

APDR

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AUSTRALIAN DEFENCE IN A GLOBAL CONTEXT

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**BATTLE
MANAGEMENT
SYSTEM
DECISION
PENDING**

ROBOTS
TRANSFORMING
THE BATTLEFIELD

INTERVIEW
WITH
ROBERT NIOA

AUSTRALIAN
ARMY AVIATION
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Managing Director/Publisher

Marilyn Tangye Butler
Phone: +61 (0) 410 529 324
Email: marilyn.tangye@venturamedia.net

Editor

Kym Bergmann
Phone: +61(0)412 539 106
Email: kym.bergmann@venturamedia.net

Contributors

Arie Egozi
Gabriel Dominguez
Chen Churenran
Geoff Slocombe
George Galdorisi

Australia

Ventura Media Asia-Pacific Pty Ltd
PO Box 88, Miranda
NSW 1490 Australia
ABN 76 095 476 065

Subscriptions

Rose Jeffree
Phone: + 61 (0)2 9526 7188
Email: subscriptions@venturamedia.net

ADVERTISING OFFICES:

Australia, NZ & Asia Pacific, USA, Canada & South America

Graham Joss
Sales Director
Phone +61 2 9526 7188
Mobile +61 (0) 419 492 836
Email: graham.joss@venturamedia.net

Europe

Diana Scogna
Mobile: +33 6 6252 2547
Fax: +33 1 7079 0534
Email: dscogna@dsmedia.com.fr

Israel

Asa Talbar
Talbar Media
Phone: +972-77-562-1900
Fax: +972-77-562-1903
Email: talbar@talbar.co.il

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Design

Stun Media
Email: tdixondesign@gmail.com



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Cover description: Australian Army soldier Private Lachlan Fletcher from 6th Battalion, Royal Australian Regiment, hands an 81mm mortar round to another soldier during a training activity at Wide Bay near Gympie, Queensland. Credit: CoA / Christopher Kingston

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KYM BERGMANN // CANBERRA

RUSSIA DESTROYING TWO COUNTRIES, NOT ONE

In a previous editorial we argued that a full-scale Russian invasion of Ukraine was the least likely of all the possibilities. We were obviously completely wrong – along with many others – convinced that rational decision making would prevail, and that President Putin would pull back from the brink. Instead, what we are witnessing is not only the destruction of Ukraine, but Russia also paying a price from which it will be difficult to recover economically, if not militarily.

Losses to date are difficult to verify independently but figures of 10,000 Russian dead, along with 300 Main Battle Tanks destroyed seem credible – as well as more than 40 aircraft and a similar number of helicopters. While figures for the Ukraine are equally unreliable, they seem to be a fraction of those for Russia – though they look likely to increase. What we can be more sure of is the impact on civilians, with more than 500 dead – including women and children – a figure that seems destined to continue to rise as the fighting intensifies. More than one million Ukrainians are seeking safely in neighbouring Poland, Hungary and Rumania – with many more likely to be added to that list in the coming days.

The economic damage to Russia is also severe – though the full effects of sanctions might take months or even years to play out. In the western world a recession is classified as two quarters of negative growth – and at its worst in 2008 the US experienced a 4% contraction in its economy, resulting in massive job losses and economic dislocation. The Russian economy is already

looking at a 7% contraction – and possibly more than that. As well as various legal measures such as crippling sanctions are also major voluntary boycotts of anything to do with Russia, which combined will make the already miserable lives of ordinary people a lot worse.

Despite attempts at sanction proofing, the Russian economy is small – about the same as Australia's but with a population six times larger – and not at all diversified. To maintain a semblance of current living standards, the export of oil and gas needs to keep increasing. It is about to go sharply in the opposite direction, with even previously supine Germany reversing its attitude to Russian energy.

The longer the sanctions go on, the greater the damage, because exploiting new oil and gas reserves needs western technology and expertise, which is why the involvement of companies such as Shell and BP have been vital. Even if Russia can sell more to countries such as China, it will face increasing difficulties extracting and transporting the stuff in the first place.

On both the military and economic fronts the outlook for Russia is bleak – but in the meantime Ukraine is being pulverised. It is now clear that President Putin expected an easy victory, somehow believing his own rhetoric that his troops would be greeted as liberators and that Kiev would surrender without a fight. Instead, what he has received is very determined resistance from a Ukrainian military that will continue to receive large amounts of high-quality defensive equipment not only from NATO but other friendly nations, such as Australia.

If the Russian Army tries to capture Kiev and any other major city such as Odessa, there will be prolonged and bitter street fighting. In these conditions the advantage is with the defender, potentially able to turn every house into a strong point. As more anti-tank missiles reach Ukraine their ability to defeat Russian armour will increase. In turn, this is likely to mean that Moscow will rely more on artillery and air power to flatten urban areas, as they did to Aleppo in Syria – or as

western air forces did to Mosul and Raqqa in Iraq during 2016 and 2017.

Logic has it that President Putin should be seeking a way out of this self-created disaster before it gets any worse, but it seems that he really does have delusions of recreating an Imperial Russia with a conquered Ukraine as part of the mix. In this regard he seems similar to the late President Slobodan Milosevic of Serbia. In the 1990s he led Serbia into three disastrous wars – all of which were lost – based on a mixture of a belief in his own infallibility and a desire to recreate Yugoslavia from the broken pieces with him at the centre of it. Sound familiar? He died in 2006 of what amounted to a self-inflicted heart attack while on trial at the Hague for war crimes.

Turning to Australia, the government has announced a sensible increase in the size of the ADF to 80,000 – up from the current 60,000 – though it will take until 2040 to reach this number. The RAN will see the largest proportional growth because new platforms such as nuclear submarines and Hunter class future frigates need far more people to crew them than are currently on the payroll. It needs time to build a skilled workforce and the sooner the process starts, the better.

Finally, on natural disasters: the ADF is once again rising to the challenge of helping flood devastated areas recover from enormous damage. This comes on top of deployments to the aged care sector to help with Covid; deployments to fight bushfires; deployments to Tonga; and deployments to help with the Covid-19 vaccination roll out – amongst others. This comes on top of all the ADF's other tasks, such as defending Australia and preparing for this role with multilateral exercises.

The thought occurs that if civilian agencies were better resourced it wouldn't be necessary to be constantly sending in the Army to fix everything. It is well past time for Australia to set up a Federal Emergency Response Agency, fund it well – and make it apolitical so that disaster mitigation spending is taking place when and where it is needed.

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NIOA BOOSTS SOVEREIGN TESTING CAPABILITY AS IT TARGETS LAND 159 T2

NIOA has revealed its upgraded small arms testing complex following a multi-million dollar investment to support the next-generation weapons systems for Australian soldiers.

Building on its state-of-the-art testing capability in Brisbane, NIOA has injected an additional \$1.1m in specialist equipment and instrumentation over the past 18 months and has provisioned a further \$1.4m in purchases as it targets the next tranche of the LAND 159 Lethality Systems Program.

This comes on top of a recent \$11m investment in collaboration spaces for NIOA and Commonwealth technical and engineering staff, taking the total spend at the company's Brisbane headquarters to \$40m.

Tranche 2 of LAND 159 will include a close combatant family of weapons, machine guns, direct fire support weapons and a contemporary family of grenades.

The fully instrumented range, which opened in 2014, is the only indoor 100m range in Australia rated for the firing and data acquisition of small arms through to medium calibre cannons up to 40mm.

It had an intensive workout over the past year as NIOA completed Stage 1 of Tranche 1 of the LAND 159 program, encompassing test, evaluation, data analysis and source evaluation recommendations for the latest sniper and close combat weapon systems for use by the ADF. This included:

- More than 500 safety and suitability for service (S3) and system confidence firing test serials.
- Data acquisition and analysis for more than 13,000 close combatant and 4200 sniper system weapons instrumented firings.

NIOA General Manager for Engineering Rudi Bekker said the company's test and evaluation capability

was world class – and it was now gearing up for the future.

"The T&E capability going forward will require best of class equipment operated and analysed by homegrown industry subject matter experts," he said.

"For Stage 1 of Tranche 1 we invested more than a million dollars in equipment purchases.

"We've additionally invested in the upskilling of our technical team during this period with training provided in areas such as systems engineering, video data analysis, weapons such as design and laser safety."

NIOA is the largest sovereign supplier of firearms, weapons and ammunition to the ADF, law enforcement agencies and commercial markets.

The company has committed to building a \$50 million small arms factory in either Brisbane, Lithgow in New South Wales, or Benalla in Victoria if it secures Tranche 2 of LAND 159.

NIOA has a long-term lease at the government-owned, contractor-operated munitions plant in Benalla and recently established a corporate base in Lithgow, which has been a centre for small arms manufacturing for more than a century.

NIOA CEO Robert Nioa said: "These are key Australian sovereign defence capabilities needed to support the war fighter and provide a lethality overmatch. Our investment reinforces our commitment to creating a strong T&E foundation on which to grow a sovereign manufacturing base."

Munitions and small arms research, design, development and manufacture have been identified as one of the Federal Government's top Sovereign Industrial Capability Priorities (SICP).

MORRISON GOVERNMENT STRENGTHENING GEELONG'S DEFENCE MANUFACTURING FUTURE

23 February 2022

The Morrison Government is creating jobs and strengthening the future of defence manufacturing in Victoria, with a new state-of-the-art armoured vehicle centre of excellence to be established at Avalon Airport in Greater Geelong.

A first of its kind, Hanwha Defense Australia's 32,000sqm armoured vehicle centre of excellence

is estimated to create a minimum of 300 jobs over the life of the \$1 billion project, generating ongoing support opportunities for Australian industry until the late 2040s.

Hanwha was contracted by the Morrison Government last December to deliver 30 self-propelled howitzers and 15 armoured ammunition resupply vehicles, collectively referred to as the Huntsman family of vehicles.

Minister for Defence Industry Melissa Price said Hanwha would build the sovereign armoured vehicle manufacturing and maintenance facility to deliver core platforms of the Protected Mobile Fires project.

"Hanwha will draw on Greater Geelong's highly skilled and experienced workforce to deliver this project," Minister Price said.

"About 100 jobs are expected to be created during the two-year, \$170 million construction of the armoured vehicle centre of excellence. It is great news for the Geelong region economy that the \$1 billion program will support at least 300 jobs during its lifespan. This project demonstrates the Morrison Government's commitment to supporting local jobs."

Senator for Victoria, Sarah Henderson said Avalon Airport was an ideal location for the armoured vehicle centre of excellence.

"Avalon Airport, complete with its international terminal which the Morrison Government helped build, is a wonderful asset for our region and will make a first-class home for the Howitzer defence project," Senator Henderson said.

"The Government's election commitment to base this \$1 billion defence project in the Geelong region, announced in May 2019, is an absolute game-changer for our local economy and for Victoria. With five Australian-owned companies currently shortlisted to construct the armoured vehicle centre of excellence, a sovereign national asset for military capability manufacturing, this will deliver an immediate jobs boom for our region and for Victoria.

"Geelong is set to become one of Australia's most important defence manufacturing centres. It is expected that other defence industry suppliers will consider re-locating to the Geelong region so the opportunities for future growth are enormous."

Design work on the facility is now in its final stages, and there is an opportunity for Australian defence industry partners to co-locate on site to streamline the manufacturing process and maximise export opportunities for the Australian defence industry.

The new facility will include multiple assembly lines, a 1500m test track, a deep-water test facility, and an obstacle course to test capability. Hanwha will build the new facility on a 20-hectare site at Avalon Airport.

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SAAB



(L-R) QinetiQ Australia Managing Director, Greg Barsby and Steve Froelich, Lockheed Martin Australia AIR6500 Program Executive

LOCKHEED MARTIN AUSTRALIA TEAMS WITH QINETIQ AUSTRALIA TO DEVELOP SOVEREIGN TEST AND EVALUATION FRAMEWORK FOR AIR6500

CANBERRA, Australia - 10 March 2022

Lockheed Martin Australia and QinetiQ Australia have signed a teaming agreement to deliver comprehensive Test and Evaluation, Verification and Validation, certification and assurance services in support of the Royal Australian Air Force's AIR6500 Phase 1 Project (AIR6500-1): Competitive Evaluation Process Stage 2.

Lockheed Martin Australia will work in partnership with QinetiQ Australia to design a test and evaluation and governance framework that supports risk reduction in the transition into the AIR6500-1 acquisition.

AIR6500-1 will provide the Australian Defence Force with a Joint Air Battle Management System that will form the architecture at the core of the Integrated Air and Missile Defence capability. This will provide persistent situational awareness, defence against advanced air and missile threats, and enhanced interoperability with Australia's allies.

Steve Froelich, Lockheed Martin Australia AIR6500 Program Executive said, "Lockheed Martin Australia is delighted to team with QinetiQ Australia."

"The teaming agreement marks an important focus on designing a highly robust, independently validated, agile AIR6500-1 program solution that supports the Royal Australian Air Force's vision to transform the Air Force into a next-gen-enabled force."

"Lockheed Martin Australia's proven expertise in building, integrating and sustaining advanced technology systems across complex joint all-domain platforms combined with QinetiQ Australia's unrivalled expertise in integrated air and missile defence test, evaluation, certification and systems assurance, means we are the trusted partner of choice to deliver an unmatched integrated air battle management capability edge to Australia."

QinetiQ Australia's Managing Director, Greg Barsby, said the teaming agreement with Lockheed Martin Australia on the next phase of the AIR6500-1 is an exciting opportunity.

"Our highly experienced local team of T&E professionals have been able to leverage QinetiQ's global expertise in complex Test and Evaluation, to deliver world-leading solutions while growing sovereign T&E capabilities in Australia. We look forward to collaborating on an innovative Test and Evaluation solution that leverages the digital age we are now immersed in," Mr. Barsby said.

"Lockheed Martin Australia's partnership with QinetiQ Australia demonstrates our commitment to working with the very best of Australian industry. Their team's early assimilation into our agile software development process builds trust and discipline. We continue to develop a sovereign AIR6500-1 solution in Australia by Australians that will create local job opportunities for Defence Industry," Mr. Froelich said.

"Lockheed Martin Australia has a distinguished history of delivering to the Australian Defence customer and collaborating with Defence Industry. I am delighted QinetiQ is teamed with Lockheed Martin as the sovereign Test and Evaluation service provider and look forward to delivering a state-of-the-art solution to the AIR6500 program," Mr. Barsby said.

Dr James Palmer, CEO Silentium Defence said, "the power of our MAVERICK passive radar can't be understated in the maritime domain. It addresses a key strategic challenge for Navy and enables critical, constant situational awareness of air, land, and sea, even in reduced or silent emission-controlled conditions.

"For decades, naval vessels have had to switch off emitters, including radars to maintain 'silence' and prevent detection, or when docked due to local restriction, and this has reduced their situational awareness.

"With our MAVERICK radars, there is no need for compromise. Our radars don't transmit like traditional radars which means the fleet can maintain critical awareness of objects in their environment, without highlighting their position."

A complementary or replacement technology to traditional surveillance systems, the MAVERICK series of radars use existing energy in the environment as the transmission source. They don't require spectrum allocation or license to operate and don't create a radiation hazard, making them easier, safer, and more cost effective to deploy without loss of performance.

The MAVERICK series of radars can be tailored to meet various operational requirements, ranging from short range drone detection through to monitoring



ROYAL AUSTRALIAN NAVY SELECTS SILENTIUM DEFENCE FOR PASSIVE RADAR TRIAL

ADELAIDE, SA - 8 March 2022

Silentium Defence has secured a contract with the Royal Australian Navy to explore application of passive radar systems for enhanced situational awareness in the maritime domain.

Under the contract, Navy has engaged Silentium Defence in a gated process to design, install and evaluate its MAVERICK passive radar across a range of maritime applications.

of objects in Low-Earth-Orbit. A key feature of this contract is to not only assess the operational performance, but to optimise their integration and configuration in order to support maritime operations across multiple classes of vessels and a wide range of mission roles.

Graeme Naylor, Chief Strategy Officer Silentium Defence said, "we're excited to put our passive radar systems through their paces in a range of scenarios that test and validate the value proposition for Navy.

"As our battlespace continues to evolve, constant, shared situational awareness across air, land, sea, and space has never been more critical. Defence's

ability to rapidly plan responses to threats depends on it, and to achieve that capability with an Australian designed, developed, and manufactured technology is an exciting prospect.”



FRANCE AND SPAIN LAUNCH TIGER MKIII PROGRAMME

MARIGNANE - 2 March 2022

OCCAR (Organisation for Joint Armament Cooperation), on behalf of the French and Spanish Armament General Directorate, the DGA (Direction Générale de l’Armement) and the DGAM (Dirección General de Armamento y Material) has awarded a contract to Airbus Helicopters for the development, production, and initial in-service support of the Tiger MkIII attack helicopter upgrade programme.

The contract includes the upgrade of 42 aircraft for France (with the possibility to add another 25 helicopters) and 18 for Spain. In addition, the contract provides the possibility for Germany to later join the Tiger MkIII programme. The first prototype is scheduled for an inaugural flight in 2025. First delivery to the French Armament General Directorate (DGA) will take place in late 2029 followed by a first delivery to Spain in 2030. Development and upgrade work will be conducted in Airbus Helicopters facilities in Albacete (Spain), Marignane (France) and Donauwörth (Germany).

“The Tiger MkIII programme will provide a European answer to the need for a state-of-the-art attack helicopter for the decades to come. With this upgrade, the Tiger will remain an essential and modern asset to its armies and reinforce defence cooperation in Europe,” said Bruno Even, Airbus Helicopters CEO. He added: “The Tiger MkIII will have no equivalent in the world for high intensity operations and will further improve the connectivity, precision, and fire power capabilities of the current Tiger”.

Tiger MkIII is a comprehensive upgrade of the European attack helicopter’s systems. Proven in combat, the Tiger is difficult to detect, highly agile,

and highly survivable, something operators will continue to benefit from with the MkIII upgrade. The new standard will allow the platform to be connected to the digital battlefield in order to perform manned-unmanned teaming as well as share tactical information in real time. It will also provide an unrivaled range of weapons (turret gun, laser-guided rockets and missiles) and renewed detection and targeting capabilities. The integration of state-of-the art avionics will reduce the crew’s workload and enable them to be fully focused on mission execution.

BABCOCK AWARDED NEW ZEALAND DEFENCE FORCE CONTRACT

24 February 2022

Babcock has been awarded a further seven and a half year Maritime Fleet Sustainment Service contract - H pai Taua Manuao - by the New Zealand Defence Force (NZDF), further strengthening its relationship with the Royal New Zealand Navy.

As the Strategic Maritime Partner to the NZDF, Babcock will provide asset management services, including engineering, project management, production and operational support, to the entire Royal New Zealand Navy fleet, from the frigates through to small craft. The contract was signed by the Chief of Defence Force, Air Marshal Kevin Short and Babcock’s New Zealand General Manager, James Morton in Wellington this week.

Babcock Australasia CEO David Ruff said: “We are very proud of our long-standing partnership with the NZDF and of our contribution to keeping New Zealand and its Pacific partners safe and secure.

“This award is a further demonstration of our commitment to continue to strengthen the breadth of our support to regional maritime capability in New Zealand, Australia and the broader Asia-Pacific region.”

Air Marshal Kevin Short highlighted the collaborative

nature of the partnership with Babcock: “One of the unique elements of the contract is that these services are delivered by a team comprised of Babcock employees, Royal New Zealand Navy personnel and NZDF civilians.

“This partnership has been recently acknowledged through an award at both the Minister of Defence Excellence Awards, and the New Zealand Business Excellence Foundation Awards.”



The new contract also has a strong focus on a range of environmental and social outcomes. James Morton said: “Babcock is aiming for our New Zealand operations to be one of the first carbon-zero dockyards in the world. As a part of this new contract we’ll be training over 100 early career STEM apprentices and graduates and we will be increasing opportunities and collaboration with New Zealand small and medium-sized businesses through Babcock’s supply chain.



“Babcock is focused on building long term partnerships with the New Zealand supply chain, and in particular developing long term relationships with Maori and Pasifika businesses. Our supply chain partners are key to our capability and our focus on delivering for our customer. We are looking forward to continuing our productive and valued relationships with them.”


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Assistant Minister for Defence, The Hon Andrew Hastie (right), MP, and Austal senior staff walk down a wharf at the Austal Ships shipyard in Henderson, Western Australia. Credit: CoA / Craig Walton

SECOND EVOLVED CAPE CLASS PATROL BOAT LAUNCHES IN WA

5 March 2022

The Morrison Government continues to keep Australia's borders safe while supporting jobs, with the second of six Evolved Cape Class Patrol Boats launched today at the Austal Ships shipyard in Henderson, Western Australia.

Minister for Defence Industry, the Hon. Melissa Price MP said the vessel's launch was a demonstration of the Coalition Government's ongoing commitment to its continuous naval shipbuilding program.

"I am proud to see Australian and in particular West Australian industry delivering our future naval capability," Minister Price said.

"We are also providing significant opportunities to workers both locally and in the broader Australian economy. The Evolved Cape Class project is worth about \$334 million and directly supports around 400 jobs that provide benefits throughout Austal's supply chain. This ensures continued employment of Australian shipbuilders and provides positive flow-on effects for small and medium Australian businesses, crucial to the success of sovereign naval shipbuilding."

Following its official launch today, the second patrol vessel will receive finishing touches and undergo sea trials before being delivered to Navy later this year.

Assistant Minister for Defence, the Hon. Andrew Hastie MP said the Evolved Cape Class Patrol Boats were a vital capability that would be used by Navy to continue to secure our borders and protect Australia's sovereignty at sea.

"This is a great day for WA's defence industry, marking another important milestone in the Government's Naval Shipbuilding Plan - further

strengthening our sovereign defence industry capability and delivering the largest regeneration of our naval fleet since the Second World War," Assistant Minister Hastie said.

"I was pleased to launch this vessel. Building these vessels here in Western Australia means a stronger defence force that will protect our borders and our national security interests, and create long-term local jobs."

"We are an island nation and these vessels will play a crucial role in the protection of Australia's maritime and national security interests," Assistant Minister Hastie said.

The Evolved Cape Class Patrol Boats will be used by Navy for border protection, fisheries and constabulary duties until the Arafura Class Offshore Patrol Vessels enter service. All six boats are currently under construction, the first vessel was launched last October and is currently undergoing sea trials. The remaining vessels will be delivered at approximately four-month intervals, with the last handover to Defence scheduled for late 2023.

SAAB AUSTRALIA'S COMBAT CONSOLE PROVIDING EXPORT OPPORTUNITIES FOR AUSTRALIAN INDUSTRY

February 2022

Saab Australia's new global export programs will provide up to \$25 million in revenue opportunities to its Australian SME partners and a pathway to global supply chains, with the in-country design and manufacture of its combat management system Multi Function Consoles (MFC).

Saab Australia Managing Director, Andy Keough, said Saab's locally designed and manufactured MFCs will be exported into defence programs across the globe.

"Working closely with Australian industry, academia and end-users, our Adelaide based hardware team fully designed and developed a new console. We have established a highly capable local supply chain to manufacture a now globally leading combat management system MFC," Mr Keough said.

"Together, we're supporting the growth of Australia's sovereign defence industry and in-country capability, and with Saab's expanding portfolio of high-tech global export programs we will continue to provide opportunities for our local industry partners, as well as strong pathways into global supply chains."

Saab began the design and development of a new generation of MFCs in 2018 to support the unique requirements of Australia's newest surface fleet, and Saab's design and integration of the Situational Awareness System (SAS) for the Arafura Offshore Patrol Vessel (OPV) Program.



Multi function console (Saab photo)

The new console design balances technical requirements, time and cost efficiency with operational effectiveness and sustainability – made possible by partnerships with local industry, including Applidyne for specialist engineering, and with academia through Saab's partnership with the University of South Australia and their Human Factors and Ergonomic studies.

Combined with a proven local manufacturing supply chain, and after successful capability testing and demonstration, this new generation of MFC is now being manufactured in country by SAGE Automation.



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The commonality between the Lynx CSV and Lynx IFV provides efficiencies and ease of use for armed forces around the world. Together, the two variants expand the Lynx family of vehicles and provide options for up to 10 variants thanks to Lynx's modular design.

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PATHWAY FOR ARMY'S BATTLE MANAGEMENT SYSTEM REMAINS OPAQUE

More than a year after suspending the use of Army's tactical Battle Management System (BMS) developed by Elbit, Defence and the Government are still to define a clear pathway forward. An article such as this runs the risk of being overtaken by events since it would appear that a recommendation will soon be before Defence Minister Peter Dutton. However, what it actually says is unknown, though there are plenty of rumours such as it might lead to the cancellation of the contract, with all of the presumed legal complexity that would involve.



Scenario in which soldier using the Elbit Systems of Australia android-based end-user device to synchronise robots and drones. (Elbit photo)

Senator Jim Molan – himself a distinguished retired Major General and best-selling author – tried his luck during Estimates hearings with the Chief of Army, who was assisted by the Head of CASG:

Lt Gen. Burr: Its current status is that the Army has paused the use of the Elbit battle management system. We have an interim battle management system in place, and Defence is still in negotiations with Elbit on how to move forward.

Senator MOLAN: Are the negotiations with the Department of Defence?

Lt Gen. Burr: Yes, with CASG.

Mr Fraser: The matter is between Defence and Elbit, as we prepare additional advice for government consideration.

Senator MOLAN: So the minister has just got to make the decision?

Mr Fraser: The minister will get the full information, and we're continuing to provide additional information.

The fact that this matter will involve the Minister seems to have stifled the release of any more information from Defence.

For its part, Elbit Systems Australia is also unclear about the way forward. It needs to be remembered that the company is no longer the prime system integrator for the project – that role was taken over by the Army itself in 2016 – and since that time has been a humble supplier to the Commonwealth. The company's Managing Director Paul McLaughlin remains confident that

there is still a role for Elbit. He said:

"We believe that if we get all our ducks in a row and restore the confidence of the customer – and correct the record from the many mistruths that have been circulated about us – that we have a genuinely disruptive capability to offer. This is not only for LAND 200 Tranche 3 but also for the upcoming 4100 series of projects.

"I genuinely believe in the product that we are able to offer – and I wouldn't be with the company if I didn't believe it was the best capability that the ADF could choose. We aren't going to walk away from this – but at the same time we do need a decision about the current phase of the project for commercial reasons. We have been assured that a decision will be made soon."

He explained that work has now been successfully completed on software release 9.1 that was at the heart of the decision more than a year ago to withdraw some parts of the BMS from service. In his view there are no longer any obstacles to moving past that particular contractual milestone – and the company is in a position to start implementing the solution as soon as given the go ahead by Defence to do so.

In the meantime, the company has plenty to get on with – including developing its bid for LAND 125 Phase 4.

The interim solution referred to above – which looks like it will be in place until June 2024 – is being provided by Danish supplier Systematic, which has rolled out their Sitaware HQ across much of the ADF. Reports are that it has been performing very well, including during Exercise Talisman Sabre last year. The feedback was positive, enabling connectivity not only with all Five Eyes countries but also potentially coalition allies Japan and South Korea and a variety of inter-government agencies. Though marketed mainly as a headquarters tool it nevertheless has the capability to be mounted onto vehicles and can connect with individual soldiers.

Not coincidentally, the company's Canberra office was opened on February 21 by their global CEO and founder, Michael Holm, who made the point that without connectivity and interoperability, true alliance operations are impossible.

SitaWare HQ has been trialled at HQJOC and has been rolled out to various parts of Defence, including the Mission Partner Environment (MPE). It was deployed to 7 Brigade last year for Joint Warfighter assessment, 3 Brigade specifically for Talisman Sabre and also 1 Brigade for Exercise Koolendong. This saw Australian Army personnel and United States Marines from Marine Rotational Force-Darwin (MRF-D) work together for high intensity, live fire training.

Army has many systems that need to connect, such as the Battlegroup and Below BMS with things such as AFATDS (Advanced Field Artillery Tactical Data System) and whatever will be the result of JP9111 – which looks to be a mess. According to Defence, this latter project aims to provide a Joint Command and Control (Joint C2) information environment to support the planning and execution of operations and exercises at all levels of command, either independently, as part of an Australian-led coalition, or as a component of a wider Five Eyes coalition. To this can be added an Electronic Warfare BMS and various other elements, all of which need to be connected.

Incidentally, Talisman Sabre also saw the demonstration of Boeing's Currawong solution to JP 20722B – a sort of secure, deployable, sovereign internet for the ADF – that is a communications system able to transfer data across the theatre using whatever bearers are available. This enabled, amongst other things, 'Headquarters on the Move.' While the system worked well, Army presenter Colonel Blaydon Morris at the MilCis conference held in Canberra from February 23 to 25 described it as being technically complex. He added that he had four goals for industry:

1. Seek to reduce complexity at the tactical edge. This is so that warfighters can concentrate on their mission, not spending time trying to get their computers to work.
2. Format and fuse data in an executable manner. There might be times when the ADF has to fight in a disconnected environment.
3. Enable the operator at the coal face to be able to plan, manage and execute various networks without reliance on the overarching strategic enterprise.
4. It's all about standards. The ability to fuse data feeds, sensors and input from coalition partners



Scenario showing soldiers using Elbit Systems of Australia C2 sight, networked using combat radio linking soldiers' data to the Battle Management System. (Elbit photo)

comes down to standards – whether they be open source or military defined.

Another part of the mix is the C4EDGE partnership of Australian owned companies led by EOS that APDR has previously covered. After a successful demonstration of a prototype battlegroup and below C2 system in December, the team is looking for indications about the way forward – and either collectively or as individual companies have the capacity to play a role in this area. For example, Canberra-based Insitec has developed a communications and data networking tool called HIVE that played an important role in the C4EDGE demonstration. They and Systematic are aware of the existence of each other and may well find ways of working together.

Finally, a word has to be said about the MilCis conference overall. All observers of the command and control space were hoping to receive some concrete information about the Army C2 roadmap

and LAND 200 in particular. While later sessions did provide some substance – and we all thank the Army presenters for their work - the opening two hours were a major disappointment, with senior speakers from Defence unable to move beyond jargon. The writer texted – in real time – the following:

Step change. Delta. Strategy. Corporate enabler. Agility. Need to pivot. Action plan. Evolve procedures and processes. Information environment. Connected and digital defence. Secure and resilient. Transform. Modern scalable flexible. Cloud. Information architecture. Uplift. Multi-year effort. Declutter. Single information environment. Highly modular. Reusable open architecture. Data centric model. Flow. Traffic. Hybrid Cloud model. THE END.

It takes quite an effort for people in leadership positions to speak for this length of time without detailing projects or budgets.

LAND 400 PHASE 3

Australian Army soldiers from the 7th Battalion, Royal Australian Regiment, stand with Hanwha Defence Australia Redback Infantry fighting vehicle (left) and Rheinmetall Lynx KF4 Infantry Fighting Vehicle (right), during user evaluation trials at Puckapunyal, Victoria. Credit: CoA / Jake Sims



KYM BERGMANN // CANBERRA

INFANTRY FIGHTING VEHICLE DECISION IMMINENT

Unless something goes very awry in the near future, predictions are that an announcement will be made in the second half of March about the winner of LAND 400 Phase 3. The competition is between Germany's Rheinmetall offering the Lynx and relative newcomer, South Korea's Hanwha. Vehicles from both companies have been put through an extremely rigorous evaluation process, having been driven in a large variety of conditions and blast tested to the point of destruction.

For the process to have continued this long, one assumes that both the Lynx and the Redback meet the requirements of the Army; if that were not the case it is reasonable to assume that the competition would have been cut short. If the performance of the vehicles is roughly equal, then the decision will turn around issues of price, Australian industry content – and risk. Or to put it more correctly, perceptions of risk.

It is for this latter reason that rumours have placed Rheinmetall as the slight favourite because they are a well-known quantity. They are the incumbent for LAND 400 Phase 2 with the Boxer 8x8 and they are delivering a new fleet of heavy and medium trucks under LAND 121 3B. It has been suggested that the Hanwha Redback performed better during the

Risk Mitigation Activity trials, being more reliable and having better ride and handling due to the use of rubber tracks. As we have written previously, it also has a Bushmaster 30mm cannon that can use aluminium cased ammunition – which the U.S. and many coalition partners prefer – which is much more widely available than the steel cased rounds used by the Lynx.

The suggestion around Canberra is that the announcement has been slow in coming because of an internal tussle in Defence, with Army preferring the Redback on performance grounds but CASG favouring Rheinmetall for broader programmatic reasons, especially lower risk. While this cannot be confirmed, it certainly makes sense from what we know. Hanwha Defense Australia signed the LAND

8116 contract for self-propelled howitzers only two months ago and there might be a strong temptation by Defence to wait and see how they perform on that one before awarding an even larger deal to them.

If Defence has recommended the Lynx, it's hard to imagine Cabinet taking a different view – though that has occasionally occurred. It might be that a better performing vehicle wanted by Army is preferred. Cabinet might also take the view that anything that strengthens relations with South Korea is a good thing – especially with the election of a new conservative President who has promised to be much tougher on China than his predecessor. In the black and white worldview of Australian politics – at least from the perspective of this government – you are either for or against China and the previous

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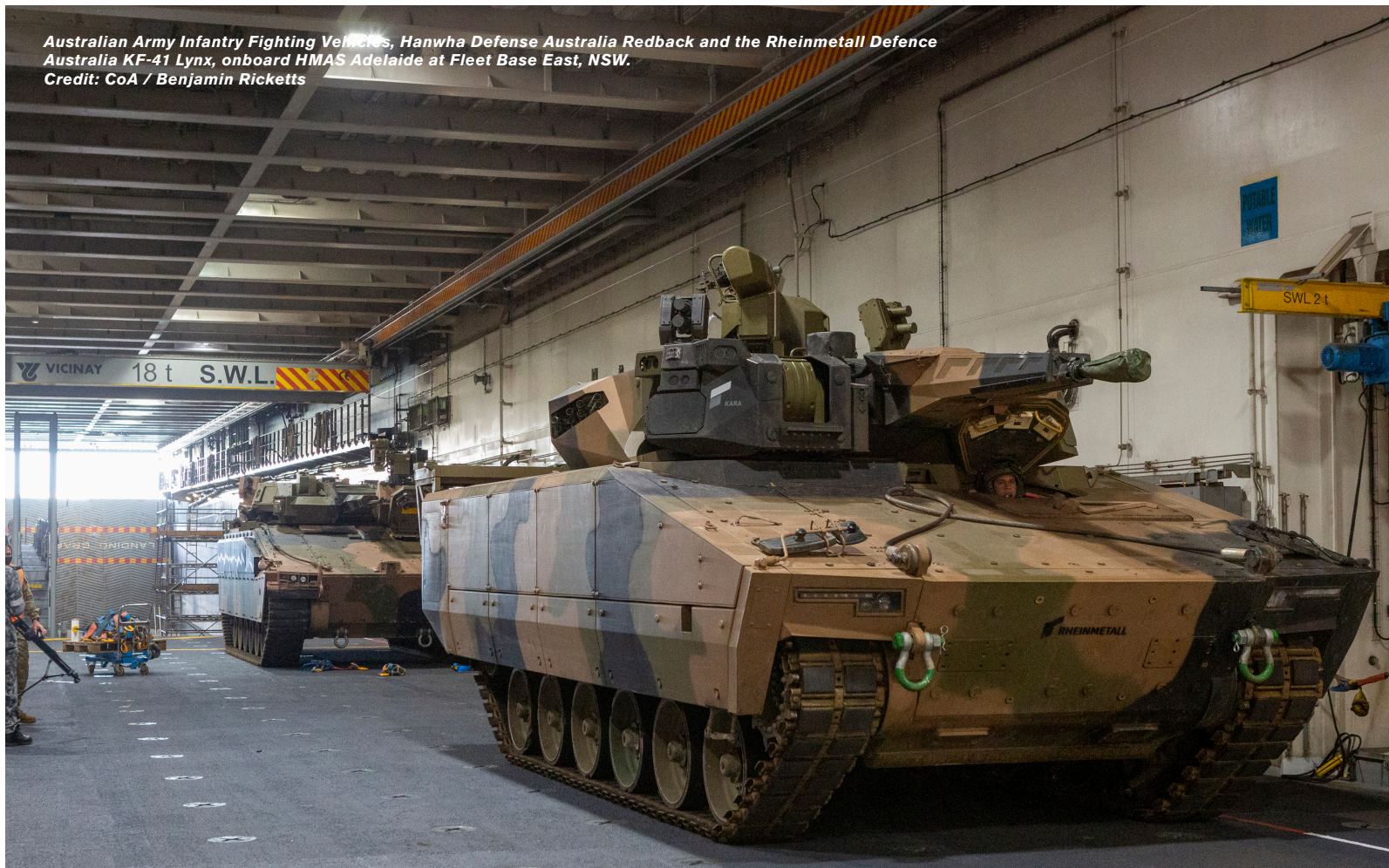
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LAND 400 PHASE 3

*Australian Army Infantry Fighting Vehicles, Hanwha Defense Australia Redback and the Rheinmetall Defence Australia KF-41 Lynx, onboard HMAS Adelaide at Fleet Base East, NSW.
Credit: CoA / Benjamin Ricketts*



ambivalent position of South Korea might have been seen as a negative.

Whoever wins the competition, questions need to be asked about the ridiculously slow delivery schedule, which will only see significant quantities of Infantry Fighting Vehicles being introduced into service in the late 2020s. This is because of the proposed methodology of the Army, which requires the construction of prototypes of all possible IFV variants and the drawn-out testing of those before final production begins. This again shows a discontinuity between the political rhetoric about the dangers posed by China and the actual timetable for beefing up capability.

The government keeps radiating a sense of urgency – such as the announcement to increase the size of the ADF – but the procurement of hardware seems to be going in the opposite direction. Because the vehicles will take such a long time to arrive, they run the risk of being obsolete – or at least very close to it. Technology is galloping along and a decade from now the world will be quite a different place.

One of the best examples of this is the Army's

insistence on a crewed turret for the IFVs. This makes Australia almost unique in the western world with most users shifting to the two operators – the commander and gunner – located far more safely inside the hull of the vehicle and the turret being controlled remotely by them. This means that it does not have to be as heavily armoured, and the entire ergonomics of the vehicle are greatly improved without the need for a large bustle intruding inside the hull.

Radar and various electro-optic sensors can now produce a picture of the world outside an armoured vehicle at least as good as the naked eye – and far better at night and during times of poor visibility, be that from the weather or due to battlefield conditions. The days of commanders having to stick their head out of the turret to see what is really going on are long gone. To do so even today – let alone against the weapons and targeting systems of the 2030s and beyond – would be an exceptionally hazardous and probably very brief undertaking.

Another area that needs to be addressed is active protection systems (APS) for armoured vehicles. As the present conflict in Ukraine is

demonstrating, in many conditions even heavily armoured Main Battle Tanks are very vulnerable to shoulder fired guided missiles of the NLAWS type that use a top-down attack profile. At present count, Russia has lost around 300 MBTs to these types of weapons and additionally more than 500 other vehicles. These sorts of losses are similar to those experienced by conventionally equipped Armenian forces against Azerbaijan – which also employed a lot of loitering munitions and drones equipped with anti-tank missiles – during the Nagorno-Karabakh conflict of late 2020.

The IFVs are likely to be equipped with some form of APS, but there are questions about whether technology is evolving rapidly enough to protect vehicles from new attack profiles and from threats such as large numbers of swarming drones. As we have touched on elsewhere in this edition, the ADF seems to be ignoring developments in these areas of asymmetric warfare. If Australia is on the cusp of committing almost \$30 billion buying 400 IFVs some thought needs to be spent on making sure that they are fit for purpose when eventually delivered.

GEOFF SLOCOMBE // VICTORIA

ROBOTIC AND OPTIONALLY CREWED LAND VEHICLES

The description of optionally crewed land vehicles is self-evident. However, robotic land vehicles (RLV – not an acronym used by the Australian Army) need to be distinguished from uncrewed land vehicles (UGV). The latter have a high level of interaction with the person controlling them.



Australian Army officer Brigadier Ian Langford, DSC and Bars, watches on as two autonomous M113 AS4 optionally crewed combat vehicle (OCCV) assault an enemy position at the Majura Training Area, Canberra. Credit: CoA / Tristan Kennedy

Robotic land vehicles are capable of autonomous behavior for quite long periods of time, operating without the need for a human controller. They use their sensors to determine the next action to take in the context of the human-provided mission goal. Some, for instance, can even disarm or remove explosives and repair themselves without outside assistance.

The distinction between UGVs and RLVs is fine in theory but is rather harder to apply in practice.

Robotic, uncrewed and optionally crewed land vehicles can be used to penetrate enemy defences, launch attack drones, fire anti-tank missiles, breach obstacles, conduct surveillance under enemy fire and deliver ammunition amid intense firefights which are all missions they are anticipated to perform. To be able to send these types of vehicle into harm's way without risking personnel can be a very attractive option for field commanders.

ADVANTAGES AND DISADVANTAGES OF ROBOTIC LAND VEHICLES

RLVs are autonomous robots that operate without the need for a human controller. They use their sensors to determine the next action to take in the context of the human-provided mission goal.

The fully autonomous robot can collect information about the environment such as creating maps of building interiors. They can detect objects of interest such as people and their vehicles. They can travel between waypoints without human navigation assistance.

By using their inbuilt artificial intelligence, robots can learn or gain new capabilities without outside assistance. They can adjust strategies based on their surroundings. They can adapt to surroundings and can develop a sense of ethics regarding mission goals.

The technology programmed into unmanned robotics allows the soldier to spot enemies on patrol or waiting to ambush coalition forces. They can help save lives. Unmanned robots can target enemy snipers in the area.

But RLVs also have disadvantages. They can be detected by enemy troops, or be blown up by mines. In certain situations, they may overheat, meaning they are vulnerable to being stuck in that same position until the vehicle has cooled down sufficiently.

If an RLV is used to clear a mine field, but it breaks down during this operation, the element of surprise is eliminated.

Bandwidth will always be the problem with the wireless solutions, as the RLV needs to occasionally report back to its base revealing what it has detected.

RLVs with weapons can violate the code of the ethics for its computers which says that they are not supposed to cause any harm to any human being. Therefore, these robots are not fully autonomous and they won't make the decision whether to shoot and kill an enemy combatant on their own.

Optionally crewed land vehicles, which might exercise the option of a driver and other crew when they move around, might be committed to enter or attack well-defended positions which could prove fatal for some or all the humans on board.

RICO

The Army's recently established Robotic and Autonomous Systems Implementation Office (RICO) is responsible for pursuing Army's interests in Robotic and Autonomous Systems (RAS) / Artificial Intelligence (AI) and disruptive technologies and ethically leverage them to gain asymmetric advantage in the future operating environment.

Areas they have been researching include Optionally Crewed Combat Vehicles (OCCV) from BAE Systems Australia, autonomous leader-follower and collision avoidance, various user interfaces,



A technician from BAE Systems Australia remotely inputs controls to an autonomous M113 AS4 optionally crewed combat vehicle (OCCV) at the Majura Training Area, Canberra.
Credit: CoA / Tristan Kennedy

platform actuation, user experiments with various robotic land vehicle technologies, autonomous control and human-machine teaming.

Their RAS Strategy identifies five fields, which include efficiency, force protection, generating scalable effects, improved decision making and improving soldier performance. Experimentation across multiple platforms (OCCV, UGV, quadruped robotic dogs, medium trucks) has considered how humans and machines can combine to achieve team effects.

Within this strategy, RAS will span the full spectrum of human input from remote control through to full autonomy – the level of autonomy required will be determined by the role and also the maturity of the underpinning technologies such as AI.

Therefore, RAS is a lens through which to describe a system, hardware and software, which has varying elements of autonomy and/or robotics and commonly both.

The RICO was also highlighted in the Force Structure Plan 2020 as a coordination function for the pursuit of this suite of technologies. The vast majority of the RICO work is with Australian Academia and Defence and supports the recent inclusion of RAS and AI as a Sovereign Industry Capability Priority (SICP).

As part of the Chief of Army Symposium, to be held in Adelaide during August 2022, Army will run its Army Robotics Expo (ARX). This follows a highly successful event held in Brisbane in April 2021

where 55 companies showcased their RAS and AI technology to Defence's senior leadership. The AUSTENDER call for ARX 2022 is now live and the closing date is 2 May 2022.

RAS offer the opportunity to change the way that Army trains and fights in the future. This is highlighted in the published Army RAS Strategy. The key will be to understand the application of the technology in the battlespace of the future, understand the threats and opportunities and to leverage the significant National robotics and autonomy capability resident within Australia.

Army also needs to understand the impact on how it is organised and will operate with and among such systems in the future.

OPTIONALLY CREWED LAND VEHICLES

There is a lot of focus on autonomous technologies by the western world's largest defence companies. This comment from Boeing illustrates the high level of oversight and direction within such a large and important international company.

"Boeing Australia continues to invest and develop autonomous technologies as part of its R&D strategy to provide customer-focused, value-generating solutions and capabilities from seabed to space. Having tested in this area at Land Forces and ARX last year, we're continuing to work on

autonomous systems technology to complement the Australian Defence Force's intelligence, surveillance, and reconnaissance requirements across multi-domains," Emily Hughes, director of Boeing's Phantom Works International told APDR.

APDR asked a Defence spokesperson for their opinions to help inform this article. They responded: "The Army contracted BAE Systems Australia to prototype the notion of optionally crewing combat vehicles. The M113 was chosen as a candidate platform given its supportability and Army's depth of knowledge of the platform. Experimentation continues to derive clear use cases, concepts of employment and force design concepts for the future ability to optionally crew platforms.

"Army has also developed an autonomous leader-follower prototype using L121 40M trucks and recently demonstrated these under trial at Monegeetta in a convoy of five. Both of these, and other exploration activities are part of the implementation of the Army's Robotic and Autonomous Systems (RAS) Strategy released in early 2019.

"The Force Structure Plan (FSP) 2020 highlighted opportunities for future uncrewed systems early in the next decade. Army expects that the role of autonomy and artificial intelligence will be part of many of the capability programs in the future. Army is undertaking exploration activities now to inform that future in terms of understanding the roles, value proposition, risks and benefits of the spectrum of autonomy which may include optionally crewing through the Robotics and Autonomous Systems Implementation and Coordination Office (RICO) within Army Headquarters.

"Army is conducting a number of innovation and exploratory activities ranging from robotic systems, artificial intelligence in decision support, human machine interface, human-machine teaming and machine-machine teaming. Much of this work is undertaken with Defence Science and Technology Group and Australian industry partners."

BAE SYSTEMS AUSTRALIA OCCV

APDR was pleased to receive this statement from BAE Systems Australia on the work they have done, and are now progressing, in the field of OCCVs:

"In 2019, a team of BAE Systems Australia Red Ochre Labs engineers began converting M113AS4 Armoured Personnel Carriers to operate as Optionally Crewed – a significant milestone in the exploration of autonomous capabilities on the future battlefield.

"The fleet of M113AS4 OCCVs now numbers twenty vehicles and is being used by the Australian



A Remote Ground Vehicle (RGV) transits the Majura Range under the control of a Defence contractor (left) as part of the Defence industry C4 EDGE demonstrations. Credit: CoA / Cameron Pegg

Army's Robotic and Autonomous Systems Implementation Coordination Office (RICO) to better understand opportunities to employ autonomy on the battlefield and implement its Robotics and Autonomous Systems Strategy.

"Today, our engineers are taking this to the next level, working with artificial intelligence and machine understanding to explore a higher level of autonomous capability: trusted autonomy. As we mature the development of these trusted systems, the OCCVs are an ideal test platform for BAE Systems Australia and Army to advance its Robotics and Autonomous Systems Strategy even further.

"Trusted autonomy is when artificial intelligence and teaming enable the platform to make reliable and responsible decisions, taking into account the environment around them and objectives and intent of the operator," says Adam Watson, Director of Red Ochre LABS.

"To move towards a trusted autonomous solution there needs to be a significant leap in the underlying technology.

"Simply put, this shift means that the vehicles will operate to achieve goal-based missions set by the operator, using machine understanding to autonomously break down high-level objectives into

lower-level tasks to deliver the mission.

"What is exciting is the ability for human operators to make informed decisions quickly, with large amounts of information processed autonomously and decisions that can be reliably made by the system deferred from the operator.

"Ultimately, this next generation of trusted autonomous solution will reduce cognitive burden, allowing the soldier to operate at a higher level."

The example below provides a simple scenario that explores some of the ways trusted autonomous systems might change the battlefield.

Mission: Move supplies from a rear logistics node to a tactical equipment collection point.

Action: The operator assigns the mission goal, to move the materiel to the front.

Outcome: The system uses AI to determine which vehicle is best placed to realise the goal while considering the optimal path, taking into consideration competing objectives including terrain and known threats. The suggested mission plan is shared back to the operator to approve.

As the vehicle executes the plan, the system constantly refines routes and reacts to new information. The machine-understanding algorithm detects an unexpected threat along the planned

route, and an updated mission plan is automatically generated to keep a safe distance and maximise mission success.

Once the munitions are delivered, the vehicle is reassigned by the system to perform its next mission. In this scenario, the autonomous system exponentially increases the safety and survivability of the mission by removing soldiers from the battlefield and increasing the information available to improve decision-making.

BAE Systems Australia is collaborating with the University of Adelaide, world leaders in machine learning; the University of Melbourne, world leaders in decision-making and planning; and the Defence Science and Technology Group, experts in trusted autonomy and signature management, to develop the next generation of autonomous capability.

"Building bridges between academia and industry will allow us to leverage the cutting-edge technologies they are developing, while growing Australia's skilled workforce and contributing to sovereign capability," Adam says.

"Our role is to bring together this world-leading research, acting as systems integrators to deploy this technology onto vehicles to demonstrate the technology."

M1A2 System Enhancement Package version 3 main battle tank. (U.S. Army / Sebastian Saarloos)



KYM BERGMANN // CANBERRA

AUSTRALIAN HEAVY ARMOUR CAPABILITY INCREASE

Decisions about increasing the size of the Australian Main Battle Tank fleet always seems to be contentious because of counter arguments about whether the capability can be justified because they will never be used in combat, given their size and weight. This line of argument goes that since they cannot be deployed outside Australia, they are only useful on home soil – and by then it will be too late. Neither argument really stacks up.

T rue, they are massive beasts. The current 59 M1A1s in the inventory weigh about 60 tonnes each. The next crop of 71 M1A2 SEPV3 are a fraction more than 67 tonnes – so moving them anywhere takes quite a bit of planning. However, they can be transported on low-loaders, rail, on Navy's LHDs – and at a pinch, and one at a time, in RAAF's fleet of C-17 heavy lift transport aircraft. In the latter case this would not be done frequently as every landing with such a weight on board reduces the fatigue life of the aircraft.

The bottom line is that if they need to be deployed outside Australia then they can be. Heavy armour has been used effectively throughout the entire region, as Vietnam War and Second World War experience shows. While they are at their most

devastating in flat open terrain – such as northern and eastern Europe and much of the Middle East – with careful handling they bring a massive amount of direct firepower and high levels of protection to most scenarios.

Because of their weight and size, careful note needs to be taken of infrastructure and ground conditions where they are to operate – particularly if they exceed the load limits of bridges and are wider than railway tunnels – but most of this is common sense and not much different to deploying commercial heavy machinery. A Caterpillar D-11 bulldozer is twice the weight of an M1A1 and they are used all over the world from the tropics to the Arctic.

Important considerations with MBTs are their good power-to-weight ratio and their low ground

pressure. All Abrams tanks use a Honeywell gas turbine engine producing 1,500 horsepower – in Australia the local support company TAE has tweaked them to go a bit higher than that – and even for the heavier SEPV3 variant gives them good acceleration and top speed. They can also push through thick foliage and knock down trees, walls and the occasional building if they need to. Because of the width of the tracks, they have lower ground pressure than almost all wheeled vehicles, meaning they can cross a wide variety of terrains, climb steep slopes and so on.

Despite the difficulties of getting them there, heavy armour was used successfully in Afghanistan. Canada used Leopard 2 MBTs and the US Marine Corps deployed a company of 15 M1A1s to Helmand province in 2010. During



An Australian Army M1A1 Abrams Main Battle Tank from 2nd/14th Light Horse Regiment (Queensland Mounted Infantry) fires its main armament during an offensive operation live-fire training serial during Exercise Diamond Walk at Shoalwater Bay, Queensland. Credit: CoA / Jacob Hilton

one weeklong operation they worked closely with Australian Special Forces soldiers clearing a series of villages occupied by the Taliban.

have the shorter L44 barrel but the new ones use the L55 with a muzzle velocity of 1,750km/s. To spell this out, that equates to it firing an anti-tank

April 2021 when the US State Department notified Congress of a possible sale to Australia of 160 M1A2 hulls that would then be converted to a variety of platforms, including the M1A2 SEPv3 (System Enhancement Package, version 3), detailing:

“The Government of Australia has requested to buy one hundred sixty (160) M1A1 Tank structures/hulls provided from stock in order to produce the following end items and spares: seventy-five (75) M1A2 SEPv3 Abrams Main Battle Tanks; twenty-nine (29) M1150 Assault Breacher Vehicles; eighteen (18) M1074 Joint Assault Bridges; six (6) M88A2 Hercules Combat Recovery Vehicles; and one hundred twenty-two (122) AGT1500 gas turbine engines.

“Also included is development of a unique

The bottom line is that if they need to be deployed outside Australia then they can be. Heavy armour has been used effectively throughout the entire region, as Vietnam War and Second World War experience shows.

The 120mm smoothbore main gun from German manufacturer Rheinmetall is one of the most powerful direct fire weapons on earth, relying on great accuracy, high muzzle velocity and durability to achieve devastating effects. The current M1A1s

round – typically a depleted uranium or tungsten spear – travelling to a target a kilometre away in half a second, virtually guaranteeing a first shot hit.

This acquisition has been on the cards since

ARMOUR

armor package, Common Remotely Operated Weapon Station Low Profile (CROWS-LP), Driver's Vision Enhancer, mission equipment, special tools and test equipment, ground support equipment, system and engine spare parts, technical data, publications, Modification Work Orders/Engineering Change Proposals (MWO/ECPs), U.S. Government and contractor technical and logistics assistance, quality assurance teams, transportation services, program management, New Equipment Training (NET); and other related elements of logistical and program support. The total estimated value is \$1.685 billion."

This figure in US dollars is equal to \$2.35 billion, well short of what Australia will be paying. Asked to explain the difference, Defence responded:

"On 10 January 2022, the Australian Minister for Defence, the Hon Peter Dutton MP, announced an AU \$3.5 billion investment in the Main Battle Tank Upgrade (LAND 907 Phase 2) and Combat Engineering Vehicle (LAND 8160 Phase 1) projects. This sum represents the entirety of the Australian Government's investment throughout the acquisition and sustainment of the capability and is the reason for the difference between the Australian Department of Defence and US

Defence Security Cooperation Agency amounts."

Defence says the replacement Main Battle Tanks, Armoured Breaching Vehicles, Joint Assault Bridges and Armoured Recovery vehicles will be based at each of the Army's Combat Brigade locations in Adelaide, Brisbane and Townsville, as well as at the School of Armour in Puckapunyal. There will continue to be a

require a net increase in Army personnel. Existing structures within the Armoured Cavalry Regiments and Combat Engineer Regiments will allow Army to upskill and train operators to crew and maintain the platforms.

The Minister's statement also mentioned that the tanks will interface with Army C2 systems, a somewhat fraught topic at the moment (see

As for the existing fleet of 59, Army is currently planning the withdrawal and disposal of the M1A1 Abrams tank in accordance with restrictions associated with disposing of equipment procured through the Foreign Military Sales process.

requirement to furnish the Australian School of Electrical and Mechanical Engineers in Bandiana with several platforms to enable training of Army's heavy armour maintainers.

Asked about whether personnel numbers will increase, Defence said that the Heavy Armour Combat System (HACS), which includes all vehicles to be procured under Projects LAND 907 Phase 2 and LAND 8160 Phase 1, will not

separate article in this edition). Asked what exactly they will interface with, Defence explained:

"Army will continue to invest in the military digital evolution under Project LAND 200. The HACS will integrate LAND 200 capabilities in order to enhance tactical situational awareness and increase speed of decision during combat operations. Upgrading from analogue-based systems in the M1A1 to the fully digitised architecture of the M1A2 SEP V3 will



ensure the Army can leverage current and future digital systems to realise its full potential as part of the Joint Force.”

As for the existing fleet of 59, Army is currently planning the withdrawal and disposal of the M1A1 Abrams tank in accordance with restrictions associated with disposing of equipment procured through the Foreign Military Sales process.

It is unclear whether the Australian MBTs will be equipped with an active protection system (APS), such as the Trophy from Israeli company Rafael. The history of recent conflicts such as Syria, Nagorno-Karabakh and the current fighting in Ukraine shows that even the heaviest tanks can be vulnerable to small and cheap anti-tank guided weapons, especially if they operate in urban terrain without effective infantry support.

Despite their massive armour, tanks – like anything else – can be subject to ambushes by small teams of trained infantry firing at them from behind cover. To reduce vulnerability to these types of threats, Trophy is an externally mounted system that uses a radar to detect an incoming RPG or anti-tank missile and automatically fires what amounts to a shotgun blast of projectiles at it. This destroys it at a distance of several metres

from the tank itself.

The Australian Army is aware of Trophy but does not yet appear to have made a decision about its acquisition, even though having APS is a big advantage in modern combat operations. Money does not appear to be an object given that this project seems to be generously funded.

Another curiosity is the RWS, mentioned in the notification to Congress. Australia makes a world class RWS, produced by Canberra-based EOS. During Estimates, Senator Jim Molan asked the Chief of Army, Lt Gen Rick Burr, why this is apparently not being fitted to the M1A2s and he replied:

“We are pleased with the government’s recent announcement for the replacement of Army’s tanks and combat engineering vehicles. As part of that process, there was a clear tender process that was followed to acquire essentially the as-is version of the US SEP V3 tank. That comes with the weapon system as they use it. To deviate from that would not meet the timelines or the cost profile that was established in this process. Then over the longer term, as we look to sustain and upgrade the tank, there will be, I’m sure, further opportunities but not at the front end.”

As it happened, the author was at the Singapore air show at this time and quoted the passage to Grant Sanderson, CEO EOS Defence Systems, whose paraphrased reply was “What?”. He said that EOS has never been asked to supply a quote for their RWS, so how the Chief has concluded that the company could not meet the required cost or schedule is a complete mystery – especially since this deal has been in the offing since April last year.

A discussion of heavy armour would be incomplete without mention of the 30 ‘Huntsman’ AS9 155mm self-propelled tracked howitzers and 15 K-10 armoured resupply vehicles being produced by Hanwha Defense Australia for the Army via LAND 8116. On February 23, Defence Industry Minister Melissa Price announced that the company would construct a 32,000 square metre world class facility at Avalon airport for the assembly and testing of the vehicles.

Unlike the fully imported M1A2s – themselves remanufactured from Cold War surplus stocks - the SPH fleet will have a high level of Australian content, with some of the technology available for export. A second tranche of AS9s and resupply vehicles will be ordered later in the decade.



Hanwha - Investing in Australia’s industrial resilience and taking it to the world.

Hanwha’s new Armoured Vehicle Centre of Excellence at Avalon in Victoria will provide our ‘centre of gravity’ for the supply of equipment to the Australian Defence Force. Given Australia’s regional proximity to Korea it is Hanwha’s intent that the same facility, and the same supply chain, will generate exports into Korea and other Five Eyes Nations.

READY. RELIABLE. RESPONSIVE.

NIOA CEO, ROBERT NIOA, IN CONVERSATION WITH APDR EDITOR, KYM BERGMANN



Robert Nioa (NIOA photo)

Kym Bergmann: What is your business background and how did you first become involved in defence contracting;

Robert Nioa: Growing up in my parents' small businesses was the best grounding I could have. It was all about hard work, perseverance, loyalty to your staff and customers... from Mum and Dad's farm to their fruit stall to the service stations and a fuel depot to a tyre shop and eventually the gun business...and those values are the hallmark of the modern NIOA company.

By the mid-80s Dad had landed the distribution rights for a handful of American firearms companies and moved to Brisbane to focus on growing the sporting market.

We were the smallest wholesaler in the country when in 1996 the industry was turned on its head after the Port Arthur tragedy and the sweeping reforms to gun laws that followed. About half of Australia's firearm dealers closed down.

By then I'd joined Dad to help the business through the changes. And if we were going to

survive, let alone grow, we decided that we needed to diversify.

About the same time, I visited a trade show where I met some people from NICO-Pyrotechnik, now part of Rheinmetall Defence, which at that time was supplying stun grenades and 40mm munitions to police SERT teams in Australia as well as mortar and sub-calibre training systems to the ADF.

The NICO connection led us to SACO Defence, now General Dynamics, who were developing a futuristic 40mm grenade launcher.

Nineteen years later, in 2015, the MK47 lightweight automatic grenade launcher (LWAGL) became our first prime contract under the LAND 40-2 project.

Q: What interested you in the defence sector in particular?

A: We have an abiding sense of admiration for the men and women of the Australian Defence Force and the role they play in keeping our nation safe. Many of our staff members, leadership team and advisory board are ex-military.

There's a sense of pride and patriotism that goes

with being a part of this industry and that purpose of keeping our warfighters equipped and ready so they can do their jobs efficiently.

It is also about being the force behind the force – creating the jobs that strengthen local economies.

Over the next decade the Coalition Government is investing more than \$270 billion to modernise Australia's defence capability.

Australian workers, skills and knowledge will be needed for this.

For NIOA as a 100 per cent Australian owned entity the decisions on how we meet those needs are made in Australia, by Australians.

Q: Do you sometimes feel out of place owning a relatively small private company competing against huge multi-nationals;

A: Out of place? No. Unique. Yes.

It's certainly a crowded playing field made up of traditional primes that are large, multi-national foreign-owned and driven by quarterly profits that go overseas.

Defence Minister Peter Dutton recently called on primes for urgency and faster delivery to meet the most ambitious re-industrialisation of defence since WWII.

Our size gives us agility.

Combine that responsiveness and that ability to pivot, with the best team in the industry, with a can-do attitude and you have a dynamic organisation focussed on delivering what only a true Australian company can offer: sovereign capability.

The best example of that is the \$60 million munitions plant in Maryborough where within two years we transformed a greenfield site into the most advanced facility of its kind in the world creating a new capability for the ADF as well as export opportunities and also Benalla where we have spent \$13 million rejuvenating capability that had become rundown and under-utilised.

Q: Have there been times when the DoD hasn't taken you seriously because you aren't a huge multi-national?

A: Not at all, and in fact going forward there are strong signals that there will be an even greater

focus on Australian-owned and Australian-made.

Amid all the chaos that COVID-19 has wrought, people are realising it is time to rethink and reshape our often heavy reliance on the benefits of globalisation and restore key parts of our economic sovereignty.

Prime Minister Scott Morrison made it clear in announcing AUKUS that Australia must become more self-reliant in defence.

Munitions and small arms research, design, development and manufacture have been identified as one of the government's top sovereign industrial capability priorities.

NIOA was chosen ahead of two foreign-owned companies to secure Stage 1 of Tranche 1 of the LAND 159 program which involves replacing and modernising 26 weapons systems to be used by the Australian Defence Force for decades to come.

It is the ADF's largest ever small arms replenishment program and will ensure our Australian servicemen and women are carrying the very best equipment on their missions - all delivered by a 100 per cent, Australian-owned company that is proud to play its part in supporting our Diggers.

We take great pride in helping to create defence

industry capability within Australia, and we strongly believe our national interests are always best served when such important projects are controlled within this country.

Q: Turning specifically to the AMC, why have you formed this consortium and why do you think you are an appropriate strategic partner for sovereign guided weapons?

A: This is an exciting opportunity to be involved in. The Australian Missile Corporation was NIOA's swift response to the Commonwealth Government's \$1 billion plan to accelerate a sovereign Guided Weapons and Explosive Ordnance Enterprise.

It was set up to facilitate collaboration between industry, academia, state governments and Defence. We have spent recent months building our capability, linking up with more than 300 partners to assist in all

facets of missile and guided weapons manufacturing.

To us, "sovereign Australian" means where the decisions are made and owned. As the strategic partner, NIOA and the AMC promise the most important component in Australian defence manufacturing – sovereignty.

Our projects are controlled in Australia with every decision made for the benefit of our nation and not overseas interests. That's different to projects that may have Australian supply chain input but with ultimate control resting elsewhere.

As an organisation we can mobilise, develop a plan and then execute quickly to deliver sovereign capability.

We see the GWEO enterprise as an important ambition for our nation in these challenging times and we are determined to ensure that the AMC can take that government vision and turn it into a true

Nineteen years later, in 2015, the MK47 lightweight automatic grenade launcher (LWAGL) became our first prime contract under the LAND 40-2 project.



Australian Army soldiers from the 6th Battalion, Royal Australian Regiment fire an Automatic Grenade Launcher during a live-fire defence serial during Exercise Diamond Walk at Shoalwater Bay, Queensland. Credit: CoA / Jason Hilton



Soldiers from the 2nd/14th Light Horse Regiment (Queensland Mounted Infantry) conduct a live-fire training serial with an Australian Army Boxer Combat Reconnaissance Vehicle at Townsville Field Training Area, Queensland. Credit: Coa / Nicole Dorrett

Our projects are controlled in Australia with every decision made for the benefit of our nation and not overseas interests. That's different to projects that may have Australian supply chain input but with ultimate control resting elsewhere.

sovereign capability that will benefit the nation for decades to come and, most importantly, to ensure Australia can defend itself and our national interests.

The AMC is and always will be Australian.

Q: Do you think there is scope for more than one strategic partner;

A: Ultimately, our goal is to deliver the best possible capability for the ADF. If working with a partner such as Raytheon means guaranteeing that capability, then absolutely yes we are open to that possibility.

Q: In the event that you are successful, how will you be able to ensure that all of your AMC members cooperate and transfer/release their IP.

A: As Australia's biggest supplier of weapons and munitions to the ADF, law enforcement agencies and the commercial sector, NIOA deals in sensitive information and closely protects not only its own IP but that of our partners and suppliers.

The appointment of an Australian strategic GWE0 Enterprise partner is intended to provide a wholly Australian spine upon which to base local manufacture of some of the most advanced systems

in production anywhere in the world.

The new model recognises that most of these systems will originate from Government and large defence companies in the US and UK so the enterprise partnership must be capable of trusted cooperation with both government and global defence primes and their supply chains.

But true sovereignty requires more than simple assembly of parts from overseas. Defence will expect the strategic partner to securely hold IP from a variety of technology providers and to identify and develop domestic manufacturing and coding capability to ensure a growing proportion of guided weapon and explosive ordnance production is truly Australian.

Our approach will see the most advanced physical infrastructure integrated with the most sophisticated ICT infrastructure to ensure the working environment is tiered but also highly secure.

NIOA has a proven ability to work collaboratively with both international and domestic defence industry organisations, we have demonstrated that we can quickly scale up to create modern, efficient manufacturing and management structures.

Kym: Thank you for your time

CHAIRMAN OF THE AUSTRALIAN MISSILE CORPORATION ADVISORY BOARD AND FORMER DEFENCE MINISTER CHRISTOPHER PYNE SAID:

"Robert Nioa has seen with clarity the opportunity presented to Australian industry to take advantage of two things – a massive increase in Australian Government defence spending since 2015 and a new focus on sovereign defence industry capability by the ADF and Russell Hill.

"The difference between Robert Nioa and many others in the Australian defence industry is that, rather than waiting for government to do everything for him, he has put Nioa and the AMC in a position to contribute by investing in plant, people and infrastructure. Nioa has built a munitions manufacturing plant at Maryborough, moved into Benalla, opened offices in Canberra and Melbourne, expanded their infrastructure in Brisbane and pursued contracts with single minded purpose.

"Critically, Robert Nioa gets that defence industry is part of the national security of Australia. In the Indo Pacific now presented to us through the actions of other countries, we must be able to defend ourselves in the event that we are cut off from our great and powerful ally in the USA. If every rivet is a bullet, then every weapon and every munition is as much part of defending Australia as the men and women who carry those weapons and munitions. They must be the best in the world. Robert Nioa is committed to nothing less."

GEOFF SLOCOMBE // VICTORIA

ANTI-DRONE TECHNOLOGIES

Uncrewed Aerial Systems (UAS) are more popularly known as drones, whether they are helicopters, quadcopters or small fixed wing aircraft. Strictly speaking, UAS is the entire system that supports the aircraft. That system includes the aircraft, the ground control station, communications systems, information analysis, maintenance, logistics and other support facilities.

Lockheed Martin ATHENA anti-drone laser. Credit: Lockheed Martin



However, the term drone is usually restricted to small systems used by Navy and Army rather than the larger systems coming into service with the Air Force. A Remotely Piloted Aircraft (RPA) is an actual large aircraft, flown by qualified pilots from a ground control station.

In Australian Defence Force (ADF) service, uncrewed aircraft range from the tiny PD-100 Black Hornet Nano helicopter which weighs only 18 grams and is carried by a soldier, being likened to a flying pair of binoculars, to the Air Force's future RPA MQ-4 Triton UAS which has a wingspan of 39.9 metres, weighs 14,628 kg and an endurance of 24+ hours.

A common characteristic of all UAS is that their flying operations are controlled from the ground by radio signals. This gives an immediate clue as to the usual type of anti-drone technology which is being adopted by the armed forces in many countries.

The choices are mainly to take over or interrupt the ground to air radio signal so that the UAS is unable to continue in its mission. There are also some high-power microwave and laser systems which have

been developed and tested overseas.

One of the main challenges for anti-drone weapons is the scalability of their solution. For example, a single drone performing a surveillance mission is much easier to neutralize than a swarm of attack drones. But of course, the targeted drone must be detected and identified. This is the role of counter-drone sensors.

So, when describing anti-drone technology, detection and identification of drone type and model is as important as the weapons used to block the drone's controlling signals and to initiate counteraction.

APDR has been unable to establish from Defence any formal project to develop anti-drone technology. (Editor: because they don't exist)

DRONES IN AUSTRALIAN DEFENCE FORCE SERVICE

The Royal Australian Navy has 822X Squadron, located at the Fleet Air Arm base, Nowra. Part of this Squadron's roles is to investigate and test UAS. This

is their written description of what they do.

The core role of tactical UAS is Intelligence, Surveillance and Reconnaissance.

Presently, high quality video and still imagery is provided to the operator in near real-time significantly improving battlespace awareness.

In a Naval context, UAS may undertake roles that contribute to tasks such as:

- Surface Warfare
- Amphibious Warfare
- Anti-Submarine Warfare
- Fire Support
- Search and Rescue
- Humanitarian Assistance and Disaster Relief
- Interdiction Operations
- Force Protection

APDR has added that 822X Squadron has been extensively investigating the capabilities of both Schiebel S-100 Camcopter and ScanEagle fixed wing drones. This has been carried out both at Nowra and from the decks of several RAN vessels. Being a quadcopter, the S-100 can take off and land directly on the deck. The ScanEagle is catapult launched, then rather ingeniously recaptured using a Skyhook Recovery System.

APDR has been unable to find any information which describes what Navy are doing in anti-drone technology. They will be well aware of the Australian DroneShield products for detecting and classifying drones.

One suspects that Navy's only plans are to shoot adversary drones out of the sky – if they are even able to detect and track them.

The Australian Army's drones are a mix of sizes and capabilities. The Black Hornet already mentioned is like a tiny hand-held helicopter which can be used by a soldier to inspect the ground and an adversary's forces within the next kilometre or so using the drone's video camera.

Army's 1.3kg RQ-12 AeroVironment Wasp AE, typically flown about 200 metres above the ground, is more like a remotely controlled fixed wing model aircraft. It has a longer range than the Black Hornet, a maximum speed of 83 km/h, and also the ability to transmit or record video back to its operator.

It is hand-launched by throwing it into the air and is recovered by lowering its airspeed until it stalls nearby.

The Army's website carries this description of their RQ-7B Shadow 200. 'The SHADOW 200 carries a suite of high-resolution cameras above patrolling troops to provide detailed information about activities on the ground.

'The air vehicles are rail-launched and have a 16' wingspan, a gross weight of 208 kilograms, and are powered by a 29 kilowatt rotary engine.'

A collaboration between RAAF's Air Warfare Centre and the Defence Science and Technology Group (DSTG) has culminated in the creation of a drone detection system. The Windtalker, designed and created at DSTG Edinburgh, is a real-time sensor that can monitor airspace for uncrewed aerial vehicle activity and then stimulate algorithms for the purposes of detection, recognition and decision-making.

DRONESHIELD UNITS PURCHASED BY THE AUSTRALIAN ARMY

Australian company DroneShield Ltd, in a mid-2019 media release, advised that it had sold a quantity of its RfOne MKII long-range sensors to the Australian Army.

This capability was being delivered immediately to allow it to assess its future counter-drone requirements and options.

The deployment of these long-range sensors will highlight the flexibility, resilience, and capabilities of DroneShield equipment in a dynamic field environment, while also assisting the Army in establishing its counter drone requirements and future capability options. The sale was structured as a one-off, and - similar to the standard purchases from DroneShield's other defence and law enforcement customers, comprises a small purchase of equipment.

Oleg Vornik, DroneShield CEO, commented:

"As an Australian company, DroneShield is immensely proud to support the Australian Army with its long-range counter-drone strategy."

The DroneGun. Operated by one individual, is a more portable anti-drone technology developed by DroneShield, with an approach that is surprisingly non-destructive.

Using electromagnetic interference, the DroneGun jams the signal between the drone pilots and its remote controller at distances up to 2 kilometres. This can either initiate the drone's return-to-home function or force it to land gently to the ground.

Keeping the drone intact is the goal of the DroneGun, as it aids in investigation and in locating

the responsible drone pilot.

As APDR was going to press DroneShield announced it is extending its C-UAS thermal imaging sensing technology, which has developed and applied its powerful AI and machine learning software algorithms via radiofrequency sensing and computer vision technologies.

Another system currently being tested is from Canberra-based EOS, which combines an autocannon, high powered laser, radar, ESM system and electro-optic sensor into a product called Titanis. The company has a great deal of experience in developing stabilised systems, evident in the wide range of remote weapons stations (RWS) it has sold. It has combined this with in-house data fusion and command and control systems to develop a fully integrated counter-UAS solution.

A common characteristic of all UAS is that their flying operations are controlled from the ground by radio signals. This gives an immediate clue as to the usual type of anti-drone technology which is being adopted by the armed forces in many countries.

It currently uses a powerful 35 kilowatt laser, but with the rate of technological development believes this will increase further with time. The RWS can incorporate everything from a machinegun to a 30mm cannon – and potentially even larger weapons. The individual elements of the system are small enough so that they could eventually be mounted on something like a Boxer 8x8 or future Infantry Fighting Vehicle to give the Army a mobile C-UAS capability.

LEONARDO ANTI-DRONE TECHNOLOGIES

Leonardo offers mature C-UAS systems that have been proven globally, with demonstrated effective performance in high visibility, 'no fail' missions.

They have been involved in counter-drone work since the London Olympics 2012, when the company loaned equipment to support Civil UK C-UAS. They subsequently launched Falcon Shield, a complete detect-track-identify-defeat system onto the market in September 2015.

This leading Italian company has now delivered four complete baseline ORCUS counter-drone systems to the Royal Air Force in support of its C-UAS research and development program.

Leonardo has provided complete counter drone solutions to the Italian Armed Forces in the form of the CON-DoR C-UAS family. Currently several

systems are available for use by the Italian Armed Forces and they have been recently operationally deployed to protect international events in urban environments.

Leonardo tends not to provide a specific product, rather its C-UAS systems are modular and scalable and built around a common architecture with a customer's specific mission in mind. What we can say is that Leonardo provides 'families of systems'.

Their Falcon Shield system provides a proven means of protection for airfields, critical infrastructure and borders. Its multiple detection sensors, AI-enabled EO/IR tracking and target discrimination and precision and long-range electronic warfare defeat capability is built for reduced reliance on the operator. The open architecture allows for ease of integration or customisation.

USA ANTI-DRONE TECHNOLOGIES

Four years ago, Raytheon gave the first demonstration of its high-power microwave and laser anti-drone capabilities. During the experiment, the two dune-buggy mounted systems knocked down 45 unmanned aerial vehicles and drones. The high-power microwave system engaged multiple UAV swarms and downed 33 drones.

The accompanying high energy laser system identified, tracked, engaged and killed 12 airborne, manoeuvring Class I and II UAVs, and destroyed six stationary mortar projectiles.

Late in 2019 Lockheed Martin demonstrated their laser weapon system when the system successfully engaged and shot down multiple fixed wing and rotary drones.

Their Advanced Test High Energy Asset (ATHENA) operated in a fully-netted engagement environment with a government command and control (C2) system and radar sensor. The radar track was provided to airmen who operated ATHENA via cues from the C2, then ATHENA's beam director slewed, acquired, tracked and defeated the drone with a high-energy laser.

Validating this type of full kill-chain performance has been a priority of the U.S. Air Force and other branches of the Department of Defense and it remains a requirement for laser weapons to be

effective against UAS on the battlefield.

The ATHENA high-energy laser system is transportable and therefore enables the Air Force to emplace it anywhere they need to defend bases and high-value assets.

Based on Lockheed Martin's decades of expertise in high-powered microwave technology, MORFIUS – a reusable, high-power microwave-based interceptor for C-UAS and C-swarm scenarios.

MORFIUS's compact airborne system provides extended range and an onboard seeker to help relieve sensor requirements for expeditionary systems, allowing it to be compatible with various defence service architectures.

OTHER ANTI-DRONE TECHNOLOGIES

SkyFence, developed by UK firms Drone Defense and Eclipse Digital Solutions, is a system composed several signal disruptors placed around a perimeter. This effectively creates an invisible fence that can

jam the signal that a drone uses to communicate with its pilot. Depending on the program of the drone, this can initiate the drone's return-to-home function and allow law enforcers to apprehend the offending drone pilot.

The SkyWall 100 takes a more back-to-basics approach. Developed by a team of UK-based engineers, it shoots out a net which can wrap around a renegade drone its propellers, eventually bringing it down.

A shoulder-mounted device that resembles a bazooka, the SkyWall 100 uses compressed air to fire off a net and bring down an enemy drone. The net can reach a drone up to 100 metres away and does a good job of keeping the drone intact for further investigation.

The DroneCatcher was manufactured and released by Dutch firm Delft Dynamics in 2017. This technology is focused on retrieving a renegade drone without damaging it, thus preserving any incriminating evidence. It is a quadcopter that can shoot out a net to catch other drones from 20 metres

away. To aid it in tracking a renegade drone, the DroneCatcher features an array of radar, vision, and acoustic sensors.

Rafael Advanced Defence Systems, the Israel Missile Defence Organisation, and the IDF have completed a successful series of live-fire tests of the 'C-Dome' system – an advanced naval configuration of the Iron Dome defence system. The test campaign consisted of a number of scenarios simulating advanced threats, including rockets, cruise missiles and UAVs. The 'C-Dome' proved capable of successfully intercepting such threats.

Thales has announced that it will manage the Geosafe project, which aims to establish state-of-the-art geofencing solutions for UAS as part of the European Commission U-space initiative.

By securing the flight pattern of drones to avoid determined zones, geofencing solutions are key safety enablers. They are mandatory to ensure that drones do not fly in protected perimeters around critical infrastructures, such as power plants or airports.

SINGAPORE AIR SHOW

Kym Bergmann / Singapore

As one would expect at a major air show with a lot of drone technology on show, various countermeasures were also being exhibited. Within the limits of time, APDR was able to have a look at two of the most prominent.

Thales is a world leader in radar, air traffic management and air defence systems. We had the opportunity to discuss the growing threat posed by UAS with Christophe Saloman, Executive Vice President of the Land and Air Systems, who said:

"Thales has a strong background in air defence, mainly linked to expertise in defeating ballistic missiles, as well as cruise missiles and other threats. From that, we have worked up various counter-UAV solutions. There are several factors:

"The company has a large number of radars in service around the world – some specifically for drones and many others are much larger and longer range. Also we have optronic systems – cameras and so on that, for example, can discriminate between a drone and a bird. We can also detect the control signals for the drones."

Once a drone – or swarms of them – have been detected and classified as hostile, they can be countered with a variety of hard and soft kill systems that Thales can supply. The former can be missiles or guns firing proximity fused ammunition or directed energy systems; the latter a variety of jammers.

Thales works with other companies such as Nexter for the supply of rapid firing gun systems, but also has many in house capabilities such as fuses. Accurate fusing is a key ingredient to an effective solution, enabling a number of rounds to explode simultaneously around or in front of a target, ensuring its destruction. The company also has Starstreak in its portfolio – the fastest short range air defence missile in the world. In addition, it has developed a small rocket powered system that can capture drones in a net, rendering them harmless.

The company has an electromagnetic weapon in service with the French armed forces that jams the control signal for drones – and a number of in-house laser projects. Work is also underway on how to conduct cyber attacks on UAVs.

To make sensors and effectors work together, Thales also produces C2 systems that are found within the air defence portfolio. The company is marketing a variety of integrated solutions of different ranges, including Eagle Shield and Force Shield – the latter having been purchased in the region by Malaysia and Indonesia. All solutions can be tailored for the needs of individual customers and to counter evolving threats.

Mr Saloman mentioned that Thales is working on a related domain – air traffic control systems for commercial drones. This is an emerging need with companies such as UPS and Amazon Prime

envisage a future where thousands – potentially hundreds of thousands – of small parcel delivery drones are whizzing everywhere and will somehow need to be coordinated otherwise there will be total anarchy. The company is also waiting on a decision for a contract to protect the 2024 Paris Olympic Games from drones – and the task is made more complex by the need not to destroy friendly drones, such as those carrying tv cameras.

Also on display was the Drone Dome system from Israeli company Rafael. This is complementary to larger systems such as Iron Dome and C-Dome (see main article) and is a self-contained deployable off-the-shelf solution. It comprises a tripod-mounted combination jammer, laser and electro-optic sensor, with separate phased array radars from Rada and a SIGINT antenna. The system can be deployed near critical infrastructure and the individual elements are small enough for all of them to be mounted on a vehicle.

Israel has a great deal of experience in countering unconventional threats and Rafael has been at the forefront of developing appropriate responses. The combat proven Drone Dome can handle multiple engagements over 360 degrees and out to 3.5km, with the laser unit able to be tilted to the vertical to counter threats from directly overhead. The company displayed several quadcopters with holes burnt in them from several hundred metres.

KYM BERGMANN // CANBERRA

ARMY AVIATION TRANSITIONING FROM EUROPEAN TO U.S. HELICOPTERS

The quick summary is that the ADF will spend more than \$10.5 billion in the next few years moving from the Tiger ARH and Taipan MRH to Apache AH-64Es and Blackhawk UH-60Ms. An unkind assessment is that the Army are in the process of replacing perfectly good helicopters with a lot of life left in them for older generation machines for reasons that are sometimes opaque and that have never been adequately debated in public, or in Parliament.



Australian Army soldiers from 176th Air Dispatch Squadron conduct an external lift training activity with a Royal Australian Navy MRH-90 Taipan helicopter. Credit: CoA / Jack Brock

The series of decisions were rolled out last year. On July 3, Congress was notified of a possible sale to Australia of 29 AH-64Es and associated spares and equipment at a cost of US \$3.5 billion that will replace 22 Tigers. Then on October 8, there was a similar notification of 12 MH-60Rs to replace the RAN's six Taipans – admittedly with a formidable anti-submarine warfare capability added to the mix. The on December 10, Defence Minister Dutton announced that 40 UH-60 Blackhawks would replace an identical number of Taipans in service with the Army.

All of these decisions have taken place without a competition, or even a tender. That's \$10.5 billion awarded sole source to U.S. companies, with zero Australian content – though they will be supported locally. On top of that, the U.S. is a decade

will be around \$3 billion. This is also supported by MH-60R pricing, which includes extra electronics such as a dipping sonar and extra data link, but is nevertheless identical in most other respects to a UH-60M. The decision to acquire more Blackhawks was announced on the day when the last of the original fleet, ordered in 1986, retired from service.

Justifying the purchase of new Blackhawks, Minister Dutton said:

“The MRH90 helicopter fleet has not met contracted availability requirements nor the expected cost of ownership ahead of its planned withdrawal from service in 2037.”

Indeed, there have been problems with Taipan fleet but the difficulty we all have is that sorting out fact from fiction is not helped by Defence never revealing how it calculates critical numbers, such as the cost per flight hour. Taipans have always looked expensive, but the figure sometimes used by Defence of \$38,000 per hour is extraordinarily high and presumably factors in elements such as pilot training and future upgrades. For all the outside world knows it might even include the daily cost of paying for security guards at whatever facility houses them.

While the cost of the Blackhawks is not known – Congress does not yet appear to have been notified of a Foreign Military Sales request – data from other international programs indicates that the bill will be around \$3 billion.

away from fielding new generation helicopter family under the massive Future Vertical Lift program, so the timing for buying Apaches and Blackhawks designed in the 1970s could hardly be worse.

While the cost of the Blackhawks is not known – Congress does not yet appear to have been notified of a Foreign Military Sales request – data from other international programs indicates that the bill

Australia is one of 15 countries to have purchased these helicopters – generically known as the NH90 (NATO Helicopter 90) – and appears to be the only user dissatisfied enough to get rid of the entire fleet. In the following article in this edition we look at the case of New Zealand, who seem happy with theirs. Other users have certainly had their problems – which can occur in the first of class of anything –

but are battling on and crucially are ordering more of them from Airbus. More than 500 have been built to date.

For example, there have been some issues highlighted about the door mounted machinegun for Special Forces operations. This is because the door on a Taipan is slightly narrower than that on a Blackhawk, which can make a difference when soldiers climb in and out with full kit. In response Airbus have made repeated modifications to it according to customer specifications, all of which have subsequently deemed to be inadequate. The company has also offered a window-mounted machinegun that would solve the problem, but Army has never taken them up on it.

The RAN seems to have been comfortable operating Taipans in a utility helicopter role, but they are part of Army's overall pool rather than a separate fleet. In any case the deal of replacing them with 12 MH-60Rs is an attractive one – even though there aren't enough ships in the inventory to make good use of them. Until the Hunter class are available at an indeterminate point in the 2030s, the only combatants than can embark what will be a total of 36 MH-60Rs are 3 Hobart class Air Warfare Destroyers and 8 ageing ANZAC frigates.

When people watch the nightly news and see images of Taipans hovering and winching people out of floodwaters or delivering supplies to volcano devastated Tonga or performing ship to shore missions during Operation Bushfire Assist, they might be entitled to wonder why Australia is getting rid of the entire fleet almost two decades before they run out of life. Even if there are compelling reasons to buy UH-60Ms, why not keep both fleets in service? It's not as if the ADF lacks the money.

There is also a precedent with RAAF's fleet of 10 C-27J Spartan tactical transport aircraft. For reasons different from the helicopters – the deficiencies are to do with electronic warfare self-protection – they can never be deployed for combat operations, but that doesn't mean that Australia is getting rid of them. What the RAAF seems to have realised is that with the international outlook deteriorating, you can't have too many capable transport aircraft. The same can be said of helicopters.

In previous issues discussing the situation with the Tiger replacement, which seems to be another case of taking a perfectly good capability – initially with a lot of teething problems – and getting rid of it because of emotions rather than facts. As formidable as the AH-64E is, it is an older design that has the same weapon load as Tiger but is heavier and with shorter range because of its greater weight. Even if Army is determined to buy U.S. helicopters there is



An Australian Army ARH Tiger from the 1st Aviation Regiment flies over the desert at Arizona, USA. Credit: CoA / Gavin Partridge

Finally, rumours abound that the Special Forces Support Helicopter Project – LAND 2097 Phase 4 – is likely to be scrapped. Like many ideas of adapting commercial platforms for military use, these seem like great ideas in the beginning but can become the subject of considerable cost escalation once factors such as 24/7 availability are priced into the equation.

no logical reason why Tigers could not also be kept in service alongside them, basically doubling Army's attack helicopter fleet.

It's a happier story regarding the Chinook CH-47F fleet, which has no direct competitor in the western world. These distinctive twin-rotor machines have been around since 1961, albeit constantly upgraded and modernised. Australia currently has 12 of these most recent variants and the number will increase to 14 in the near future. The entire fleet is supported by Boeing Defence Australia in Townsville with around 37 fulltime technicians and specialists on site.

The F-models for Australia differ only slightly from US Army aircraft, mainly by the installation of a rotor

brake – an important safety feature for when they deploy at sea on the Canberra class LHDs. For the last three aircraft that modification was incorporated in Townsville. Their acquisition was performed in record time by CASG.

Finally, rumours abound that the Special Forces Support Helicopter Project – LAND 2097 Phase 4 – is likely to be scrapped. Like many ideas of adapting commercial platforms for military use, these seem like great ideas in the beginning but can become the subject of considerable cost escalation once factors such as 24/7 availability are priced into the equation. With more Blackhawks on the way, these might be more than sufficient for future needs.

NZDF EXPERIENCE WITH NH90 HELICOPTERS

After some initial problems, the Royal New Zealand Air Force (RNZAF) has become the first air force user to have any of their NH90s reach 2,000 hours flight time, while also now being highly satisfied with their performance. The NH90 helicopter, operated by No 3 Squadron, at Ohakea Air Base on the North Island, enables the RNZAF to fulfill a wide range of operational commitments ranging from humanitarian aid and land warfare to close cooperation with Navy ships.

*Dismounted soldiers move away from their landing zone.
Credit: NZDF*



The RNZAF retired its fleet of UH-1H Iroquois in 2015 and now operates eight NH90s. It was looking for a very versatile helicopter and that is exactly what it found with the medium lift TTH (Tactical Transport Helicopter) variant of the NH90.

This is the same variant as chosen by the Australian Defence Force, where it has been called the MRH-90 Taipan. Unfortunate serviceability and configuration experiences have led the ADF to plan abandoning their 46 Taipans and replacing them with new Black Hawks and Seahawks imported from the United States.

The RNZAF took delivery of the first two NH-90 helicopters on 18th January 2012. The helicopters were flown in by a Russian Antonov plane and moved to the new hangar facility at Ohakea. It welcomed the delivery of its eighth and last NH90 helicopter at Base Ohakea on 30th October 2014.

The aircraft purchased for the RNZAF are few in number, but their versatility enables them to handle a wide range of missions, from traditional military operations to support for different government agencies, including search and rescue as well as maritime operations. In the latter case this is with the NH90 embarked on the New Zealand Navy's multi-role vessel, HMNZS Canterbury. This ship can transport up to 4 NH90s internally in its Hangar Deck.

Since introduction, RNZAF NH90s have been involved in a wide range of responses to challenges arising in our region and domestically. Examples of this include responding to a number of tropical cyclones in the South West Pacific and most recently to the volcanic eruption and tsunami in Tonga.

RNZAF NH90s have conducted several successful Search and Rescue missions in New Zealand and have responded to disasters such

as the Kaikoura earthquake, Canterbury floods, Australian bushfires and White Island eruption.

After two NH90s were transported by HMNZS Canterbury to Tonga recently, APDR asked how far south of NZ have NH90s been transported then flown? An RNZAF spokesperson said:

"The furthest south NH90s have been operated by the RNZAF is the Campbell Islands. An NH90 was transported by and operated off HMNZS Canterbury in support of the Department of Conservation in 2019."

The Campbell Islands are located at 52.4 degrees south latitude, some 360 nautical miles south of New Zealand's South Island.

The Air Force's early experiences with their first NH90s led them to conclude that these aircraft were not at a mature stage of their development and caused some anxious moments as the first arrivals were being put through their paces. An RNZAF spokesperson told APDR that:

"RNZAF NH90 Capability Release was achieved through the issue of a series of airworthiness instruments including a Special Flight Permit (SFP), Interim Type Certificate (ITC) and Type Certificate (TC).

"The first SFP was issued on 10 February 2012 to allow initial developmental flying in New Zealand. An ITC was first issued on 4 February 2013 which released a limited capability and then subsequent ITCs were released as the capability was expanded.

"A TC for the NH90 was issued on 4 April 2019 which is equivalent to Full Operating Release."

A SENIOR OFFICER'S VIEWS ON NEW ZEALAND'S NH90 EXPERIENCES

APDR approached the NZDF's Air Component Commander, Air Commodore Shaun Sexton for his views on local experience with the NH90s. He told us that:

"New Zealand has adopted an agile and innovative approach to operating and supporting



NH90 training exercise. Credit: NZDF

NH90 operations while remaining cognisant of 'best practice' from overseas operators.

"An example of this has been working with Canadian aerospace and defence technology company CAE to acquire an NH90 Flight Training Device (FTD). The FTD blends cutting edge simulation technology with software and data packs leveraged off ADF MRH-90 Full Flight and Mission Simulators.

"Introduction of the NH90 has prompted the need for fresh thinking rather than relying on legacy practices. The RNZAF has adapted aspects of its structure to accommodate the different maintenance requirements of the NH90. For example, a blended civil/military workforce was introduced to conduct deeper level maintenance. This blended workforce comprises military technical personnel working alongside contracted personnel from Airbus.

"While lacking economies of scale, the RNZAF tries to offset this disadvantage through targeting and cultivating key relationships with Industry and our Defence partners to leverage cost effective outcomes for New Zealand's national interest."

CONTACT BETWEEN THE RNZAF AND OTHER NH90 USERS

As the operator of a relatively small fleet, the RNZAF has a keen interest in leveraging information sharing from other operators of the NH90. New Zealand is a participant in the NATO Helicopter Management Agency (NAHEMA) and maintains close contact with other nations operating the NH90 through various user groupings.

New Zealand also maintains a small resident team located in France to help facilitate NH90 through-life-support. New Zealand has close linkages with the ADF including having ADF aircrew (2 Pilots and 2 Helicopter Load Masters) currently on exchange flying the NH90 in New Zealand.

MOVING TO AND FROM OPERATIONAL AREAS

For operations within New Zealand the Air Force's NH90s can fly there directly. Of particular note is the fact that they can and do operate in New Zealand's extensive snow-clad mountain ranges both on exercises and also search and rescue missions.

To move them overseas and back home by air, larger aircraft are required than the RNZAF's current C-130H(NZ) or their C-130J aircraft which start to arrive on 2023.

For example, in January 2020 when the RNZAF deployed three NH90 TTH helicopters and roughly 80 additional NZDF personnel to Australia to provide support in the fight against the country's ongoing bushfires, the helicopters required larger RAAF aircraft.

The NZDF personnel were transported from RNZAF Ohakea Base in New Zealand to Base Richmond, NSW by an RNZAF Lockheed C-130H(NZ) Hercules. The helicopters required three flights of RAAF Boeing C-17A Globemaster III aircraft.

The helicopters return to their Ohakea Base was by three flights across the Tasman in Royal Canadian Air Force CC-177 Globemasters.

As already mentioned, the Navy's multi-role vessel, HMNZS Canterbury, can transport up to 4 NH90s internally in its Hangar Deck. Unloading and/or reloading can be done by flying the NH90s off or onto this vessel's flight deck, at approximately one-hour intervals.



NH90 getting a lift to Australian bushfires in an RAAF Globemaster. Credit: NZDF

MAINTAINING THE RNZAF'S NH90S

There was some very innovative thinking in the New Zealand Ministry of Defence when ordering the eight NH90s and formulating a spares order.

They decided to order a ninth helicopter purely for parts. This was delivered to New Zealand as a package of sub-assemblies that were then further disassembled into spares.

The initial acquisition spares package was sized to take this into account – therefore it can be considered that the ninth aircraft was absorbed into the general spares pool and never an aircraft per se.

The RNZAF does not differentiate between spares sourced from the ninth aircraft compared to those purchased during acquisition or through routine in-service logistics ordering processes.

Through the ninth aircraft, the RNZAF gained some components which would not normally be included in a Recommended Spare Parts List (RSPL) which has proved to be very useful.



This landing is not for the faint-hearted. Credit: NZDF

IN CONCLUSION

After the first delivery of RNZAF's NH90 helicopters, there was a lot of critical commentary on the decision to acquire these aircraft which were not fully developed.

This was particularly evident in written commentary on a 2012 Defence Force report by then Auditor-General Lyn Provost which stated:

"Eight new \$700 million air force helicopters have a serious flaw that even when fixed will prevent use in snowy conditions.

"The Royal New Zealand Air Force is the first military force to use the high technology NH-90s. This country should not be buying "first of type" equipment."

Provost says in her report that no other air force was using them when they were commissioned, although she said 16 countries now have orders in for 500 NH-90s.

Fortunately, the ingenuity and clear thinking by Defence planners and personnel overcame the initial problems to provide the RNZAF and the New Zealand Government with a first-class set of helicopters which now meet every operational challenge successfully.

'MILITARY QUANTUM TECHNOLOGIES - WHY ARE THEY IMPORTANT?'

The 15 September 2021 joint AUKUS announcement by the leaders of Australia, United Kingdom and United States included this paragraph 'Recognizing our deep defense ties, built over decades, today we also embark on further trilateral collaboration under AUKUS to enhance our joint capabilities and interoperability. These initial efforts will focus on cyber capabilities, artificial intelligence, quantum technologies, and additional undersea capabilities.'

The primary quantum technologies (the application of quantum physics into real-life applications) could give the three nations' militaries a distinct advantage over other countries when it comes to remote navigation, stealth, and intelligence.

The integration of quantum technologies currently represents one of the most anticipated advances for armed forces, yet their precise impact remains difficult to predict. Although economic applications are now increasing, there is little doubt that they will have a disruptive effect when they are employed more widely.

In May 2018, the head of quantum computing at technology firm Intel suggested that 'if 10 years from now we have a quantum computer with a few thousand qubits, that would certainly change the world in the same way the first microprocessor did'. (A qubit, or quantum bit, is the basic unit of information in a quantum computer, analogous to a bit in a standard computer.)

Quantum technologies are leveraged by the vibrant quantum science, technology and innovation capability across Australia to develop technology solutions of relevance to Defence. Through partnership with industry, academia and government research agencies, Defence aims to understand the potential of quantum technologies, create prototype systems, and demonstrate the practical application of quantum systems to Defence problems.

Quantum technology includes military applications in metrology, simulation, imaging, sensing, timing, stealth, computing, weapons, communications, data encryption and breaking encrypted messages.

The trouble with quantum technologies is that they seem impenetrable, improbable and impractical. This article is not the place for detailed explanations, but a good reference 'Quantum Technology: an Introduction' has been placed on line by the Australian Army Research Centre and can be found at [https://researchcentre.army.gov.](https://researchcentre.army.gov.au/library/land-power-forum/quantum-technology-introduction)

[au/library/land-power-forum/quantum-technology-introduction](https://researchcentre.army.gov.au/library/land-power-forum/quantum-technology-introduction).

In fact, the Australian Army has a leadership position in seeking out quantum technology which they need to stay ahead of potential adversaries. Their Quantum Technology Challenge 2022 has been released. Its Demonstration Day has been scheduled for 11 August 2022 and will be held in conjunction with the Army Innovation Day and the Chief of Army's Symposium at the Adelaide Convention Centre. The Challenge themes are:

- Locating electromagnetic emitters in the battlespace: Can quantum sensors detect, locate and identify electromagnetic emitters with greater precision, range and bandwidth, whilst reducing (or at least not increasing) detector size, weight and power?
- Identifying threats and critical information in signals and images: Can quantum computers identify and classify features in signals and images more precisely and efficiently?
- Securing our communications against quantum computers: Can post-quantum cryptography be practically employed to secure communications from the growing threat of quantum computers?

The Challenges see teams of Australia's world-leading quantum scientists and engineers competing to show how quantum technologies can solve important Army problems and deliver unprecedented capabilities. Teams undergo an initial selection process. After which, the selected teams are awarded seed funding and have six months to develop their solutions before demonstrating and pitching them at the Demonstration Day. The pitches and demonstrations are evaluated on Demonstration Day by an expert panel, drawn from across Defence and industry.

The top-ranked teams are then invited to submit proposals for the further development and evaluation of their solution over the subsequent 1-2 years.

AUSTRALIAN PROGRESS IN QUANTUM TECHNOLOGY RESEARCH

What are the current efforts of Australian Defence in quantum technology, apart from Army's Quantum Challenges just mentioned?

Military quantum technology research is led by the Defence Science and Technology Group (DSTG). Their main efforts are distributed across the key quantum technology streams of quantum sensing, quantum communications, quantum computing, and timing (atomic clocks).

Quantum technologies is a priority theme of the Next Generation Technologies Fund, aimed at realising the potential game changing capabilities afforded by developments in this domain. It recognises the need for Defence to respond to this technology opportunity, and that technological advances in the quantum domain are likely to lead to the introduction of new capabilities in our region.

The goal of the Australia's Quantum Technologies Research Network is to inform Defence of the potential benefits and practical limitations of quantum technologies through studies and demonstrator systems within three years.

A typical research teaming approach includes this Request for Proposals, published on the Austender website, which closed on 25 October 2021:

"The DSTG Quantum Research Network (QRN), under the Next Generation Technologies Fund, is seeking submissions in the area of Precision & Quantum Sensing (PQS). We will contribute funding and support innovative proposals from industry, academia and Government-Funded Organisations (GFO) which identify and pursue PQS S&T areas critical for future Australian Defence capability. This new call seeks to build upon the successful outcomes of the first round of Quantum Research Network (QRN) investment, and to identify new partnering opportunities at the intersection of quantum technology and precision sensing.

“S&T proposals are sought in the field of PQS technologies and systems, applicable to one or more of the following broad focus areas:

1. Precision sensing for undersea surveillance (Particularly magnetic field sensing)
2. Quantum enabled precision, navigation and timing
3. Other applications of precision quantum sensing technologies relevant to defence innovation priorities e.g. Enhanced Human Performance, CBRN (Chemical, Biological, Radiological and Nuclear).

“The NGTF Advanced Sensors Priority Theme is particularly aligned to the RUS (Remote Undersea Surveillance) STaR Shot. A key priority is to build sovereign capability in strategic sensor technologies that will assist in addressing the challenge of establishing a remote undersea surveillance network.”

In potentially ground-breaking quantum research, scientists from Defence, RMIT University, and the universities of Adelaide, Melbourne, and South Australia announced recently they have had a major breakthrough in their quest to combine diamond with glass to create a new quantum sensor.

This promising research could enable the creation of low-cost sensor networks of enormous benefit not only to Defence, but areas such as mineral exploration or even brain scanning.

On 17 January 2022 a University of Melbourne-led team announced that quantum computers could be constructed cheaply and reliably using a new technique perfected by them. They have found a way to embeds single atoms in silicon wafers, one-by-one, mirroring methods used to build conventional devices.

The new technique – developed by Professor David Jamieson and others from UNSW Sydney, Helmholtz-Zentrum Dresden-Rossendorf, Leibniz Institute of Surface Engineering, and RMIT – can create large scale patterns of counted atoms that are controlled so their quantum states can be manipulated, coupled and read out.

Professor Jamieson said his team’s vision was to use this technique to build a very, very large-scale quantum device:

“We believe we ultimately could make large-scale machines based on single atom quantum bits by using our method and taking advantage of the manufacturing techniques that the semiconductor industry has perfected.”

QUANTUM TECHNOLOGY FOR MILITARY ADVANCEMENT

According to a neutral U.S. third-party congressional research service there are three specific application areas of quantum technology when it comes to

military advancement. These are quantum sensing, quantum computers and quantum communications.

Quantum sensing is a tricky topic to fully understand, as much of the research is still ongoing. It works by using properties of quantum mechanics to beat the current limits of sensor technology. Many times, quantum sensing uses photons or individual atoms to make the technology more cutting edge and more sensitive for accurate data, making it easier to use GPS and other navigation tools in extremely remote areas, where GPS navigation is nearly impossible.

This better sensing could also be used to detect electromagnetic emissions, which would enhance the military’s capability for electronic warfare, the detection of submarines and of stealth aircraft in flight.

Unlike regular computers, quantum computers use specialized pieces to run algorithms and answer extremely difficult mathematics and computer problems at lightning-fast speeds. These computers have many benefits for warfare applications, including better target identification for autonomous weapons.

Quantum cryptanalysis refers to the specific application of quantum computing for decrypting encoded messages. Current encryption standards primarily rely upon mathematical algorithms for encoding data, which are effectively unbreakable in any reasonable period of time. For example, US military-grade, Advanced Encryption Standard 256-bit encryption would theoretically require billions of years for modern computers to crack the code through brute-force methods (i.e., ‘trial-and-error’ of all possible solutions).

Quantum computers, however, will eventually be able to replace sequential trial-and-error methods for processing such complex mathematical problems with alternate means to consider many possibilities simultaneously. The promise of quantum cryptanalysis is so alluring that some countries are already beginning to collect encrypted foreign communications with the expectation that they will be able to extract valuable secrets from that data in the future.

Quantum computers are also effective at running simulations. The military can use these simulations to demonstrate military deployment, possible strategies, and other scenarios to develop better strategies for warfare.

Quantum communications is probably the most important for military applications, because it focuses specifically on encryption. One type of encryption is known as Quantum Key Detection (QKD). QKD works by sharing an encryption key between two people so they both can use the key to decrypt the

encrypted data. QKD can also determine if someone is trying to hack into the encrypted data. This encryption could make all military data and strategies better protected from possible leakage.

Quantum communications has already made its debut in 2021 when China launched the world’s first quantum satellite. Named “Micius,” the satellite, has been able to use QKD to encrypt sensitive information, including a video conference meeting between Beijing and Vienna. With a launch mass of 600kg, it integrates a Sagnac interferometer instrument with a quantum key communicator, quantum entanglement emitter and entanglement source. The spacecraft also includes a processing unit and laser communicator.

Atomic clocks are so precise because they take advantage of the natural vibration frequencies of atoms, which are identical for all atoms of a particular element. These clocks operate at or near the standard quantum limit, a fundamental limit on performance imposed on clocks where the atoms are all independent of each other. The only way to push the clocks past that limit is to achieve entangled states, strange quantum states where the atoms are no longer independent and they become intertwined.

Entangled atoms interact with each other even when physically distant. The improved clocks will allow researchers to ask questions about fundamental physics, and they have applications in improving quantum computing and GPS.

IN CONCLUSION

For at least 15 years this article’s author has been following quantum computer developments by Canadian firm D-Wave Systems. Their computers are running more than 250 solutions including those for manufacturing and logistics, financial services and life sciences amongst others.

Practical quantum computer applications have been developed in the manufacturing and logistics fields ranging from chemistry and materials science, automotive and mobility to supply chain optimisation and logistics.

Quantum computer applications in financial services range from financial modelling, portfolio optimisation, and risk management to fraud detection.

In the life sciences field, there are now applications ranging from drug discovery, clinical development, medical imaging, and early disease detection to genomics.

The D-Wave Systems website has a solutions section available at <https://www.dwavesys.com/learn/featured-applications/> giving access to 189 different non-military subject videos, presentations or papers.



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MATT MEDLEY // GEORGIA, USA

THE THREE DIGITAL DATA THREAD DEVELOPMENTS IN 2022 THAT WILL TRANSFORM DEFENCE LOGISTICS ACROSS LAND, AIR AND SEA

Military organisations and their in-service support partners have made big strides towards using software to manage mission-critical weapon systems and IT infrastructures but data collection, analysis and execution are not advancing at the same pace. It's this data backbone which permeates three key predictions for defence logistics and support in 2022.

It has been well-documented that military operators and defence in-service support providers have modernised their logistics and supply chain processes, accelerated by the pandemic, more connected assets entering operations and the maturity of enabling technologies including augmented/virtual reality, digital twins, 3D printing, AI, among others.

But there is still a digital disconnect at play despite this progress. While tech-enabled workflows, assets and processes have grown rapidly, supporting IT infrastructure has not. The U.S. Government Accountability Office highlighted this in a recent report that cited that the DOD's data collection and IT development was not matching the speed of technological change with mission critical weapon systems.

As the role of IT infrastructure is put under the microscope, it's exactly this data backbone that runs throughout the three key military logistics and support developments to watch out for in 2022 and beyond

1. Ensuring military asset outcomes takes precedence over traditional procurement models – resulting in outcomes-based software growth of over 10%

For equipment procurement and support, in recent years, the military has ascended the so-called 'transformational staircase' out of the scenario of simply buying and maintaining their own assets and equipment. The risk and availability linked with supporting an asset through its military lifecycle has increasingly involved industry assistance from OEMs or military in-service support providers. Now, performance-based logistics (PBL) is the widely accepted



Chief of Navy, Vice Admiral Michael Noonan, AO, RAN stops to check out progress on Nuship Pilbara, during a tour of CIVMEC's shipbuilding facilities, where the Offshore Patrol Vessels are being built in partnership with Lurssen. Credit: CoA / Bradley Darvill

model for the procurement and support of military equipment. PBL strategies work effectively when applied to a specific asset or components but these service-based agreements can even be taken a step further—what is deemed at IFS as “Total Asset Readiness®” in relation to force-wide asset mobilisation and visibility.

This move towards a service-based approach for military asset support is underlined by recent research from Boston Consulting Group (BCG)

who examined the cross-industry shifts towards delivering outcomes and, pinpointed servitisation as “the focus of creating and capturing value shifts from one-time sales to long-term partnerships.” It's therefore no surprise that the BCG report sees the defence sector prioritising the adoption of enterprise asset management (EAM) solutions in the next three years.

My prediction is for the 'next evolution' of asset support to be focused on installing a constant

and transparent framework across the entirety of a military force, connecting the military operator, OEM and in-service support providers. All separate reporting mechanisms and software systems can be consolidated within a single, all-encompassing solution, giving commanders planning operations a real-time image of each asset at their immediate disposal—tracking asset readiness within the context of the mission they need to complete.

You can see this already in progress with the U.S. Navy's Naval Operational Business Logistics Enterprise (NOBLE) project. The programme will eliminate over 700 database/application servers and consolidate over 23 currently isolated application systems—ultimately aiming to improve asset readiness both on a shore and material basis. As part of a support agreement for the NOBLE project, Lockheed Martin and IFS will deliver an intelligent maintenance solution that will help power digital transformation of multiple legacy systems into a single, fully modernised and responsive logistics information system. The solution will support planning and executing maintenance, repair, and overhaul of more than 3,000 Navy assets including aircraft, ships, and land-based equipment.

2. Maritime digitisation to manufacture and support naval systems is on the near-term horizon – digital shipyard investment will quintuple

My next prediction involves the digitisation of shipyards across the globe in the maritime and naval sectors. Much like the U.S. Navy, shipbuilders, maintenance providers and other military operators are beginning to realise the value of digitising operations. ResearchAndMarkets data sees the digital shipbuilding sector poised for explosive growth—from \$591.63 million in 2019 to \$2.7 billion by 2027, growing at a CAGR of 21.1%. This will be fuelled by rising adoption of digital twins in the shipbuilding industry and increasing use of new manufacturing technologies.

Digital oversight of maritime and naval assets begins not at sea, but right at the beginning of a ship's lifecycle—in the design process and at the manufacturing plant. This means shipbuilders themselves will have to prioritise digital advancements in the coming years. Take IFS customer, Australia's largest defence prime contractor, submarine and warship builder ASC, that recently announced a company-wide digital transformation programme. The comprehensive

programme will set the ground for the ASC digital shipyard transition—facilitating more streamlined processes, enhanced integration between systems, and the expanded use of real-time data to drive optimised decision-making across the organisation. The ASC digital transformation programme will strengthen its enterprise resource planning system and introduce advanced technologies to enable its workforce and optimise its capabilities to support the sovereign sustainment of the Royal Australian Navy's Collins

drones will only grow with an expected rise in spending of \$11.1 billion in 2020 to \$14.3 billion by 2029.

In addition to removing human soldiers from harm, unmanned systems also bring about certain operational advantages. For instance, being unencumbered by life support systems (breathing apparatus, ejection seats) means 'uncrewed' aircraft can carry larger payloads with sensors for improved intelligence and reconnaissance or carry more fuel which allows for longer missions.

Much like the U.S. Navy, shipbuilders, maintenance providers and other military operators are beginning to realise the value of digitising operations.

Class submarine fleet, now and into the future.

Digital shipyard progress will be rooted in enterprise-wide software.

Any successful naval or maritime digital transformation programme means putting in place a full Integrated Data Environment (IDE) to ensure the barriers to executing a digital transformation project are removed, requiring close collaboration from military organisations, industry players and software providers.

In order to build a naval or maritime digital transformation programme, most organisations need a digital overhaul. They need an enterprise-wide system that can do more than simply manage essential MRO or supply chain processes and optimise scarce resources and assets in isolation. They require a software system that's agile enough to act on the increasing data volume and complexity to deliver quantifiable operational benefits.

3. Unmanned system usage will expand by one-third over the next decade – dedicated maintenance strategies must emerge

We're looking further forward in my final prediction, into the world of unmanned systems and drones—which are increasing in use across land, air, and sea. There is a high degree of R&D investment planned in the unmanned systems sector going forward, drones in particular are increasingly being used in military operations. In fact, according to the Drone Databook, an in-depth survey of the military drone capabilities around the globe, over 100 military organisations now have some form of drone capability—and a rising number now have combat experience using unmanned systems. The proliferation of military

The key near-term area of focus I see with the inevitable growth of unmanned systems space is the sustainment of these military assets. As this is something military organisations are still scoping out, consider these thoughts from Australian Defence Force Captain, Stephen Wardrop: "One of the key questions that must be answered is how the Army should structure maintenance support for UAS (Unmanned Aerial Systems) into the future. UAS maintenance is much more widely scoped than just the Air Vehicle (AV)—it encompasses the Ground Control Station, launch and recovery equipment including automatic take-off/landing systems, and all communications equipment involved in controlling the receiving data from the AV and its payload(s) during flight."

The key to drone sustainment and support is very similar to the all-encompassing ecosystem I've outlined in my first two predictions, with critical importance being placed on having an end-to-end system to link all data sources and stakeholders. This means unmanned system design, manufacturing, supply chain and aftermarket services need a digital backbone capable to support sustainment now and into the future.

As military equipment and supporting technology development continues apace, this growing data disconnect will need to be a key focus point for all players in the defence ecosystem, including military operators, in-service support providers and OEMs themselves. Putting in place a powerful data backbone now, will be the key to military logistics success going forward.

(Matt Medley is the Industry Director, Defence Manufacturing, IFS.)



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NEWS FROM ACROSS THE TASMAN



Nuku'alofa Harbour – HMNZS Canterbury in the foreground, HMNZS Aotearoa alongside the wharf. Credit: NZDF

NZDF PLATFORMS IDEAL FOR TONGA HADR RESPONSE

Military aircraft are often dispatched by their governments after some disaster situation in their own country or in other countries where they feel bound to offer help. To be able to respond promptly to requests for imaging, their air forces often have aircraft on standby.

APDR asked a spokesman for the NZDF about how these situations are dealt with in New Zealand having in mind the recent events in Tonga. He replied:

“The NZDF maintains maritime, land and air capabilities on short notice to assist civil authorities to save lives concurrently with sustaining current operations and maintaining readiness for contingent military operations.

“A P3K2 Orion is normally held at two hours’ notice to move for Search and Rescue (SAR) tasks. It may also be tasked at the direction of the Government of New Zealand in response to a natural disaster, either in New Zealand or abroad.”

Also, around October each year the RNZN

starts preparing some of its vessels for emergency responses around New Zealand’s coastline or further afield in the South Pacific region.

The recent Tongan disaster provided a timely reminder that the NZDF has the right aircraft and ships to provide prompt and effective humanitarian assistance and disaster relief response to the affected area(s).

The Hunga-Tonga-Hunga-Ha’apai volcano, located on the Pacific Ocean seabed near Tonga, has erupted regularly over the past few decades. During events in 2009 and 2014/15 hot jets of magma and steam exploded through the waves. But these eruptions were small, dwarfed in scale by the 15th January 2022 events.

On that day the volcano erupted, sending ash 20 kilometres into the upper atmosphere, and unleashing a devastating tsunami that destroyed homes on Tonga’s nearby islands. The airborne ash was so dense that it was not possible for reconnaissance aircraft to fly through it, meaning it was not until 18th January that an RNZAF P-3K2 Orion and an RAAF P-8A Poseidon were able to fly

their imaging missions over the Tongan islands and report back on the level of devastation.

Because of the ash on the Nuku’alofa airport runways, the first RNZAF C-130 Hercules flight loaded with emergency supplies was not able to arrive until 4pm on 20th January. That aircraft was carrying humanitarian aid and disaster relief supplies, including water containers, kits for temporary shelters, generators and hygiene and family kits.

That same afternoon the first Australian Air Force C-17A Globemaster military transport aircraft touched down in Tonga also carrying humanitarian assistance and disaster relief supplies.

THE RNZAF AND RAAF CONTINUED DELIVERIES OF RELIEF SUPPLIES IN MULTIPLE FURTHER FLIGHTS

Meanwhile, at the Auckland naval dockyard, the RNZN readied their offshore patrol vessel HMNZS Wellington, with an embarked Seasprite helicopter. This vessel departed Auckland overnight on 18th/19th January and by travelling continuously at 22 knots arrived in Tongan waters on the afternoon of 20th January. HMNZS Wellington had specialist teams of divers and hydrographers on board who inspected and surveyed damage to infrastructure, ports of entry and harbours, ensuring ships, including those of partner nations which were also assisting with relief efforts, could safely enter to deliver aid to Tonga.

The RNZN survey team’s work was initially in preparation for the arrival of large sustainment vessel HMNZS Aotearoa, which left Auckland on Tuesday 19th February and arrived safely on Friday 22nd February to tie up at a wharf in Nuku’alofa harbour. Almost immediately the ship began discharging its load of 250,000 litres of drinking water, and commencing distilling sea water at the rate of 70,000 litres per day. After testing, the clean water was delivered to the population from truck water tankers on the wharf.

It also started unloading the emergency stores it was carrying. There was particular emphasis on strict Covid protocols so each item of stores was sanitised before it was unloaded onto the wharf for contactless handover to Tongan military personnel.



First reconnaissance flight over Tonga by RNZAF P-3K2 Orion 18 January 2022. Credit: NZDF

While HMNZS Aotearoa was in transit and unloading water and supplies in Tonga, the Navy's amphibious and military sealift vessel HMNZS Canterbury was being loaded in Auckland with two NH90 helicopters, personnel and supplies including water, tarpaulins and milk powder. The HMNZS Canterbury was also carrying NZ Army engineers and plant operators together with vehicles and several containers of construction equipment requested by Tongan authorities. The ship sailed overnight 22nd/23rd February and arrived in Tonga on 26th February.

Communications systems had been affected by the natural disaster and an RNZAF NH90 helicopter, embarked on Canterbury, flew communications engineers to repair communications links to the badly hit Ha'apai island group.

A week later the roles of HMNZS Aotearoa and HMNZS Canterbury were taken over by other countries and these two vessels were able to return to New Zealand to prepare for their next assignments.

Reviewing the overall effort by the NZDF in response to the Tongan emergency, a reasonable conclusion is that their personnel and platforms performed superbly in a timely and effective manner. As importantly, because at the time Tonga had no cases of Covid.19, the contactless handover of all supplies landed maintained that status for the entire 120,000 population living on multiple islands.

NAVY SHIPS RETURN FROM TONGA AFTER ROLES IN RELIEF EFFORTS, TWO HAVE NOW BEEN SOUTH

Fresh from her deployment to Tonga where she provided essential aid supplies, refuelling services and water generation, HMNZS Aotearoa one week

later sailed from Lyttelton, South Island and headed south to support Antarctic environmental and scientific programmes.

With the construction of HMNZS Aotearoa, the NZDF now has a purpose-built, polar-class sustainment vessel specifically able to operate deep into the Southern Ocean and Ross Sea with an ice strengthened hull and upper deck trace heating.

For the Commanding Officer of HMNZS Aotearoa, Captain Simon Griffiths, the last month has been testing for ship and crew. "Aotearoa is an amazing ship, but it's the people on board that make it work," he said.

"They have got us from the tropics helping Tonga, to the freezing cold of Antarctica. It is a team effort and we are incredibly proud of what we do on the ship, and proud of what we do for our Navy. But most of all we are proud of what we do and what we represent for New Zealand."

The ship has now returned to New Zealand. On the way back the crew conducted a series of maritime safety trials and experiments for the Defence Technology Agency.

On her return to New Zealand, HMNZS Canterbury immediately started preparations for the ship's mission to the Sub-Antarctic Islands in March, which will enable the Department of Conservation and MetService to carry out conservation and maintenance work on these remote and protected islands.



NZ Extra caption: A Royal New Zealand Navy Kaman SH-2G Super Seasprite helicopter prepares to land on the flight deck of HMAS Anzac during BERSAMA GOLD 21. Credit: CoA / Leo Baumgartner

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