen concept as well as endeavours like Plan Jericho.

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Predicting the future is always a fraught exercise. But a brief reading of the tea leaves can reveal some useful hypotheses: maritime strike will likely increase in importance, prompting an increasingly joint and perhaps uncrewed response, at the same time that climate change places greater HADR demand on the ADF.

So in sum, there is a lot of work ahead for the RAAF – work that will no doubt set the next century apart from the first. ■

VIEW FROM CANBERRA

Many readers will of course have read and enjoyed novels by American insurance salesman turned author Tom Clancy, attributed with invention of the techno-thriller genre.

A SPECIAL CORRESPONDENT | CANBERRA

DEFENCE

CLANCY explicitly denied any inside knowledge of US military technical capabilities but had a useful skill of extrapolating beyond what was in the public domain.

His skill was such one senior US Navy officer remarked that had he seen a pre-publication draft of The Hunt For Red October, they would have sought deletion of some descriptions of USN sonar capabilities. For this reason alone, this novel is worth rereading.

But Tom Clancy, who died in 2013, never had much to say about Australia and neither did many of his successors, with the notable exception of Australian author FX Holden, the nom de plume (nom de guerre?) of writer Tim Slee.

His books feature a female RAAF pilot and UAS specialist as a central character, along with existing and emerging technology such as AI and uncrewed aerial, underwater and ground systems.

In particular, he delivers a good imagining of actual operational deployment of BATS - the Boeing Airpower Teaming System – a fighter sized drone called Loyal Wingman which will accompany fourth and fifth generation fighters into battle.

BATS – surely we'll have to come up with a better name – will go where crewed fighters can't because it's too dangerous – on high-risk escort, reconnaissance or electronic warfare missions.

In Holden's books, these initially operate in semi-autonomous mode, acting as bait for Russian stealth fighters and getting shot down, but eventually in fully autonomous mode, releasing weapons without the participation of a human operator.

Right now, that would be a step too far for the RAAF but as aerial combat features more UAS and AI, with reaction times far faster than humans, it would seem to be the way of the future.

Loyal Wingman was unveiled at the 2019 Avalon Air Show, which sadly won't be happening in 2021.

It made its first flight on 27 February this year. Initially, Defence ordered three prototypes, subsequently upping that to six to enable more realistic trials of the technology and development of the appropriate tactics.

This is overwhelming Australian tech – the airframe is Australian and the core autonomy system was developed by BAE Systems Australia.

For Boeing the big payoff would be success in the US Air Force Skyborg program, a series of experiments with drone aircraft operating in conjunction with crewed aircraft.

For Skyborg, the Boeing Loyal Wingman is to be pitted against prototypes from General Atomics and Kratos Unmanned Aerial Systems.

The USAF launched Skyborg in May last year, with preliminary flight trials now under way.

It sees this as a transformational capability: reusable drones which can be adapted to different missions, ranging ahead of crewed F-35, Super Hornet and other aircraft, learning from their experiences and not costing too much or making people sad when blatted from the sky. That happens not infrequently in Holden's books and surely would in real high intensity air combat.

Outside Defence and defence industry circles, Australia's engagement with this very advanced technology is little known or appreciated in the broader community.

Right now, the only significant national thought on defence capabilities relates to nuclear submarines, which are the better part of two decades away and in some views, may never happen.

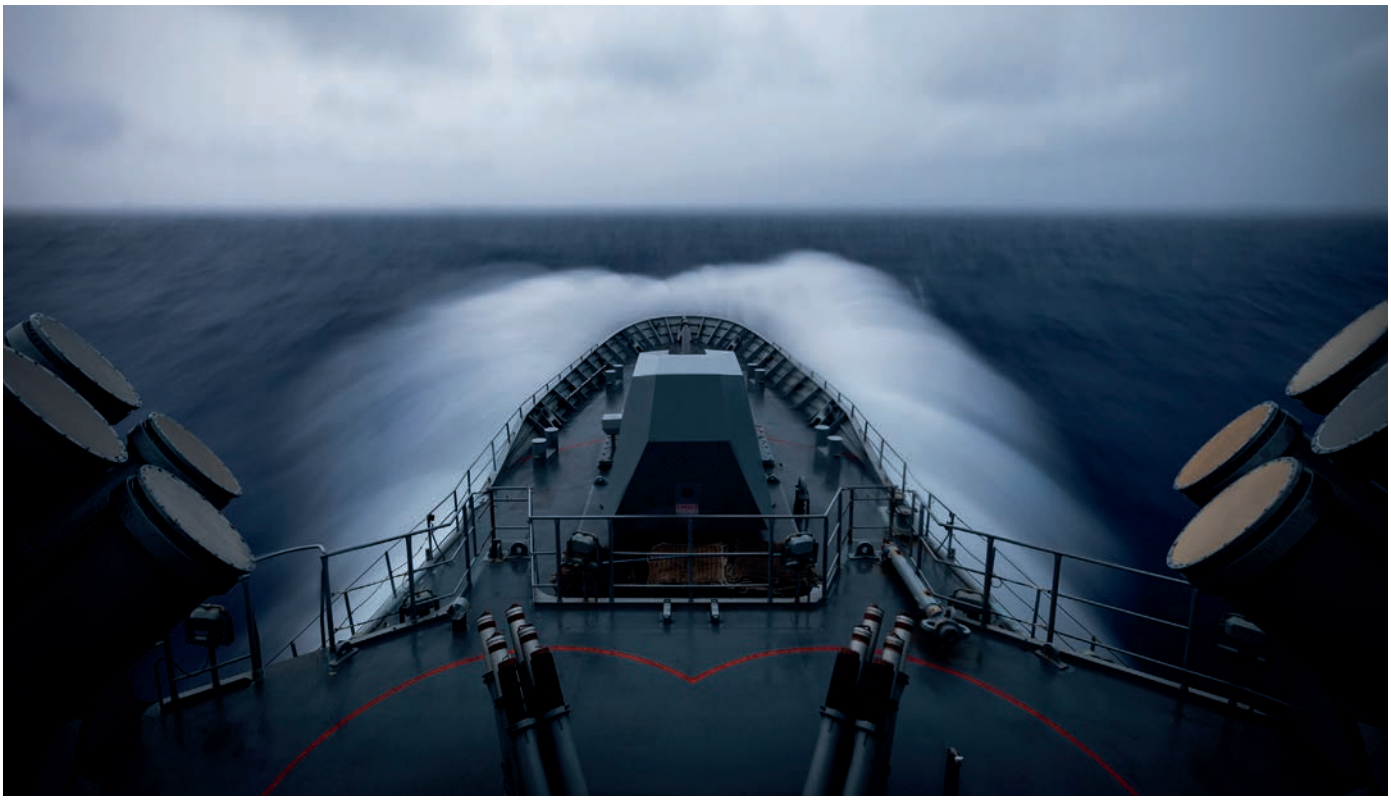
Much can happen in the world in two decades, but Loyal Wingman is happening right now and is looking very much like a viable system which will accompany RAAF airmen and women into combat and maybe save their lives.

In late September, Boeing Australia, in conjunction with the Queensland government announced it had selected the Wellcamp Aerospace and Defence Precinct at Wellcamp Airport outside Toowoomba as preferred site for assembly of Loyal Wingman.

This is actually a really big deal on all sides. For Boeing, this is the first aircraft assembly facility of its kind outside North America.

For Australia, Loyal Wingman is the first military combat aircraft designed, developed and manufactured in Australia in half a century. ■

ABOVE: Boeing's Airpower Teaming System, or Loyal Wingman, flew from Woomera for the first time on 27 February 2021



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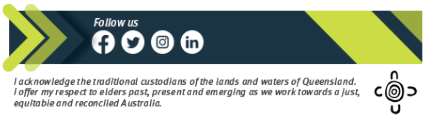

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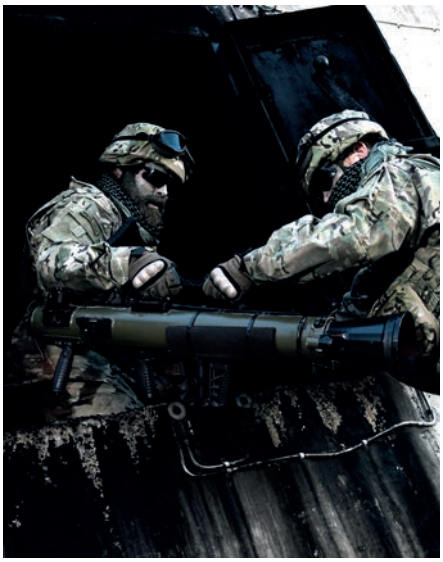

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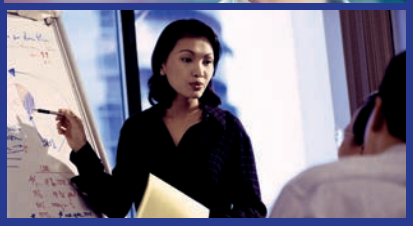
WOMEN IN DEFENCE AWARDS 2021

The Women in Defence Awards program celebrates talented, determined, successful women who make a positive impact in the defence business arena, as members of Defence industry, Australian Public Service (APS) or in uniform.



The program recognises women within the following categories:

- **COMMUNICATIONS**
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- **OPERATIONS**
- **PEOPLE & CULTURE**
- **PROJECT MANAGEMENT**
- **RISING STAR (UNDER THE AGE OF 30)**
- **TECHNICAL TRADE**
- **RESEARCH & DEVELOPMENT**
- **HALL OF FAME LIFETIME ACHIEVEMENT AWARD**

The awards will be presented to the winners at a Gala Awards Dinner at the **National Arboretum Canberra on 1 February, 2022**

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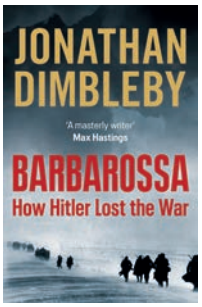
WITH MY LITTLE EYE

THE INCREDIBLE TRUE STORY OF A FAMILY OF SPIES IN THE SUBURBS

By Sandra Hogan
Published by Allen & Unwin
RRP $29.99 in paperbacks
ISBN 9781760878467

As incredible as it sounds from what we believe we know and understand of 1950s Australia, a seemingly everyday family of Mum, Dad and three kids actively participated in the activities of ASIO in the 1950s and 60s. Father Dudley Doherty was an ASIO officer as was his wife Joan until the arrival of their first child. Together, they made the extraordinary decision to involve their children in their espionage work, which became the 'family business'. Most notable among their missions was hosting Soviet defectors Vladimir and Evdokia Petrov on a Gold Coast holiday. The book contains some never-before-seen photographs of this period. But we see, too, the confusion of a daughter who could never quite separate her father's work from the man himself, even to the extent of not believing for some years that he had died, believing instead that he had disappeared on a job for ASIO. Verdict: A fascinating insight into activities that are mostly hidden from view or whispered of in dark corners.



BARBAROSSA

HOW HITLER LOST THE WAR

By Jonathan Dimbleby
Published by Viking/Penguin
RRP $35.00 in paperback
ISBN 9780241979181

This work by the renowned writer Jonathan Dimbleby has been variously described as 'the best single-volume account of the Barbarossa campaign to date' (Andrew Roberts) and a 'fast-paced gripping read' (Julia Boyd). Barbarossa is the code name for Hitler's invasion of the Soviet Union on 22 June 1941, which Dimbleby describes as the 'biggest, bloodiest and most barbarous military enterprise in the history of warfare'. With this plan, Hitler hoped to annihilate the Soviet Union and become master of Europe's destiny, his ultimate aim to establish the Thousand Year Reich. This fatal overreach saw him postpone plans to invade England while he concentrated on taking the Soviet Union first. Using a vast array of sources, Dimbleby delivers a detailed yet highly readable account of the geopolitical environment which led ultimately to Hitler's disastrous decision to invade the Soviet Union and the subsequent military engagements that ended in defeat for the German army. He has skilfully used eyewitness accounts to bring the story of this brutal campaign to life.

GUY GRIFFITHS

THE LIFE AND TIMES OF AN AUSTRALIAN ADMIRAL

By Peter Jones
Published by Australian Scholarly Publishing
RRP $39.95 in paperback
ISBN 9781922454683

This is the authorised biography of Rear Admiral Guy Griffiths, RAN. Griffiths joined the Navy in 1937 having successfully negotiated the rigorous application process for the Royal Australian Naval College. His navy career began in earnest with his appointment, in March 1941, to the Royal Navy ship HMS Repulse, one of three battlecruisers in the fleet, initially tasked as an escort for Atlantic convoys. Repulse was later sunk by the Japanese near Singapore with 508 casualties. Griffiths was among the lucky ones to be picked up by a destroyer. Later, for his efforts defending against Japanese attack onboard the cruiser HMAS Shropshire, he was awarded the DSC. He was to witness the last act of the Pacific War – the surrender in Tokyo Bay. His remarkable career would go on to cover two more wars – the Korean War and the Vietnam War - and also include significant Navy Office postings. He retired as a Rear Admiral after 42 years' service. Peter Jones, who himself retired as a Vice Admiral, has produced a very thorough and highly readable account of Guy Griffiths' life and achievements.

TEDDY SHEEAN VC

A SELFLESS ACT OF VALOUR

By Tom Lewis
Published by Big Sky Publishing
RRP $29.99 in paperback
ISBN 9781922387905

The words of one survivor from the sinking of HMAS Armidale on 1 December 1942 describe, first hand, the heroic deeds of 18-year-old Teddy Sheean, already wounded by the bullets of an attacking Zero, having turned back from abandoning ship and, "strapped himself in, and brought down a Jap plane, still firing as he disappeared beneath the waves". This selfless act of valour was to save many lives but it took more than 70 years for this act of heroism to be officially recognised with the awarding of the Victoria Cross, the first in Australia's naval history. Tom Lewis is highly regarded for his work in naval history. With this book, he has traced the short trajectory of Teddy Sheean's naval career against the backdrop of the often brutal conflict that was war in the Pacific. It was Sheean's nephew Garry Ivory who spearheaded the campaign for posthumous recognition of his uncle. Recognition came too in the form of the naming of the fifth of six Collins-class submarines. But it was the awarding of the VC to Sheean's family in December 2020 that was the final instalment in his life story.

NIGEL PITTAWAY

CONTINUED FROM PAGE 162

ADM: How would you describe the capabilities of the RAAF in its 100th year?

AM HUPFELD: We are now in the second century of Air Force, a new fast-moving era for Australian air and space power. The Defence Strategic Update, Force Structure Plan and the Air Force Strategy (AFSTRAT) provide the vision, strategic direction and capability framework to prepare air and space power to enable the joint force in peace and war. I have made it very clear that Air Force's purpose today is to enable the joint force in pursuit of national objectives. I do not think there has ever been a time in our history where the unified purpose of the Australian Defence Force, under One Defence, has been so strong.

Our capabilities and the opportunities being exploited to enhance those capabilities are described in AFSTRAT and it also highlights and reinforces that the Air Force capability is not all about flying platforms.

Our capabilities are potent and effective because our people are talented, skilled, and trained to the highest standards. As people are our critical asset to achieve the "edge", we have to continue to invest into supporting these critical capability enablers as we have done with Air Force's new platforms.

Our capabilities cover a broad range of technologies and systems that enable air and space operations. Our permanent air bases, and our capabilities to deploy and operate from austere, and sometimes damaged, airfields are showcased regularly, most recently during our contribution to the Afghanistan evacuation.

Rapid development and enhancement of our capabilities in information warfare is also a key feature of the strategy. A notable and very complex system is the Jindalee Operational Radar Network (JORN). Our integration as part of the Joint Force is already extensive, but one of the things I want to emphasise is that the days of traditional thinking about Navy, Army, and Air Force as discrete operating institutions are over. This is truly about multi and all-domain integration. Without a strong integrated joint culture, we cannot be effective in an integrated all-domain contest.

ADM: What role will people play in the RAAF of the future?

AM HUPFELD: On 31 March this year, I announced that, as we commence our second century, we would change the terms airmen and airwomen to 'aviators'. We are ALL aviators and our trade is aviation. In everything we do, we are aviators, first and foremost. Our common collective purpose to the nation is to think, act and imagine from the perspective of the skies and space above us. I also constantly impress on our Air Force aviators the importance of expanding their expertise outside of the air and space domain – to how these intertwine with maritime, land and cyber domains, in pursuit of common purpose. This is crucial in order to contribute fully to the Joint Force in a multi-domain environment.

Our future force will be powered by the talent of our people with the right skills, in the right environments, within a supportive culture. In defining our future workforce needs, we need to take into account the lead times for emergent capabilities. We also need to understand that the workforce of tomorrow will be digital and have a more intuitive connection with technology. It is important to develop an understanding of trusted human/machine

ABOVE: The RAAF has a very impressive aeromedical evacuation capability, which is supported by permanent and reserve personnel

DEFENCE

CONTINUED FROM PAGE 153

relationships, and carefully consider the use of Artificial Intelligence (AI) and robotics to augment or replace legacy roles, as AI and automation proliferates across Air Force.

Air Force will continue to need a workforce that is responsive to the rapidly changing demands of an uncertain world. We will continue to pursue innovative approaches to workforce management that recognise the importance of our people and organisational structures. Transforming to more appropriate, contemporary and responsive methods of leading and managing our people will be critical to ensure we fulfil the strategic imperatives outlined in the Air Force Strategy, notably the delivery of integrated air and space power as part of the joint force; deepening our relationships and strengthening our engagement internally to Defence, externally, and internationally with partners and potential competitors alike.

"WE ARE NOW IN THE SECOND CENTURY OF AIR FORCE, A NEW FAST-MOVING ERA FOR AUSTRALIAN AIR AND SPACE POWER"

The future Air Force will look very different from what we have had in the past. Significant increases in computational power, advanced manufacturing, miniaturisation, sophisticated sensors, enhanced access to space, and artificial intelligence will dramatically change the capability landscape. Combined with global power shifts and near-peer competitors' investment in technologically advanced military systems, the future battle-space will be a complex one.

Air Force will become one of Australia's most advanced organisations. And it must, if we are to adapt to this changing world. Air Force will have different skills, different weapon systems, agile bases, multiple networks, and we will be active in space. Space will become more pivotal – supporting our multi-domain operations. We will do this together as part of the joint force across Defence. To succeed in this space, I need innovators and disruptors in the organisation who see things differently – those who are willing to try something and to fail, but in the process learn something for next time – innovation that enhances our capabilities and future-proofs us. While our technologies and systems are important, they are only one part of what enhances the delivery of Air and Space power. Without our people intelligently wielding them, our cutting-edge technologies are simply inanimate objects.

Our people not only need to be technically brilliant, but also strategically aware, have a solid understanding of their place in the joint force and their responsibilities to Government. Our people need to be comfortable operating in the environment of constant competition within our Joint Force. Our strategy is to give our people the tools they need to be creative and to encourage their curiosity to build the effects we need for the future.

Our people are our future, and our future is everything.

ADM: How will the introduction of autonomous air vehicles like Loyal Wingman impact RAAF's procurement plans for crewed combat aircraft post-F-35?

AM HUPFELD: It's too early to tell. The Loyal Wingman project is a pathfinder for the integration of autonomous systems and artificial intelligence to create smart human-machine teams.

The Loyal Wingman is designed to work with and be commanded by crewed assets, with a mission system incorporating advanced AI techniques to work as an effective member of the overall air combat team with minimal command inputs required. Freeing up human operators from having to fly each individual air vehicle represents a significant leap from previously fielded systems.

This project will position the Royal Australian Air Force to field a fleet of teaming air vehicles—advanced systems with a high level of autonomy, that when teamed with crewed assets will bring mass and flexibility to the air combat dimension of the Joint Force. The program will further mature the system and Defence's understanding of how uncrewed systems can team with crewed platforms to enhance capability.

Air Force fighter aircrew have been working alongside the Boeing team to assist in developing an understanding of how they will work alongside advanced autonomous systems.

Understanding how advanced autonomous platforms operate safely and effectively as part of a large team of air vehicles while allowing the Air Force to flexibly employ the platforms is one of the great challenges and an early focus of the program. The creation of an advanced mission system, integrated with a range of advanced sensors, and communicating as required to form part of the overall air combat system, is a large and complex undertaking.

ADM: How will climate change impact Air Force's core mission over the next 30 years and do you foresee adoption of Sustainable Aviation Fuels?

LEFT: An RAAF Air Traffic Control officer participates in modern 360-degree Tower simulation at the School of Air Traffic Control at East Sale

BELOW: RAAF personnel marshalling an F-35A Lightning II from 3 Squadron at Eielson Air Force Base in Alaska

AM HUPFELD: Sustainable Aviation Fuel (SAF) has been a feature of several environmental sustainability strategies and policies developed by our allies and partners. This forms part of an increasing Government focus on national resilience, with significant reforms underway to enhance the nation's capacity to withstand future natural disasters and more extreme weather conditions.

Sustainable aviation fuels are a part of that approach, as is a full understanding of our national resource advantages, the roles of resilience and credibility in deterrence and the force projection opportunities that a responsible approach to emissions could afford us. Air Force will contribute to these efforts and ensure that climate change implications, such as harsher environmental conditions, are incorporated into our strategic, operational and capability planning.

SAF is currently not cost competitive or available in commercial quantities within our region; however, growing industry demand for less carbon intensive fuels will likely improve the viability for increased production. Greater availability of SAF may provide Air Force (and Defence) with more realistic opportunities for adoption. Remaining inter-operable with our close allies and partners remains key and will inform thinking about our future energy requirements.

ADM: How do you guarantee adequate reserves of fuel?
AM HUPFELD: This requires us to clearly understand where traditional fuels will continue to be an essential dependency and review the full lifecycle of those products. Air Force, in conjunction with the lead area in Defence responsible for fuels management, regularly reviews its policy settings to ensure we can deliver against Government and Defence objectives. Through assessing and responding to security challenges in the strategic environment we build resilience into our operational planning and preparedness for fuel requirements. This includes assessments of activities such as humanitarian aid and disaster relief, Defence aid to the civil community and a range of other scenarios and contingencies. All these factors inform our operational and strategic fuel holdings (as well as projected fuel reserve requirements) in conjunction with our industry suppliers, to meet current and projected commitments. Defence can also acquire additional fuel through existing contracts to meet surge requirements.

ADM: How has RAAF adapted to grey zone warfare?
AM HUPFELD: The Indo-Pacific is at the centre of great strategic competition, making the region more contested and apprehensive. These trends have arguably been accelerated by the pandemic.

In response to our changing environment, the Australian Government has set Defence three strategic objectives,

DEFENCE

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LEFT: An RAAF member of the tactical air control party supporting 3rd Brigade during on Exercise Talisman Sabre 2021

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Shape, Deter, Respond: To shape our strategic environment; To deter actions against our interests, and; To respond with credible military force, when required.

In my mind, understanding and shaping the context in which we may be called upon to respond and fight is the essence of what 'strategy-led' means. Understanding and shaping the context in which we may be called upon to compete and if necessary, contest, becomes the guiding principle in my view.

We will have ambiguous warning time – it is arguable that the warning time came and went as we are in that contest today. That contest is challenging traditional force design assumptions and taking place in a strategic setting requiring competition in the grey zone – it may not be the type of 'fight' we typically conjure in our minds for traditional operations. Responding may not require a named operation – as our response to grey zone competition must be business as usual.

"OUR PEOPLE ARE OUR FUTURE, AND OUR FUTURE IS EVERYTHING"

It needs to be integrated across Defence and the Whole of Government and executed and commanded through multiple domains. We must be able to work in a whole-of-government context where the military arm of national power is orchestrated in concert with all others in cooperative and complementary ways.

End states as we know them in our prevalent Joint Military Appreciation Process will be elusive in this environment, and we must instead seek to achieve transient operational and strategic advantages. The traditional campaign-phasing model is a linear approach and is arguably no longer fit-for-purpose to deal with political warfare and actions in the so-called grey zone. The concept of 'Shape, Deter, Respond' runs the same risk if we try to box it and serialise it – it is not meant to be linear. We will not be doing one, then the next, then the next. We will likely need to operate across all, concurrently.

To succeed in this new reality, Air Force needs to change. In driving this change, we need to understand that Air Force does not generate air or space power for itself. We provide air and space power options as a component of military power, realised by the Joint Force in support of national objectives. Our approach to advanced warfighting is a necessary but not sufficient response.

In order to prepare Air Force for its next century, I have released an updated Air Force Strategy (AFSTRAT), which aims to position Air Force for this contest. The strategy calls for us to embrace delivering Air and Space power as part of the Joint Force. Air Force has traditionally focussed on high-end warfighting, and while that capability remains an essential part of our tool kit, as recent events have shown, we need to be able to offer a wider proposition to government.

The strategy compels us to develop a skilled and intelligent workforce. As part of the joint force, we need to grow air and space power leaders, not just Air Force leaders. This will require educating our people (at all levels) to foster 'strategic acumen'. I do not have all the answers, the best thing I can do for Air Force during my tenure as Chief is to foster the conditions whereby people have the ability to be curious and strategically aware.

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I want our Air Force to be ready to seize opportunities to engage and assure access in our region, while denying the opportunity for malicious actors. For us to contest along the full breadth of the competition continuum, we need to be an integrated, joint, multi-domain, and interconnected force. Our interconnectedness is everything and our common objective is Australia's national security.

These challenges are inherently dynamic, difficult to prepare for and by their nature blur traditional boundaries. However, Air Force's approach is similar to our approach to our traditional roles – we strive to generate a broad range of potent air and space power effects, with the tools and people we have to meet the need of the day. What grey zone warfare is making us better at is understanding where to place competent, connected practitioners of air and space power within joint, inter-service and whole-of-government functions. We do this so that we can fundamentally change how effectively we can support a broad spectrum of options with our people and capabilities.

ADM: With lengthy warning of future combat now unrealistic, how can the RAAF address lack of combat mass and survivable operational range?

AM HUPFELD: Defence is committed to ensuring it has the right mix of capabilities to defend Australia and its national interests. Air Force is transitioning out of bespoke stand-alone capabilities to a networked force that is capable of delivering Air and Space Power effects for the integrated joint force, across the full spectrum of conflict.

The KC-30A Multi Role Tanker Transport is an example of how the Air Force has optimised its air combat and air mobility mix to meet Australia's needs. The KC-30A provides an air-to-air refuelling capability that extends the range of the Air Force's air combat aircraft. There are multiple other examples.

"THE F-35A—ALONG WITH THE F/A-18F SUPER HORNET AND EA-18G GROWLER—IS KEY TO OUR CURRENT AIR COMBAT CAPABILITY"

At government's direction, we have done excellent work to enhance our Air Force so that it possesses the adaptability and the sophistication needed to respond to the challenges ahead. We are creating the right culture, the right workforce, and the right mix of technologies to succeed in our second century.

ADM: Given changing strategic circumstances and Chinese capabilities, is there any urgency, or any intention, of hardening vital C2 and other facilities in Australia?

AM HUPFELD: Defence closely monitors military capability developments within the region, including those of China.

Accordingly, Air Force, and Defence more broadly are undertaking a series of activities aimed at increasing the resilience of key infrastructure and a variety of C2 capabilities.

This is being conducted using passive defence concepts and incorporates a variety of measures from concept development, basing studies, hardening and a series of other activities. The measures chosen will be appropriate to perceived threats and the unique circumstances facing the ADF.

ADM: Does Air Force have sufficient airlift capability to support both Defence and civil requirements – the Australian Antarctic Division, for example?

DEFENCE

LEFT: A Maritime Patrol and Response Offic r Co-Tactical Officer, monitors his station onboard a RAAF P-8A Poseidon during Exercise Tasman Shield

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AM HUPFELD: Defence provides airlift capacity in response to a range of military and civil requirements. Force Structure Plan 2020 has identified a future need for more air lift and more air-to-air refuelling, and subsequently allocated future projects to deliver these capacity increases.

ADM: Why has the Spartan fleet been reassigned to HADR?

AM HUPFELD: The C-27J is a very capable light tactical fixed wing aircraft able to conduct near-region operations in response to national and regional engagement objectives, crises and natural disasters. Humanitarian Assistance and Disaster Relief is a small but critical part of the role required of the C-27J. The other roles include logistics support (passengers, cargo and airdrop), surveillance, search and rescue and aeromedical evacuation.

"TO EVOLVE FOR THE FUTURE, WE NEED TO CONCENTRATE ON HOW BEST TO USE OUR TOOLS FOR THE GREATEST EFFECT"

ADM: From a capability standpoint, what are your priorities?

AM HUPFELD: Air Force's contribution to the joint force will become more about realising the unsurpassed advantage of the ultimate high ground – the air and space domains.

The force of tomorrow will be characterised by invisible connections across air, land, maritime, space, information and cyber – with masses of data from sensor inputs fused with artificial intelligence and machine learning to rapidly convert data to information to knowledge, and to insight at unfathomable speeds.

My priorities are to: Use the Strategy-led capability design model to create an Air Force future blueprint, to conceptualise and shape capability acquisition and sustainment for the future force; Ensure that novelty and creativity are central characteristics or our force design – enabling air and space power to be applied in ways that cannot easily be anticipated by competitors, and; Conceptualise the future workforce requirements to realise the air and space power blueprint and to drive creativity and agility across all levels of the force.

ADM: When will the MC-55A Peregrine capability become operational and how would you describe its role and importance to the ADF?

AM HUPFELD: Air 555 will deliver four MC-55A aircraft including mission, ground and support systems and Australia-based facilities. The MC-55A is a first of type modified Gulfstream G550 aircraft with mission systems incorporated by L3 Harris USA.

The Peregrine will provide a new airborne electronic warfare capability that will be integrated into Defence's joint warfighting networks, providing a critical link between platforms, including the F-35A Lightning II, E-7A Wedgetail, EA-18G Growler, Navy's surface combatants and amphibious assault ships and Land force.

The project is progressing through the design and development stage of the program. Facilities are in the build phase with an interim operating facility at RAAF Base Edinburgh due for completion in second quarter of 2022.

During 2021 and 2022, the first four MC-55A airframe modifications will continue. The first aircraft to begin mission system integration is expected to return to Greenville Texas (L3H) in second quarter of 2022.

The Peregrine capability is anticipated to be fully operational in 2025/26 financial year.


DEFENCE

LEFT: A Royal Australian Air Force pilot in the final phase of the six-month operational conversion course for the F-35A Lightning II

ABOVE RIGHT: An Aircraft Technician with 2 Squadron performs maintenance on a CFM56-7B engine on a Wedgetail AEW&C aircraft

DEFENCE

ADM: How would you envisage an ideal F-35A replacement?

AM HUPFELD: The F-35A—along with the F/A-18F Super Hornet and EA-18G Growler—is key to our current air combat capability, and critical to achieving the objectives set out in the Defence Strategic Update 2020 to Shape, Deter and Respond.

We remain satisfied with the next-generation capability provided by the F-35A; and look forward to the aircraft being the cornerstone of our air combat capability for the next 30 or so years.

Beyond that, changing circumstances and technology advancements mean the right choice for future capability may not be more F-35As, nor a fighter jet at all. Rather, the right choice will be what provides the required air combat superiority and strike capability.

ADM: How are you positioning the RAAF for the next 100 years?

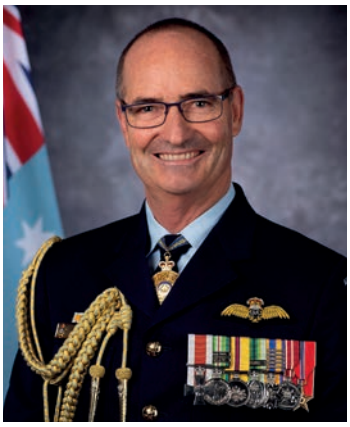
AM HUPFELD: High-end combat has always been our focus, and we have succeeded at producing a force which is capable of lethal air power, however as recent events have shown, we need to be able to offer a wider set of options to the Australian Government. We need to be smarter about how we configure, train and think about the ways we influence and force-project.

We will not do this in isolation, The Air Force is committed to integrating air and space power with land, maritime and cyber domains. To evolve for the future, we need to concentrate on how best to use our tools for the greatest effect. The Air Force needs to focus on preparedness settings and readiness to be able to support our Joint Force, partners and allies to succeed in the current geostrategic environment.

From the outside looking in, the Air Force of next generation will not necessarily look very different – our platforms will still be cutting edge. But where you will see a huge shift is in how we think about those platforms and their contributions within a wider array of effects being generated right across Defence and government. We will have a workforce that is strategically aware. Confident that they know their place in the Joint Force, know what their responsibilities are to the Government, and understand the strategic effects they generate every day. They will be agile in their thinking, and will strive to seize opportunities when they present themselves.

I wouldn't claim to know what the Air Force will look like in another 100 years, but my guidance for our young leaders who will be part of that progression is to prioritise opportunities which maximise our resource advantages while managing risks associated with our current dependencies. In this, I imagine they will leverage sovereign supply chains, new and interesting fuel technologies and families of systems (both exquisite and expendable) which will heavily rely on human/machine teaming to make sure we continue to punch above our weight long into the future. ■

AIR MARSHAL MEL HUPFELD



CHIEF OF AIR FORCE | CANBERRA

The Royal Australian Air Force is today a highly competent and professional force of men and women, operating cutting-edge platforms and technologies and providing support and surety to the Australian Government as required.
As the service celebrates its 100th anniversary and looks forward with confidence to the next 100 years, Chief of Air Force Air Marshal Mel Hupfeld answers questions from *ADM* Editor Nigel Pittaway.

ADM: Are you pleased with the RAAF 100th anniversary celebrations in light of the constraints imposed by COVID-19?

AM HUPFELD: It is a very proud moment for me to be the Chief of Air Force during this important milestone in our history. The motto of our centenary is "Then. Now. Always." This simple theme encompasses Air Force's journey of service, sacrifice, and unswerving commitment to our nation over the past 100 years and into the future.

This year, we honour the service and sacrifice of over 350,000 personnel who have served the Australian people as members of the Air Force, and we particularly remember the over 11,000 Air Force members who lost their lives while serving Australia.

The Air Force Centenary program (Air Force 2021) has been a very special opportunity to recognise the service and sacrifice of previous generations of Air Force men and women, demonstrate the highly capable force of today and foreshadow how Air Force will continue to evolve in our second century.

From the outset, the AF2021 program was planned as a 'digital first' initiative – to share the stories of our first century with the entire nation and broaden public understanding of how Air Force has supported Australia's interests in both conflict and peace. While COVID-19 has limited Air Force's ability to conduct physical events, our digital engagement has been extremely successful in highlighting Air Force's achievements in its first 100 years and demonstrating the quality and diversity of today's force as an important component of the joint force. As an example, there was a 900 per cent increase in Air Force YouTube followers in the 12 months leading up to our 100th anniversary on 31 March 2021.

There have been many highlights of the Centenary program. These include Her Majesty the Queen visiting the Air Forces Memorial at Runnymede on 31 March, HRH Prince William Duke of Cambridge recording a special video message, and the Governor-General presenting a new Queen's Colour to the RAAF – a once in a generation event. In Canberra we conducted a welcome ceremony which recognised Indigenous members' service through our history, a special memorial service on ANZAC Parade, and a commemorative flypast of more than 60 current and heritage aircraft. Additionally, there have been commemorative activities, within COVID-19 constraints, at all bases in Australia, our main Middle East base and a number of Australian High Commissions and Embassies around the world.

The Air Force Centenary year will run through to 31 March 2022. Notably, Air Force is planning to dedicate a new Memorial at our original base – Point Cook – early next year. The event will be scaled and arranged to comply with COVID-19 health directions.

I am enormously proud of the Centenary program. It has been a modest but very appropriate reflection of Air Force's enduring commitment to support Australia and Australians, and our ability to continue to adapt as the strategic environment changes, particularly in the relatively new domains of cyber and space.

PROFILE

2019	Chief of Air Force
2018	Chief of Joint Operations
2016	Head Force Design in VCDF Force Group
2015	Acting Chief Capability Development Group
2014	Head Capability Systems Division
2012	Air Commander Australia
2009	Commander Air Combat Group
2008	DG Air/ Director General Air Command Operations
2007	Director of the CAOC in the MEAO
2006	Officer Commanding 81 Wing
2004	Director Aerospace Combat Development ADF HQ
2001	Commanding Officer 75 Squadron
1997	Master of Arts in Defence Studies, King's College London-RAF Advanced Staff Course
1995	Executive Officer of 2 OCU
1989	Fighter Combat Instructor – F/A-18
1983	Bachelor of Science – RAAF Academy

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SAFER TOGETHER

CAE congratulates the Royal Australian Air Force on celebrating its Centenary during 2021 and 100 years of service to Australia.

CAE is proud to have supported the training of RAAF aircrew for many years. From platforms such as the B707 and C-130H long since retired to current platforms including the C-130J, KC-30A, Hawk Mk127, P-8A and others, CAE has been an industry partner playing a small role in preparing and training the men and women serving in the RAAF.

With a focus on training, CAE supports the training of more aircrew each year than any other company. Following the acquisition of L3Harris' Military Training business, including Link and Doss Aviation, we are now the world's leading platform-agnostic training and simulation company. We provide full-spectrum solutions across the training enterprise – from digitally-enabled integrated learning environments to ground-based and airborne training.

As the RAAF evolves as a fifth-generation air force to face the near-peer threats of today and tomorrow, CAE looks forward to being your air power training partner of choice over the next century.

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