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Print Post Approved PP349181/00104

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Printer

Times Printers

ISSN 1446-6880

Design

Stun Media

Email: tdixondesign@gmail.com







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EDITOR'S LETTER



KYM BERGMANN, EDITOR – CANBERRA & SEOUL

t seems to cost Australia more to buy items of military equipment than any other comparable nation. Having said that, it is sometimes difficult to determine exactly how much a particular aircraft, ship or vehicle is costing because Defence tends to lump everything into an overall project budget, which can throw things such as weapons into the mix rather than listing them separately. Also sometimes support costs can be added in – even though a separate sustainment budget is meant to cover that.

When speaking with companies with an international presence, or procurement officials from every other nation except the U.S. there is an overwhelming consensus that Australia is paying too much for the relatively small number of platforms that we field. To provide more fidelity, it seems that Australia is often forking out 20% more for much the same item as an allied nation.

There are several reasons for this, but two stand out: 1) the amount of paperwork required by Defence; and 2) Australian-specific changes that do not improve the functionality of a product but which have to be made because the customer insists on it. These are not new problems and it is frustrating that so little has been done to address them even though they have been known for years.

What brings these issues into sharp relief now are three overlapping events. The first is the Defence Strategic Review that is meant to have a look at the Integrated Investment Plan and make some rapid decisions about what needs to stay in, what needs to be increased, and what needs to be removed. The second is an ASPI report by Rob Bourke with the title 'Budgets, the economy and the Defence Strategic Review'. The last is a visit that the writer

TIME TO REVIEW THE COST OF BUYING DEFENCE EQUIPMENT

made to Korea as a guest of the company Hanwha – along with other members of the media.

Australia is the 12th largest spender on defence in the world yet, despite that, the number of platforms we operate is often a fraction of that of other countries. Countering this are arguments that our systems are modern – which is generally, but not always, true – and that we have high rates of availability. While spending less on the military than we do, countries such as Israel and Turkey have more firepower in almost all domains. Israel in particular is also a leader in fields such as Space and cyber warfare.

For several decades South Korea and Australia spent similar amounts on the military, though in recent years Seoul has pulled away and is now 10th on the list of global spenders. Their economy is much the same size as ours, unlike both Israel and Turkey which are smaller. To read a list of Korean hardware is eye watering – with 24 active submarines (with more on the way), around 2,000 Main Battle Tanks, and 400 combat aircraft just to pick a few. Korea have just conducted the first test flight of its indigenous twin-jet KF-21 supersonic fighter. The country has its own submarine program and even plans to build an aircraft carrier.

Addressing the problem of how Australia can get more stuff without increasing the budget beyond 2%, in his study Rob Bourke has two main suggestions. The first is to buy more hardware off the shelf from international suppliers. The second is to tighten Australian industry content guidelines to focus only on items that are critical for self-reliance. Both are worth considering, particularly in an era of skills shortages in the workforce and \$1 trillion of national debt.

However, as an avid supporter of Australian industry, we believe that a third factor needs to be reviewed – and fast – namely, the cost of doing business with Defence. If by reducing the amount of documentation that bidders need to supply and stop fiddling with designs the cost of systems will fall. Those savings could then be used either to buy other things, or larger numbers of the same product.

This would seem to be beyond the scope of the DSR, but now would be a good time to update the procurement system with a view to achieving world's best practice. Defence doesn't particularly like reviews – and there was a period about a

decade ago when it was the subject of an inordinate amount of scrutiny with multiple inquiries being conducted, sometimes with seemingly overlapping objectives.

To pick one, who remembers the Black review conducted by Dr Rufus Black to examine personal and institutional accountability within Defence? It might have its supporters, but like many other studies appears to have sunk without trace. But we are now well into the 2020s and it is high time that the Department – and particularly CASG – was the subject of a study to see what can be done faster and with reduced overheads. This should also have a look at guidelines developed by other Departments such as Finance with a view to seeing what can be streamlined.

To conclude on another major activity that has the potential to distort the Defence budget forever: the acquisition of nuclear-powered submarines. As my colleague Andrew Greene from the ABC first reported, Rear Admiral Scott Pappano, Head of the Program Executive Office Strategic Submarines, cautioned that neither US industry nor that of Britain had the capacity to build nuclear submarines for Australia.

Not long after that, UK Secretary of State for Defence, Ben Wallace, said in the presence of his Australian counterpart Richard Marles that the UK was not in a position to build any more Astute Class submarines. Period. Full stop. His thinking is that the RN and RAN might work together and come up with a common design to be constructed at some future point.

To disappoint all of the boosters of nuclearpowered submarines: it is not going to happen anytime soon. We need to start preparing for that now.

PREVIEW NEXT ISSUE

- JP 9102 update Part 2
- Nuclear powered submarines
- Sovereign guided weapons

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GENERAL NEWS



Assistant Minister for Defence, and Assistant Minister for Veterans' Affairs the Hon Matt Thistlethwaite MP with Commodore Training, Commodore Charles Huxtable, RAN and Manager Director CAE Asia Pacific, Mr Matthew Sibree during a platforms and systems training contract signing ceremony at the Navy Training Systems Centre - Randwick, NSW.

Credit: CoA / Leo Baumgartner

CAE AWARDED CONTRACT WITH THE ROYAL AUSTRALIAN NAVY TO PROVIDE AGILE AND INNOVATIVE PLATFORMS AND SYSTEMS TRAINING FOR FUTURE MARINERS

2 September 2022

CAE announced that CAE Australia Pty Ltd. has been awarded the Platforms and Systems Training Contract (PSTC) by the Royal Australian Navy to deliver improved quality, efficiency, modernisation, and remote capability in training.

Under a 5-year agreement, CAE Australia will support the transformation of future training delivered to mariners across the Canberra Class Landing Helicopter Dock (LHD), Hobart Class Destroyer (DDG), Supply Class Auxiliary Oiler Replenisher (AOR) and Huon Class Minehunter Coastal (MHC). CAE's innovative solution will enable the Royal Australian Navy to accelerate training throughput and enhance delivery of sustainable distributed training - on-site, in port, and at sea.

CAE Australia will leverage the expertise of Australian Industry partners Navantia Australia, UNSW, 3by3 Solutions, and MMCLD to present a diverse, innovative, and enduring enhancement to naval technical training. CAE's training systems integration will align the training program, assets, and operations to ensure 110+ foundation, operator, and maintainer courses are delivered efficiently and effectively, whilst innovation opportunities are explored and developed.

"CAE is humbled by the trust and confidence displayed by the Commonwealth through the award of this contract to transform and deliver training," says Matthew Sibree, Managing Director, Indo-Pacific, CAE Australia Pty Ltd. "The Royal Australian Navy has developed the Navy Mastery Model to shape the process of learning for future mariners,

enabling them to achieve competency and to fight and win at sea. CAE is privileged to be contributing to Maritime, Social, and Technical Mastery through the delivery of the Platforms and Systems Training Contract. Together with our team of partners, we are empowering the next generation of mariners through professional training supported by a vision to increase agility and efficiency."

As the prime contractor leading the program, CAE Australia is leveraging experience in training military aircrews and mariners worldwide. CAE currently supports training of the United States Navy in multiple naval aircraft platforms, bridge training for the Littoral Combat Ships, and the US Army Maritime Integrated Training System (MITS).

Grumman Asia Pacific. "Together with our Australian industry partners, we look forward to working with the Commonwealth to build a highly collaborative 'JABMS Enterprise' in support of the Australian Defence Force."

The demonstration executed a number of realtime operational scenarios where the audience was able to view the command and control functions and had a complete overview of the battlespace. Additionally, this demonstration validated our agile delivery approach and our ability to rapidly integrate Australian sovereign capabilities into the JABMS solution.

"We have brought the best of breed technology from our all-domain C2 program of record and



A Royal Australian Air Force E-7A Wedgtail aircraft from No. 2 Squadron. Credit: CoA / Annika Smit

NORTHROP GRUMMAN AUSTRALIA TEAM DEMONSTRATES JOINT AIR BATTLE MANAGEMENT SYSTEMS STEWARDSHIP

CANBERRA, 31 August 2022

Northrop Grumman Australia successfully completed a demonstration of a sovereign, fifth-generation Joint Air Battle Management System (JABMS) proposed solution supporting the Australian Defence Force.

Performed to the AIR6500 Program Office in the Department of Defence, the demonstration showcased the JABMS product solution and the modular, open systems architecture leveraging a proven U.S. all-domain command and control (C2) architecture to demonstrate genuine risk reduction to the future AIR6500 capability.

"Over the last twelve months, Northrop Grumman Australia has made significant steps to reduce key risks to delivering our proposed JABMS solution," said Christine Zeitz, general manager, Northrop engineered a truly sovereign, Australian JABMS capability," said Mary Petryszyn, corporate vice president and president, Northrop Grumman Defense Systems. "This technology is relevant now and will continue to be relevant into the future, providing an effective and enduring defensive capability to Australia and its allies."

Northrop Grumman Australia's JABMS solution is designed to link sensors and effectors across domains with the ability to optimise responses and operate within a broader C2 functionality. The contemporary design of an open, modular systems architecture enables the joint force to utilise current and evolving platforms, accelerate decision making, and respond at the speed of the threat.

Northrop Grumman Australia is one of the two shortlisted companies selected to participate in the Commonwealth of Australia's AIR6500 Competitive Evaluation Process, for the design, development and delivery of the JABMS. The successful strategic partner for the JABMS is expected to be announced in late 2023.

Northrop Grumman is a technology company focused on global security and human discovery. Their pioneering solutions equip customers with capabilities they need to connect, advance and protect the U.S. and its allies. Driven by a shared purpose to solve customers' toughest problems, 90,000 employees define possible every day.

LOW EARTH ORBIT SATELLITE **CLUSTER TO PROVIDE SECURE** DIGITAL MILITARY INTELLIGENCE FROM 2024

7 September 2022

BAE Systems is set to launch its first multi-sensor satellite cluster into Low Earth Orbit (LEO) in 2024 to deliver high-quality information and intelligence in real time from space to military customers.

Known as Azalea, the group of satellites will use a range of sensors to collect visual, radar and radio frequency (RF) data, which will be analysed by on board machine learning on edge processors to deliver the resulting intelligence securely, anywhere in the world while still in orbit.

Following the acquisition of In-Space Missions last year, BAE Systems is one of a small number of British companies with the capability to design, build, launch and operate satellites. The expertise brought by In-Space Missions complements the Company's existing advanced technologies and will become an integral part of its multi-domain capability. Azalea will also boost the UK's ability to understand the threats and hazards in, from and through space.

The Azalea cluster will deliver timely, actionable intelligence, essential for military operations and disaster response. Comprising four highly resilient satellites which, together, are capable of gathering, analysing and communicating Synthetic Aperture Radar (SAR), optical and RF signals.

Unlike conventional, single-purpose satellites, the cluster can be fully reconfigured whilst in orbit in the same way a smartphone installs a new app; this ensures it can deliver future customer missions and expands the lifecycle of the satellites.

The programme supports the UK Government's Defence Space Strategy, published earlier this year, which named Earth observation as a priority area to help protect and defend UK interests, a sovereign capability which Azalea could provide.

BAE Systems is working with Finnish firm, ICEYE, to combine its own expertise in sensor technology with ICEYE's advanced SAR technology to be included in the cluster. SAR provides high-resolution imagery of the Earth's surface, day or night and in any weather conditions. This persistent monitoring makes it easier to detect instant physical changes, such as the movement of hostile ships or aircraft or the location of people at risk during natural disasters, such as floods and forest fires.

Existing space-based sensors require multiple terabytes of data to be transferred to Earth before being processed and distributed. The traditional transfer process can take many hours and is reliant on intermittent RF links and the availability of suitable ground stations.

The Azalea system saves valuable time by combining and analysing data in space. It will be able to identify activities of interest and directly communicate with users on the ground within moments of detection – securely delivering assured data, in a useful timeframe, directly to the hands of decision makers.

Dave Armstrong, Group Managing Director of BAE Systems' Digital Intelligence business said: "The Azaleasatellite cluster will process data in space

to provide swathes of digital intelligence wherever it's needed. We understand how important spacebased intelligence is to every domain, whether that's informing strategic command, alerting an in area warship, or providing real-time intelligence to forces on the ground. The launch of Azalea in 2024 will be a major step forward for the UK's sovereign space capability.

Rafal Modrzewski. CEO and Co-founder of ICEYE. added: "ICEYE helps to solve problems using data. There is a clear advantage for governments and organisations to receive accurate information when they need it, regardless of weather conditions - this is what ICEYE brings. By combining our SAR technology with the security expertise of BAE Systems and the other data sources in the cluster, we can help decision makers make the right choice at the right time."

Doug Liddle, Chief Executive and co-founder of In-Space Missions, said: "We're working together to create a step-change in military intelligence and capabilities. Our technology will monitor adversaries. but will also provide substantial civil benefits by helping humanitarian response missions."

Dirk Noordewier, General Manager of Digital Intelligence Australia, said "Azalea 's LEO satellites could be of huge benefit to the National Security and Defence community in Australia, providing advanced multi-sensor capabilities from space with data processed on-board that will deliver intelligence to users on the ground faster than ever before. Azalea also offers a pathway to true sovereign capability through ownership of an Australian constellation. Australian users will then be able to prioritise and control the end to end process of tasking, collection, processing and dissemination of sensor data, with the potential to contribute to and share data with allies."



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GENERAL NEWS



SureFire suppressor (NIOA image)

NIOA INKS NZ CONTRACT FOR SUREFIRE SUPPRESSORS

6 September 2022

NIOA has partnered with one of the world's leading weapons systems manufacturers to provide a mission-critical rifle ancillary carried by New Zealand's elite military forces and police.

NIOA Regional Business Manager (New Zealand) Fraser Winskill said the company had signed an gareement with US-based SureFire to supply the New Zealand Defence Force and NZ Police with rifle suppressors.

SureFire is renowned worldwide for making highperformance illumination and tactical tools for special operations units, including the US Special Operations Command (USSOCOM).

Mr Winskill, an 18-year NZDF veteran, said the NIOA distribution contract was to support in-service and future acquisitions of sound suppressors and muzzle devices.

NIOA in New Zealand supports the NZDF and NZPOL through various weapons systems including personal protection weapons, sniper and anti-materiel rifle systems and ancillaries, a wide array of hand and special effects grenades, night-fighting equipment and optical systems

"SureFire is one of the defence industry's most respected brands," Mr Winskill said. "I've personally used SureFire suppressors on deployment and training with the NZDF. Their reputation speaks for itself."

"We are proud to partner with SureFire in providing our defence and police forces with the world's best equipment so they can do their jobs safely and effectively no matter their mission set or operational environment."

Founded in the US in 2002, SureFire's Suppressor Division was awarded the coveted USSOCOM contracts for suppressors and muzzle devices early in their inception.

Over years of brutal frontline service, SureFire has refined Sir Hiram Maxim's original design, coupling it with modern materials and advanced machining processes to produce the world's finest next generation weapons suppressors.

Barry Dueck, vice president of SureFire's Suppressor Division, said: "We are pleased to join with NIOA in New Zealand and look forward to continuing our mission to provide our allied defence and law enforcement customers with the highest-quality equipment."

NIOA in New Zealand represents several the world's renowned firearm and ammo manufacturers including Savage, Federal, and recently added Remington arms and ammunition to the line-up.

NIOA was founded in Queensland, Australia 50 years ago on connections to the sporting, recreational and hunting markets.

It is now the leading privately-owned supplier of firearms, weapons and ammunition in Australia.

The company successfully integrated Aucklandbased Sportways Distributors into the group in April.

UK SKIES PROTECTED BY C4I PTY LTD SECURE VOICE COMMUNICATION SYSTEM

UK / AUSTRIA, 5 September 2022

C4i Pty Ltd, a Melbourne-based secure voice communications company, has provided its VOICE C2 voice over IP (VoIP) communication system (VCS) for the Ministry of Defence (MoD) Guardian project, providing the UK's new Air Command and Control System. C4i Pty Ltd, a member of the Frequentis Group since 2021, is subcontractor to IBM. IBM Consulting in the UK are the Prime contractor that is leading the program to develop and install the replacement system.

The Guardian project is replacing current systems at RAF bases in the UK with new technology allowing the RAF to enhance its air situation picture in support of continued early detection and rapid response of suspected aircraft threats. Replacing the existing Royal Air Force (RAF) VCS with the new VOIP based system from C4i provides enhanced flexibility, capability and security, as well as reducing overall life cycle costs.

The new system, already in full time operations at RAF Boulmer, will connect the UK's defence radars and radio network, as well as delivering new capabilities to improve communication and interoperability between UK, NATO and coalition



RAF controller (Frequentis photo)

aircraft, which is essential to the protection of the UK's skies.

"The installation of the UK's new air command and control system at Boulmer is the first step in this project to deliver enhanced capability to deal with the increased demands of UK airspace and essential surveillance of its skies, supporting



Roll out of Astute class submarine, HMS Anson (BAE Systems photo)

the MoD and NATO tasks. We are pleased to be providing the essential communications for the defence of the UK, supporting the transition to digital technologies to support future capabilities," says Darren Gardner, Managing Director C4i Pty.

Installations for other vital parts of the voice control system are continuing in other locations throughout the UK.

VOICE C2 is an advanced IP communications system based on simplified hardware and software components that, when combined, deliver a sophisticated communications platform. The system provides users with the ability to access and control radio, telephony, intercoms and paging systems using a single intuitive GUI. It enables customers to operate securely and seamlessly across multiple security enclaves while maintaining isolation as required.

Specifically designed for fixed and deployable air defence environments, VOICE C2 Red/Black

platform is operationally proven and purpose-built, it is in active use around the world including for Australian defence forces and the US Department of Defense (USAF, US Army, US Marine Corps).

With integrated Classified and Unclassified modes of operation, the system provides operators with internal and external communication and conferencing capabilities via a range of air and ground-based communication networks. Operators have simultaneous access to Red and Black Air/ Ground and Ground/Ground communication channels from a single console.

AUSTRALIA WELCOMES SUBMARINE TRAINING OPPORTUNITY FROM UK

1 September 2022

The Deputy Prime Minister and Minister for Defence, the Hon. Richard Marles was hosted by former Prime Minister Boris Johnson and Secretary of State for Defence Ben Wallace at the commissioning of HMS Anson at BAE Systems, Barrow.

As part of our AUKUS partnership, Prime Minister Johnson and Secretary Wallace announced the

training of Royal Australian Navy submariners aboard the newly commissioned HMS Anson, an Astute-Class submarine.

Having Royal Australian Navy submariners train alongside Royal Navy crews, is an important step, taken with our partners in the United Kingdom to further strengthen our defence ties.

Australia is embarking on the next generation of submarines and in doing so, ensuring we have Royal Australian Navy personnel training with our partners under the AUKUS partnership.

Quotes attributable to the Deputy Prime Minister, the Hon. Richard Marles MP:

"It was an honour to be hosted by Prime Minister Boris Johnson and Defence Secretary Ben Wallace at today's commissioning ceremony for HMS Anson.

"Australia is eager to learn from our counterparts, and who better to learn from than our friends in the United Kingdom.

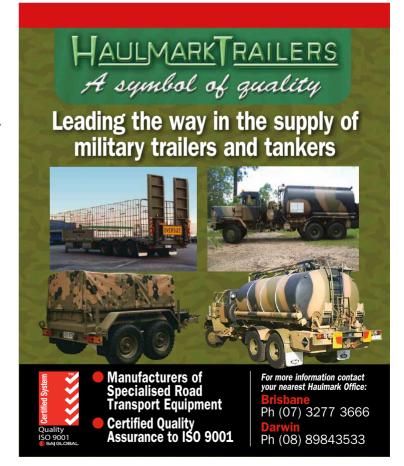
"Our countries are working hand in glove on training and building the skills required for our future submarines, is an important part of bolstering our Defence Force.

"Today's announcement of Australian submariners training aboard HMS Anson says everything about our future plans of building the AUKUS partnership.

"During my visit to Govan shipyard, where the Type 26 is being built, we have Australian workers- engineers, mechanics and the like- who are learning from their UK counterparts to deliver the high-tech skills required to deliver for our Frigate program back home in Osborne, SA.

"I have been warmly welcomed during my time here in the UK and I would like to thank my counterpart, Defence Secretary Ben Wallace for hosting me.

"The technology, capability and lethality on show is truly impressive and Australia looks forward to progressing our talks through the AUKUS partnership."



INFANTRY FIGHTING VEHICLE DECISION **TIMING UNCERTAIN**

One is reminded of the ancient conundrum: what happens when the irresistible force meets the immovable object? In the case of LAND 400 Phase 3, how will the clash of Army's scheduled procurement of new Infantry Fighting Vehicles survive the timing of the government's Defence Strategic Review? Is some sort of compromise possible?



Redback being readied for trials in Korea (Hanwha image)

a decision will be taken and announced. It is possible that the Defence Strategic Review team will be asked to have a look at the paperwork and make a ruling:

"The Review must consider all elements of the Integrated Investment Program and provide recommendations for the Program's reprioritisation, particularly in light of recently announced largescale projects, to provide Australia with the force structure required by 2032-33."

LAND 400 Phase 3 is certainly a significant part of the IIP and in its current form will be the largest single Army contract by value, ever. Navy have already succeeded in having consideration of the nuclear-powered submarine and the Hunter class future frigate project removed from the equation, so if IFVs were also excluded there wouldn't be much left to examine.

A problem in all of this is timing. The DSR will report back in March next year - but then those findings will need to be considered by the Government and Defence. Unless the Review improbably concludes that everything is

his is the competition between Germany's Rheinmetall and Hanwha of South Korea for an order of between 300 and 450 next generation IFVs worth in the range of \$17 - \$27 billion - a huge order by international standards. It also has implications for future business opportunities - whichever company is selected here will be in a stronger position for further orders from other countries. Whatever our faults, we are seen as a thorough and reputable purchaser of military systems - and an excellent reference.

With tender evaluations, no matter the magnitude, Defence does things by the book - and especially during the final stages of a competition when the incorrect release of information could destabilise the entire well-managed process. APDR put a number of questions to the department, including whether there were ongoing activities with the

"A recommendation on the preferred LAND 400 Phase 3 tender remains on schedule to be considered by Government this year."

bidders, and was not surprised to receive a generalised response:

"LAND 400 Phase 3 is pending a decision by Government and is subject to a live tender process. As part of this process, it is normal to engage with tenderers to scope a range of options.

"A recommendation on the preferred LAND 400 Phase 3 tender remains on schedule to be considered by Government this year."

That is in line with the position of Defence for the last few years regarding their acquisition timeline. However, even though everything remains on schedule for the recommendation to be sent to Government soon, that is not a guarantee that

100% perfect it will take time to decide which recommendations to accept and which to reject. If we add a couple of months for that to happen, we are in the middle of 2023.

A possible escape clause for everyone is that the Review will submit some sort of interim report by the end of October. Surely by now LAND 400 Phase 3 will have been highlighted as a major impending capability decision - possibly the most important near-term choice facing Defence, apart from AIR 6500.

Army has had a number of inputs into the DSR already and it is hard to imagine that IFVs are not at the top of the future capability list. Perhaps a middle course would be for the Government to announce the winner of the bid on schedule and thus allow further risk mitigation work to occur but put off a final decision on total numbers and functions of IFVs until a later date.

The bottom line is we just don't know. The least likely scenario is that the project will be cancelled. Army is adamant that this acquisition is fundamental to its long-term plan of having a combined arms capability and is the final piece in that jigsaw puzzle (see separate interview with LTGEN Simon Stuart). Also, with the previous Government having cancelled the Attack class submarine project and cancelled the Sky Guardian UCAV acquisition, one assumes that the new incumbents will be keen to arrest the slide in Australia's international reputation for reliability and transparency.

In the meantime, the bidders are waiting nervously. Hanwha in particular has plenty to get on with and in one of the peculiarities of the situation there is a chance that the Redback IFV – designed specifically to meet Army requirements – will first be sold to a country that isn't Australia. This is because Poland has entered into a massive framework agreement with South Korea for the purchase of military hardware, of which the 42 tonne Redback could be a part.

One of three Redbacks built for the Australian Risk Mitigation Activity – which concluded in November last year – is currently somewhere in Poland undergoing field trials. These are reported to be going well and since Poland is in the market for a Heavy Infantry Fighting Vehicle, a contract might be signed by the end of this year. The motivation is very clear: Russia's invasion of Ukraine and the understandable fear that fighting might eventually spread to Poland.

The Redback is attracting interest for several reasons. It is very modern – arguably the most modern IFV in the western world, having been designed and built in a 6-month period in 2019 – and is optimised for high intensity conflict. The vehicle has enhanced survivability features – and can take enormous punishment, able to withstand 30mm direct fire at 500 metres and 155mm shell blasts 10 metres from the vehicle.

Its own firepower is considerable, with two Spike anti-tank guided missiles, a Northrop Grumman 30mm Bushmaster turret-mounted chain gun, 7.62mm coaxial machinegun and a second heavy machinegun in a remote weapon station. The design of the turret means it could be easily upgraded to a 35m cannon – or even a future



A possible escape clause for everyone is that the Review will submit some sort of interim report by the end of October.

50mm version.

It has a number of advanced features, such as the Iron Vision system from Elbit. Based on a series of external cameras, it allows the crew and embarked infantry to "see" through the vehicle when wearing appropriate goggles – a revolutionary concept originally developed for the F-35 program – that adds greatly to situational awareness and therefore adds to both survivability and lethality. It has all weather thermal sights and integrated laser range finder and a full self-protection suite that could include the Iron Fist APS, also from Elbit.

If Poland decides to buy Redback before Army does it will lead to an awkward situation for Australian industry. Being the lead customer puts any country in a strong position to negotiate local content and if suddenly Warsaw announces a major purchase, it will be in the box seat to insist on the involvement of its own suppliers, of which there are many in the armoured vehicle domain – a throwback to Cold War days.

On the other hand, if Australia is the first to make the commitment to Redback, the opposite becomes the case – local suppliers would almost certainly be contributing to the Polish program.

This has been confirmed by Hanwha and also the Korean government.

Other exports of Redback could also be to South Korea itself. The Korean Army is considered a likely purchaser of the Redback for their own IFV needs, albeit with a different turret carrying a 40mm main gun and locally produced anti-tank guided weapons. Redback is also a contender for the US Optionally Manned Fighting Vehicle project, designed to replace the ageing M-2 Bradley fleet.

As for Rheinmetall, despite requests for information about the Lynx Infantry Fighting Vehicle and the Australian program - and an indication of a willingness to provide an update on developments - no material has come through. However, regarding the aforementioned US project, the company announced on August 7:

"American Rheinmetall Vehicles (Sterling Heights, MI), a leading developer of tactical wheeled and tracked combat vehicles and systems has formed a strategic partnership with Anduril Industries, a defense technology company, in pursuit of the U.S. Army's Optionally-Manned Fighting Vehicle (OMFV) program.



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

One of three Redbacks built for the Australian Risk Mitigation Activity – which concluded in November last year – is currently somewhere in Poland undergoing field trials.

"American Rheinmetall Vehicles has built an elite U.S. industry team that consists of numerous leading U.S. defense companies including, Textron Systems, Raytheon Technologies, L3Harris Technologies and Allison Transmission, who are collectively known as "Team Lynx."

"Anduril, the newest member of the team, brings its deep experience in software development, mission autonomy, systems integration, and command and control; developed and deployed in support of National Defense priorities. American Rheinmetall Vehicles leads Team Lynx in offering the Army a next-generation infantry fighting

vehicle (IFV) solution for the OMFV program that features a mature, game-changing platform with a purposeful, future-proof modular design that ensures not just overmatch today, but overmatch for decades to come."

"Anduril will support Team Lynx with customised command and control software for Lynx OMFV formations that enables collaborative formation manoeuvre, and collaborative detection, targeting, and engagement of threats for future armoured combat formations. Anduril's software, in alignment with Army IDEE software development process will have an agile based development and improvement

plan, integration, and delivery cycles, enabling persistent modernization for IFVs to rapidly adapt to and defeat emerging time-sensitive threats.

"The Team's solution, the Lynx OMFV, redefines the modern battlefield and enables the Army to satisfy its number two modernisation priority, a next-generation combat vehicle with leading protection, mobility, growth, and lethality capabilities that will sustain overmatch for decades. The Modular Open Systems Approach (MOSA), along with substantial growth potential in power, weight, and volume make the Lynx OMFV exceptionally well prepared to confront the challenges of the future battlefield like no other."

(Disclaimer: the author travelled to South Korea as a guest of Hanwha. He would like to thank Katherine Ziesing for her assistance.)

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ARMY HELICOPTER TRANSFORMATIONS

The Australian Defence Force's fleet of helicopters is part-way through its second major transformation in 20 years. Following the decade-long multi-phased Project AIR 9000 helicopter fleet rationalisation effort which saw nine ADF helicopter types reduced to five, a further rejigging is now underway.



AIR 9000 REDUX

AIR 9000 was an ambitious program for such a small military force, with the retirement of eight ageing or obsolete helicopter types, and the introduction into service of five new models in quick succession.

Following the AIR 9000 Phase 1 scoping study, the first cab off the acquisition rank was the Phase 2 Additional Troop Lift helicopter which sought to augment the Australian Army's fleet of 34 Sikorsky S-70A-9 Black Hawks with 12 new machines. Despite Army's reported preference for the then-new Sikorsky UH-60M Black Hawk, the NHI/Eurocopter MRH 90 – a version based on Germany's NH 90 TTH – was selected in 2005 on the back of a local assembly program and the development of an ongoing composite-manufacturing and maintenance capability.

Running concurrently with Phase 2, AIR 9000 Phase 3 sought to buy the Royal Australian Navy some time by implementing a Capability Assurance Program (CAP) for its ageing S-70B-2 Seahawks, pending a planned replacement of that airframe. Some of the improvements included new sensors, improvements to the gearbox, a crash-data recorder, and a new countermeasures system and electronic support measures (ESM).

In 2006, AIR 9000 Phase 4 resulted in an order for 28 additional MRH 90s to replace the Black Hawks from 2012, while Phase 6 saw an additional six MRH 90s ordered to replace the Royal Australian Navy's remaining Westland Sea King Mk.50s in the fleet logistics role. All of the Army and Navy MRH 90s were to be drawn from a common pool of machines supported by Australian Aerospace (now Airbus Australia Pacific) at Brisbane.

With the withdrawal of Australian ground forces from Afghanistan in 2014, the Army needed to replace its five remaining CH-47D Chinooks which had been worked very hard while deployed. Following Phases 5B.1/B.2 in the early 2000s which saw the CH-47Ds receive new engines, door gun placements, armour plating, and obsolescence issues addressed, AIR 9000 Phase 5C saw 10 new CH-47F Chinooks ordered in two batches in 2015 and 2017.

Four more CH-47Fs were added in 2021 and 2022 to bring the fleet to 14, with the extra machines

HELICOPTERS

reportedly rapidly acquired and drawn from US Army stocks to provide additional battlefield airlift due to the unsuitability of the RAAF's C-27J Spartan fixed-wing transport in that role

AIR 9000 Phase 7 saw the Army's remaining Bell 206B-1 Kiowa and Navy's Eurocopter (Airbus) AS350BA Squirrel training helicopters replaced from 2016 with a new joint Helicopter Aircrew Training System (HATS), Based around 15 Airbus EC-135T2+ helicopters and a comprehensive suite of synthetic flight and crew training devices, HATS is operated by Boeing Defence Australia and Thales Australia.

The final phase of AIR 9000 was the Phase 8 Naval Combat Helicopter program to replace the Navy's S-70B-2s and the failed SH-2G(A) Seasprite. Competing against the navalised NFH 90 which shared systems commonality with the MRH 90, in 2012 the Commonwealth ordered 24 Sikorsky MH-60R Romeo Seahawks for Phase 8, with the final machine being delivered in 2017.

MRH 90 TROUBLES

The MRH 90 promised much on paper. Apart from the obvious Australian Industry Capability (AIC) benefits and, on paper at least, performance advantages over the Black Hawk, the MRH 90 has never achieved a final operational capability in Army or Navy service and has featured on the government's projects of concern list for more than a decade.

Despite a concerted effort by Airbus and the Army through 2017 and 2018, the MRH 90 fleet has continued to suffer from poor availability and inconsistent configuration management since entering service, forcing Army to lease two AW139 helicopters under the Plan Corella Army Interim Commercial Helicopter (AICH) capability in 2021 to conduct training and non-combat support missions from Townsville.

The MRH 90 fleet has also been grounded at least four times since 2010 due to various technical issues, including a tail rotor delamination, while the effort to adapt it to the special operations support role with Sydney-based 6 Aviation Regiment (6Avn) has also proven to be too difficult, with issues reported with the aircraft's door gun position, fast-rope repelling system, and cargo ramp.

A BLACK HAWK RESURGENCE

The issues with the MRH 90 meant Army was forced to delay the retirement of some of its S-70A-9 Black Hawks for more than two years, retaining a flight of them at 6Avn through the MRH 90's protracted introduction.

But the Black Hawks were worn out and, despite sterling work by Army and Sikorsky to keep them going, they were finally withdrawn from service in December 2021.

Australia's S-70A-9 was the direct commercial sale version of the US Army's original UH-60A model which was developed to replace the UH-1H Iroquois in the late 1970s. An initial order for 14 Black Hawks was placed in May 1986, and a further 25 machines were ordered a year later. The first Australian Black Hawk flew at Sikorsky's Hartord facility in the US in September 1987, and all but that first machine were assembled by Hawker de Havilland at Bankstown in Sydney.

In a surprise at the December 2021 retirement

into the future, with reasonable and predictable operating costs.

"The Australian Government is exercising its right to understand what options are available to provide the necessary capability at a reasonable cost into the future," he added.

Despite the announcement in July this year of a Defence Strategic Review by the new Labor Government and some uncertainty cast by new Defence Minister, Richard Marles, the acquisition approval process for the new Black Hawks has continued to progress through the US system. On 25 August, the US Defense Security Cooperation



An Australian Army MRH90 Taipan helicopter from the 5th Aviation Regiment, at the capability display, during Exercise Vigilant Scimitar at Charters Towers Airfield, Queensland. Credit: CoA / Carolyn Barnett

ceremony, then Defence Minister Peter Dutton announced that MRH 90 would be withdrawn from service some 10 years earlier than planned, and that about 40 new UH-60M Black Hawks would be acquired under the Project LAND 4507 Phase 1 MRH Rapid Replacement requirement. This announcement came just 18 months after the release of the Force Structure Plan which had forecast a 2034 withdrawal for the MRH 90.

"The performance of the MRH90 Taipan has been an ongoing and well-documented concern for Defence, and there has been a significant effort at great expense to try to remediate those issues," Dutton said in a 10 December release. "It is critically important there is a safe, reliable and capable utility helicopter available for our service men and women

Agency announced that the State Department has approved the sale of the machines.

During a media doorstop interview on 25 August, when asked whether the Black Hawk sale had been "quarantined" from the Review process, Marles said, "Well, there is a process underway in relation to that specific capability that was underway and put in place by the former Government and has continued since the election under our government.

"What we've said with the Defence Strategic Review is that it is not about all the operations of the Defence Force being put on hold until the review is complete," he added. "We are continuing to evolve our capabilities, and that means that those immediate questions are still being worked through and considered and this is one of those processes

HELICOPTERS



Four Australian Army Tiger armed reconnaissance helicopters join HMAS Adelaide for Exercise SEA EXPLORER 22. Credit: CoA / Robert Whitmore

which is underway, and the Black Hawks form a part of that."

In the meantime, the Navy has also decided to withdraw its MRH 90s, and the government announced in October 2021 that 12 additional Romeos would be acquired under the Project SEA 9100 Phase 1 Embarked Logistics Support Helicopter Capability requirement which is seeking to, "expand and rationalise the support and logistics helicopter fleet consistent with the expectations for larger naval operations."

This announcement was ratified in May 2022, along with a stated intention to buy an additional airframe to replace a Romeo which was lost at sea in 2021. The process for the new Romeos has moved quickly, with a contract being awarded to Lockheed Martin by the US Navy on 29 August for the 12 new Australian machines through a Foreign Military Sales (FMS) construct.

APACHE UNCERTAINTY

A project that started a few years before AIR 9000 was the Project AIR 87 Armed Reconnaissance Helicopter (ARH) requirement which sought a replacement for Army's Vietnam-era UH-1H Bushranger gunship and Kiowa light reconnaissance helicopter.

The Commonwealth ordered 22 Eurocopter (Airbus) Tiger ARHs – based on France's Tiger HAP variant – in December 2001. Like the MRH 90, the industrial offset plan for the Tiger for the machines to be built and supported at Brisbane was a compelling one. But, also like the MRH, the Tiger's introduction into service was a painful and protracted one for Australia.

Production delays were followed by lower than expected availability rates, high operating costs,

and obsolescence issues. It was also found that upgraded electronic warfare and communications systems couldn't easily be integrated with the Tiger's systems, and a number of federated 'patches' had to be devised.

Despite these issues which culminated in a scathing Australian National Audit Office (ANAO) report in September 2016, availability had begun to improve, the Tiger has been popular with its crews, and the aircraft achieved its full operational capability (FOC) in April 2016.

But the ANAO report was seemingly the final straw for the Commonwealth, with a plan being released to replace the aircraft from 2025 while embarking on a scaled-down Project LAND 9000 Armed Reconnaissance Helicopter Capability Assurance Program (CAP).

A request for information (RFI) for the Project LAND 4503 Armed Reconnaissance Helicopter Replacement program was released to industry in July 2019, with the document calling for 29 new machines to, "deliver armed reconnaissance efforts in close and deep contested battlespace".

Boeing confirmed in September 2019 that it would offer the AH-64E Apache Guardian for the requirement, Airbus touted an upgrade of the Tiger that would align with the planned Tiger Mark III upgrade being developed for France and Spain, and Bell offered its AH-1Z Viper, the ultimate version of the Vietnam-era Cobra attack helicopter.

A request for tender (RFT) was released to Boeing and Bell in August 2020, but Airbus was not invited to tender. Despite this, Airbus offered an unsolicited proposal of an upgraded Tiger which would be augmented with seven additional airframes from an unspecified source – likely France – to meet the

requirement for 29 aircraft, but this was publicly rejected by then Defence Minister, Senator Linda Reynolds.

The Commonwealth announced in January 2021 that it had selected the Apache to replace the Tiger in service and the FMS approval process was progressed, with the DSCA announcing State Department approval of the sale in June 2021.

"This new ARH capability will strengthen Australia's armed reconnaissance force to better shape our strategic environment and deter actions against our national interest," Minister Reynolds said in a statement in a January 2021 statement. "Defence considered a number of helicopters against key criteria of proven ability, maturity and an off-the-shelf operating system.

"The Apache Guardian is the most lethal, most survivable and lowest risk option, meeting all of Defence's capability, through-life support, security, and certification requirements," she added. "By pursuing a proven and low-risk system offered by the Apache, Defence will avoid the ongoing cost and schedule risk typically associated with developmental platforms."

Despite the former government claiming in May 2022 that the Apache sale had been "finalised", a contract for the sale has not been listed on the Pentagon's contract notification website. This suggests that either Australia's aircraft have been batched under a larger US Army contract, or the sale isn't as "final" as had been claimed and may be subject to a second look as part of the Defence Strategic Review process.

Prior to the Apache announcement there were suggestions from some in Industry that Australia might be better placed by retaining the Tiger, and instead joining the US Army's Future Vertical Lift (FVL) program – specifically, the Future Attack Reconnaissance Aircraft (FARA) effort to replace the long-retired Bell OH-58D Kiowa Warrior as well as earlier-build Apaches.

But FARA appears to be too far away for the Australian Army, with a selection of the successful design – either the Bell 360 or the Sikorsky Raider X – planned for 2028, and US service entry for 2032.

Apart from the MRH and ARH, another casualty of the Black Hawk and Apache acquisitions appears to be the Project LAND 2097 Phase 4 Special Operations Light Support Helicopter requirement. With reports in late 2020 that Jet Aviation with the Bell 429 had been selected as the preferred solution to provide 18 machines to be based at Holsworthy near Sydney, that project now appears to have been shelved.



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AUTONOMOUS IN-FIELD RELOADING FOR THE HUNTSMAN SPH ON THE GROWTH PATH

Technology rarely stands still – and even before the Army receives its first Huntsman AS-9 155mm Self Propelled Howitzer plans are already underway for a major series of upgrades and improvements. If Australia is interested in being involved, first cab off the rank could be a locally produced autonomous version of the K-10/AS-10 armoured resupply vehicle. To be known as the AX-10 it would operate without the usual two-person crew. It could operate in either follow-the-leader mode or in a more advanced configuration able to move to, resupply and if necessary, unload, 155mm ammunition from the SPHs without human intervention.



already well protected by armour, but if they could be replaced by technology it would be a good case of removing humans from danger because in any future conflict the resupply vehicles will be high priority targets.

At one level the concept is fairly simple: move a main supply base further back out of range of enemy weapons, load the AX-10 in safety and send it on its way to link up with two AS-9s dozens of kilometres away and transfer more ammunition to them. However, Hanwha says it is feasible to also have an automated data link between all the vehicles so that the base and headquarters are aware of the status of all of the platforms in the group. All vehicles will be connected via Army's future Battle Management System.

The concept is helped by rapid advanced in Artificial Intelligence which – at the risk of offending some readers – is making machines better drivers than humans are. Things have advanced way beyond giving vehicles point-to-point coordinates and sending them on their way. With Al and

he current Russian invasion of Ukraine is teaching us many things, including that rear areas previously considered safe are now proving to be vulnerable to enemy attack. While both sides have suffered, in more recent times it appears to be Russian logistics facilities – such as large ammunition stockpiles – that have been targeted and destroyed by Ukraine rocket systems such as HIMARS. Once a fighting force runs out of supplies its days are numbered.

The only known 155mm SPH system in the world that comes with an in-field armoured resupply vehicle is Korean company Hanwha's K-9/K-10 combination, which in their Australian incarnations are the AS-9 and AS-10, respectively. The first tranche being purchased under LAND 8116 Phase 1 will see the delivery of 30 AS-9s and 15 AS-10s for a 2:1 resupply ratio. Each AS-10 is able to carry

The only known 155mm SPH system in the world that comes with an in-field armoured resupply vehicle is Korean company Hanwha's K-9/K-10 combination, which in their Australian incarnations are the AS-9 and AS-10, respectively.

more than 100 155mm rounds – slightly more than a full load for two SPHs. While it has not been done yet, Hanwha suggests that AS-10s could also carry fuel or stores as an alternative to ammunition in a K-11 configuration.

The resupply vehicle uses exactly the chassis as the AS-9 and works by driving to the rear of the SPH and connecting with it using a mechanical transfer mechanism. The two-person crew is

Machine Learning they can now sense and avoid, calculate the safest route to travel, assess terrain and natural features – and can re-prioritise on the move. If the first Huntsman they were going to resupply still has plenty of ammunition but another one nearby runs out, then the mission parameters change to reflect those circumstances.

South Korea is investing heavily in autonomous systems with military applications, with Hanwha

HUNTSMAN



RoK Army K-9 battery firing (Hanwha photo)

being one of many companies looking at the technology. There are several methodologies to use, but according to Forbes Magazine, the biggest company in Australia is the Commonwealth Bank with revenue just over US \$30 billion. The Hanwha corporation is more than twice that size. When a company like that decides to invest in a particular technology, they bring a lot of horsepower to bear. That is something that could benefit the Army with their interest in robotic and autonomous systems.

Hanwha believe that an autonomous AS-10 has a number of features that make it worth investing in:

- Reduce the number of soldiers exposed to lethal environments
- Less training time for personnel
- Reduced cross country vehicle damage due to Al controlled movement
- Reduced injury through AI controlled ammunition / stores transfer
- Less personnel for the same military effort
- Reduced impacts of fatigue, enabling extended operating hours

As exciting as an AX-10 is, it is only one part of potential growth path for the K-9/AS-9 family. It is worth noting that this SPH is now the most popular in the western world, having been ordered by Australia, Egypt, Estonia, Finland, India, Norway, Poland, South Korea itself and Turkey. The UK is a probable future customer.

Some countries have opted for local licensed production – such as Australia – while others are buying straight from the massive production line in

Changwon, which is producing a K-9 every 3 days to meet global demand. To date, 1,700 SPHs have been built – with a lot more to come.

The latest customer is Poland, which on August 22 announced a US \$2.4 billion deal with Hanwha for K-9s. Later tranches will be built in Poland, but the initial order – media reports say it is for 212 SPHs – will be delivered from South Korea. This is part of a package deal signed between the two countries that also includes K-2 Black Panther

main battle tanks and 48 FA-50 light attack fighter jets. The total order for Poland is for 648 K-9s – an indication of how seriously concerned that country is about a future conflict with heavily armed Russia.

A future version of the K-9 will feature an autoloader for the 155mm gun, reducing the crew from five to two. Some consideration is also being given to increasing the barrel length from its current 52 calibre to 56 calibre or even 58 calibre, though the latter is probably getting unwieldly. A Huntsman will be able to fire conventional ammunition more than 30km – and with techniques such as base bleed will exceed 40km. With a longer barrel and enhanced technologies in the future, ranges approaching 100km can be expected.

Hanwha believes that by the 2030s, fully autonomous SPHs will be feasible, with the designation K9-A3. Australia is already part of the journey – and an autonomous AX-10 could be a very good way to cement an ongoing role in a huge defence technology area. The local subsidiary is already working on this with a number of entities such as Deakin University, Eclips Logistic Engineering, and Gaardtech. The Korea Research Institute for Defense Technology is also involved.

If Australia became a centre of excellence for autonomous AS-10 production the export potential to the global fleet of K-9 operators the export potential would be considerable.

(Disclaimer: the author travelled to South Korea as a guest of Hanwha. He would particularly like to thanks Katherine Ziesing.)



Rok K-9 battery on exercise (Hanwha photo)

ARMY BATTLE MANAGEMENT SYSTEM LAND 200 UPDATE

A key project for the Army for more than a decade has been LAND 200 – an amalgam of the previously separate projects LAND 75 for a Battle Management System and LAND 125 for a future soldier system. The official intention is that LAND 200 is providing Army with a tactical Battle Management System and an integrated Tactical Communications Network to transform command and control of Land Forces into a modern networked system.



An Australian Army officer talks to Secretary of Defence Greg Moriarty about a Bushmaster-mounted Battle Management System based command post during the Army Demonstration Day on 23 August 2019.

Credit: CoA / Sebastian Beurich

rmy has several existing C2 systems, including for Electronic Warfare and also artillery in the form of the Advanced Field Artillery Tactical Data System (AFATDS), but the one we refer to is designed to network soldiers, vehicles and commanders. The incumbent supplier is Elbit, although – as has been widely reported – much of their system was withdrawn, or the use of it suspended, for reasons that remain opaque. Asked for an update, Defence supplied a high level summary:

"The Battlefield Command System to be delivered by the LAND200 Project consists of a Tactical Communications Network and a command and control Battle Management System. The current delivery phase of Land 200, Tranche 2, includes partnerships with L3Harris

Communications Australia Pty Ltd (L3Harris) for the Tactical Communications Network and Elbit Systems Limited (Elbit) for the Battle Management System.

"Defence is currently preparing a proposal for Land 200 Phase 3, the next phase of the project, for Government consideration."

When fully fielded, the BMS will digitise the Joint Land Forces command and control system to allow the ADF to decide and act faster than its adversaries.

The situation is that Land 200 Tranche 1 represents the capability fielded today and achieved Final Operating Capability in 2015. It digitised approximately one third of Army's vehicle platforms with a Battle Management

System (BMS). It also provisioned a tactical communication radio network across Army capable of supporting intelligence, fires, electronic warfare and command and control functions. Elbit was awarded the initial contract in 2008.

Land 200 Tranche 2 is currently technically in acquisition – though that has been paused - and was scoped to expand Tranche 1 into additional combat vehicles and training establishments. This is the current phase and while Elbit have a contract to support what has been delivered to date the roll out has been paused because of issues regarding the maturity of software releases. We have attempted to grapple with the complexity of the situation in previous editions, with limited success.

An Army proposal for Land 200 Phase 3 will be presented to Government for First Pass Approval later this year. It is believed to be scoped to complete digitisation of the Joint Land Force and evolve capability to meet future needs – and some additional detail has been provided by Chief of Army, LTGEN Simon Stuart (see separate interview)

This article is focused on progress, including one major disruption, to the newly installed Battle Management System (BMS). This is really the deliverable for the Australian Army which involves transition to digital systems for planning and monitoring battles with maps which include overlays, orders, messages and blue and red force tracks.

The BMS relies on mobile, highly secure communications infrastructure, called the Tactical Communications Network (TCN), which provides voice and data distribution to it and other combat systems such as the AFATDS.

Defence's planning and control of its battlefield command system is creating a change from an analogue paper and voice system to a digital one that is functionally much more capable. They believe that this move to a modern fighting force enabled by digital systems will generate speed of action through faster and more agile decision-making.



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BMS

In their words 'The capability will provide modern information technology to link sensors, weapon systems, commanders and their personnel in a networked environment. This will allow personnel to access and exchange command, control, situational awareness, and targeting information regardless of the operational scenario.'

LAND 200 deliverables were divided up into three tranches.

Tranche 1 comprised three separate, but related projects intended to equip a third of the Army: These were Land 75 Phase 3.4, known as the Battle Group Command, Control and Communication System (BGC3) which enabled the distribution of tactical combat data to and from vehicle commanders and infantry. LAND 125 Phase 3A a dismounted (soldier-carried) Battle Management System, and JP 2072 Phase 1 – vehicle-mounted radios and vehicle installation kits. Tranche 1 achieved Final Operational Capability in March 2015.

Tranche 2 was intended to equip almost another third of the Army with the Land 200 capability. Tranche 2 is also continuing the development of the Battle Management System, including enhancements to Joint (Australian Defence Force) and Coalition (international) interoperability. Contracts were signed with Elbit (BMS, services), Harris (Network Enabled Radios, TCN) and Raytheon (Tactical Data Radios) in September 2017.

Tranche 3 of LAND 200 was intended to run from 2018 to 2027, completing the introduction of the LAND 200 capability across the Joint Land Force, at a cost of \$1 billion-\$2 billion. The main capability elements of Tranche 3 are:

- Expansion of the Battle Command System across Army and to select Navy and Air Force elements
- A Beyond-Line-of-Sight Communications capability
- Dismounted BCS capability (including hardware and communication equipment, not including BMS software)
- · Radio modernisation
- · A data interface with Joint and Coalition systems
- · Technology refresh

Without wishing to prolong this recording of LAND 200 progress it should be noted that the Australian National Audit Office's report 'Modernising Army Command and Control - the Land 200 Program' released on 23 May 2019 contains a very detailed analysis of events, why they occurred, and what corrective action has been taken.

An article published on the APDR website 17 May 2021 included this section 'The December 16, 2020, cancellation order from Army. 'While rumours about problems with the Battlegroup and Below Battlefield Command System have been swirling for a while – and the project was officially paused last year for a re-evaluation. The events nevertheless have come as a shock, partly because the situation has developed without any form of public information, taking everyone by surprise.

'The Army instruction was very specific about what needs to have happened:

'The employment of the BMS-02 system version 7.1 within Army's preparedness environment is to cease no later than May 15.

'The following items are to be withdrawn, consolidated and quarantined by Signals Support Staff: memory portable solid state BGC 3 software USB memory stick; disc drive unit BMS-LAN PC, 256GD SSD, complete with mounting caddy; disc drive unit BMS ETC/SPLIT ETC, 64GB HDD; Personal Data Unit

'The BMS-C2 system version 7.1 is not to be configured or accessed on the following systems:'
(APDR does not publish classified information.)

Elbit reacted strongly and expressed full confidence in the BMS they had been developing over the previous 10 years at a cost of around \$1 billion.

APDR approached both Defence and Elbit for details of the current BMS situation. Both were reminded that APDR did not want any classified or commercial-in-confidence in responses to our questions. Elbit made their position clear immediately: "Aside from any public political comments made by government, Elbit Systems of Australia would not comment on private commercial discussions."

ELBIT SUMMARY OF CURRENT SITUATION

When APDR asked Elbit Systems Australia about the current situation, their Managing Director, Major General (Ret'd) Paul McLachlan AO CSC, gave us a very straightforward response. He noted that:

"Elbit Systems Australia was advised in April 2021 that Army would be issuing a "Cease Order", that with effect from 15 May 21, Army was to cease using the in-service versions of the BMS.

"Elbit has not been advised if that order has been rescinded. Elbit remains in contract to sustain the in service BMS, BGC3 and BMS Training System.

"Elbit continues to update the in-service BMS software, ensuring its security configuration is up to date, maintains the BGC3 hardware and delivers BMS training to Army. The sustainment contract is active and continues until the closure date in March 2023."

There has been continuous development of Elbit's BMS products. APDR has been made aware that Elbit Systems continues to develop the global baseline for BMS-C2 as an open Platform as a Service software model, ensuring it delivers the functionality sought by a range of international customers, and remains accessible to third party software developers.

BMS-C2 related product sets are in service with, or being developed for, multiple militaries and national security bodies including the UK, US, Canada and Israel. The Australian Land 200-2 Program is scoped to deliver BMS-C2 against the Australian specification.

Given this situation of ongoing product development, APDR asked Elbit about the current contractual relationship with the Commonwealth Government. Paul McLachlan's very clear response was that:

"Elbit Australia remains contracted to sustain the in service BMS and BGC3 and is actively working with Commonwealth contract representatives in doing so. This contract closes in March 2023."

IN CONCLUSION

Are we any further ahead in knowing what will happen next with LAND 200 and the Elbit BMS and BGC3?

While Defence is not supplying a lot of detail on the current Elbit BMS situation, it must be assumed that there are intense negotiations going on behind closed doors.

What a challenge this will have presented to Australian Army staff who had already made the conversion from pen and paper analogue working to the sophisticated Elbit digital system.

Noted that Elbit are continuing BMS developments both in Australia and overseas, while remaining contracted until March 2023 to honour and support their BMS, BGC3 and BMS Training contracts.

Whatever Army's reason for withdrawing BMS and the BGC3 infrastructure from active service, and there have been some clues about what that was, let us hope that everyone – industry, Army and CASG – has learned from this unhappy experience.



CHIEF OF ARMY, LIEUTENANT GENERAL SIMON STUART, AO, DSC, IN CONVERSATION WITH APDR EDITOR KYM BERGMANN



Official Portrait of LTGEN Simon Stuart, AO, DSC.

Kym: Let's start with current events and the Defence Strategic Review. What is the process for engaging with Army?

LTGEN Stuart: The reviewers are fully independent – and we are supplying answers to their questions. I've done that face-to-face, as have many of my colleagues. We have also organised ourselves to make sure we can answer any further questions they may have and provide the detail required for their deliberations. It's a good opportunity for engagement and we have a lot to contribute about the environment in which we operate today and in the near future.

We need to explain how Army contributes to the Defence strategy and managing the tension between maintaining our current readiness while also preparing for tomorrow's contingencies.

Q: There has been a lot of speculation in the media that the DSR is holding up projects such as LAND 400 Phase 3. Can you comment?

A: You are right – there has been a lot of speculation. What we know is that we are coming to the end of an exhaustive multi-year process for LAND 400 Phase 3, which is the last component of Army's combined arms fighting system. This is pending a decision by government and is still the subject of a live tender. Overall, the scope and timeline has not changed – nor has the requirement for the capability to ensure that the ADF is relevant and credible in all warfighting domains.

Q: The other question on my list relating to a specific project is Army's Battlegroup and Below Battle Management System. Can you update what is happening there?

A: You are referring to the Battlefield Command System, which has two key components. One is the tactical communications network and the other is the applications that support decision making. The latter is the Battle Management System – and we have learned a lot through our partnership with Elbit over more than a decade of interaction.

That has informed the requirements that we have for Phase 3 of LAND 200. At the top level that has three requirements:

- Open architecture
- Compatible with the US and other partners
- Able to be used on our classified systems
 Experience to date has helped us refine
 those requirements for Phase 3, which is due
 to be considered by government for First Pass
 consideration in the fourth quarter of this year.

In the interim we have fielded a system that is based on in-service software. We have given it to our people – and as Australian soldiers always do, they have been innovative and produced a system that works. But to be clear, it is not a long-term solution. That's why we are very focussed on making sure that we apply what we have learned to get the best possible outcome for Phase 3.

Q: Moving to the bigger picture, your promotion comes at a time of great change, particularly in the strategic environment. How do you rate the biggest challenges that you and Army have to face?

A: You are exactly right Kym to say that the biggest challenge is how do we evolve and adapt in a way that meets the demands of our operating environment. To my mind there are three key areas that need our focus. They are: people; readiness; and modernisation.

When it comes to people, we are in a very competitive market – and this is probably the case for every employer in Australia. There are a couple of aspects to that. First is retention – keeping the people we currently have. The other is being able to recruit new people to join our organisation.

When it comes to retaining our people, we want to make sure that the value proposition for them and their families is competitive. We will never be in a position where we can pay as much as people might receive when working for commercial entities, but there are a range of other aspects that contribute to the lived experience of our staff and their families. When that is added, I think we can compete – and that also applies to recruitment.

I would like to engage a bit more on two things – purpose, and people. Being part of something that matters is bigger than us as individuals and which give us a sense of pride are important things. Being part of an organisation that serves the society in which we live is hugely fulfilling and satisfying. I'm not sure that the people we are seeking to recruit necessarily understand the benefits of that value proposition – but it's something that everyone in uniform who continues to serve is cognisant of.

That's why we continue to serve.

The other key aspect is our people – you get to work alongside a really diverse range of people with different backgrounds, different skills, different education and who make a variety of contributions to our collective mission. Ultimately they are people who you can trust with your life and I think that's



Vehicles from the School of Armour fire on target during the firepower demonstration at Puckapunyal Military Area in Victoria, on 17 August 2022. Credit: CoA / Michael Currie

worth a lot in the society in which we live.

On the matter of readiness, we are now in our third year of domestic support operations. We are an Army in the community, and we have been there in their hour of need – and we always will be.

our contributions to the cyber and space domains. We are working towards a modernised, world class combined arms fighting system. We are the only part of the ADF that can engage in combat in the most lethal of land environments. On top of that, we are

We have put a lot of effort into making sure that we have a future-ready workforce – and we are also transforming the ways that we train and educate our people – be they full time or part time.

However, the opportunity cost is that we haven't been able to focus the time and attention on our primary reason for being, namely our warfighting skills – so that's an area of focus for me. It's important that we rebuild our readiness, particularly for contingency operations.

The third key focus is our modernisation program. We are transforming the Army in terms of new capabilities such as long range fires, littoral manoeuvre, modernised special operations, and

enhancing our capacity and capability in aviation, logistics and engineering.

We are applying new and emerging technologies to all aspects of Army's modernisation. We have settled on four key technology areas: robotics and autonomous systems; artificial intelligence and machine learning; quantum technologies; and human performance optimisation. They span all of our modernisation efforts.

We have put a lot of effort into making sure that

we have a future-ready workforce – and we are also transforming the ways that we train and educate our people – be they full time or part time.

Q: Regarding your point about the need to focus on readiness and the disruptions of fires and more recently floods, how will you be able to do that if natural disasters continue, or even intensity?

A: The range of support, as you pointed out, has been from fires to floods to Covid and including assisting in aged care – and it's clear that those needs will not just go away. This is both for humanitarian missions and disaster relief, domestically and offshore. We will always be there when our community needs us. However, it is a national challenge to ensure that we have the capacity to deal with these events with the right elements from the community and government - so that we are using the right tools for the job.

We will always have a role to play in initial response, but when it comes to relief, recovery and resilience, that's where I think the broader national challenge really comes to the fore.

1ST PERSON



Australian Army soldiers from 5th Battalion, The Royal Australian Regiment, on board F470 Zodiacs conducting small boat training in the littoral environment during Exercise Tiger's Run 2022 on the Timor Sea off the coast of NT. Credit: CoA / Rodrigo Villablanc

Q: To focus on just one area of modernisation, I'm particularly interested in autonomy because of work Army has been doing with things such as modified M-113s. Would you mind expanding on how that might affect the future of Army?

A: Certainly. It's very clear to us that as a modest sized organisation – and that's both the ADF and the Army – there are great advantages to be had in terms of scale, mass, and effect from the application of technology. Also, wherever we can we try to reduce the risks to our people. We have been using various types of robots and autonomous systems for a while. We have invested in a range of proof-of-concept activities that will help us to define requirements and apply solutions in the short and medium term.

Some of those are things such as leader-follower technologies. We have been investing in the development of sensors and algorithms that, for example, could see a logistics convoy that is fully autonomous – or it might have one or two crewed vehicles and other uncrewed vehicles that are able to follow them. During Exercise Koolendong with

the US Marine Corps in northern Australia last year we demonstrated a remotely operated M-113-based combat team.

The things to focus on are the sensors, the communications links and the algorithms, as well as the tactics, techniques and procedures and

soldiers on the operational problems of the day and how to apply new and emerging technologies to solve them in practical ways.

We are also investing in alternate concepts like additive manufacturing in the field; alternative form factor water purification; and electrification. Minister

It has highlighted for all of us – and I mean that globally – the value and fragility of the rules-based order that we have relied upon for the last eight decades.

operational concepts. The reason we used the M-113 is because that is what we have to work withbut the attention is really on the technology, where we think there is great potential payoff.

We have been working with industry – and there is a really impressive small-to-medium enterprise sector in Australia. We conducted two experiments last year - the Army Robotics Exposition (ARX) and the Quantum Technology Challenge (QTC) which we added to the long standing Army Innovation Day to focus teams comprising academia, industry and

Matt Thistlethwaite just unveiled an all-electric Protected Mobility Vehicle – a Bushmaster – at the Chief of Army's Symposium on August 10.

All of these developments are aimed at reducing the burden of supply, support and overall logistics – cognisant of the challenges of distance and the difficulties of mobility in Australia and the region. There's a lot of great work going on in the hands of soldiers, who are good at figuring out what works and what doesn't.

We are supporting them through some key



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This will ensure commanders have decision confidence and enable capabilities that will seamlessly integrate with new and existing technologies as needs evolve.





Australian Army soldiers from the 1st Battalion, Royal Australian Regiment, conduct Point Target Reconnaissance during the 2022 Duke of Gloucester Cup in Singleton. Credit: CoA / Madhur Chitnis

initiatives. One is called an IXG – an innovation experimentation group – which helps our soldiers with design and thinking skills that are then applied in a Maker Space. We rolled out seven of those last year. Maker Space provides the physical environment and the tools to apply those skills to address the challenges they face daily in doing their jobs.

It is also resident in some of our capability decisions, such as acquiring Apache helicopters, which will give us the most capable human-machine teaming interface and provide us with a logical waypoint on the way to crewed-uncrewed teaming and then future autonomous systems. I could go on, but I won't – but it's an area that personally I'm quite passionate about.

Q: I'm aware of that from our previous conversation. A big current topic of course is the Russian invasion of Ukraine. Are there any lessons that Australia can learn in a military sense?

A: Yes, there are – though I think it's too early to be drawing conclusions from this phase of the war, which started on February 24th. This has to be seen in the context of a conflict that actually goes back to 2014 when Russia annexed Crimea. This particular phase is greatly increased in scale, scope, level of kinetic activity, the destruction – and most importantly the visceral impact it is having on human lives.

There are a few things that can be said under

four broad headings. The first is in the category of historical context, where this war is an example of how deterrence can fail and how assumptions can be wrong. Another is that once a conflict begins it can unfold in unexpected ways and move in unusual directions, not as it may have been envisaged.

It has highlighted for all of us – and I mean that globally – the value and fragility of the rules-based order that we have relied upon for the last eight decades. It's also seen the re-emergence by some state actors of a willingness to try to impose their will on others by the application of violence.

The conflict has also reinforced the enduring human nature of war and the impact it has on people and populations. It's also a reminder that war is a national endeavour – it's not just something that the military does alone.

Strategically, it's a really good illustration of where an aggressor overestimates their own capabilities and underestimates those of their opponent. We are seeing the perpetual cycle between the rise of new technologies and ways of operating – and their various counters. We are watching these developments very closely.

At the operational level, we can draw some lessons about the importance of planning and preparation and in particular logistics. For us, there are also issues from a national resilience perspective that are worth noting - including having an industrial base that can support operations.

At the tactical level, very simply if you pit old systems and vehicles against modern systems and vehicles – and if you then double down by employing them very poorly - you are going to lose the fight.

Q: It's also a reminder of the importance of deterrence and how truly ghastly a conflict can get.

A: Indeed.

Q: To switch to a couple of hobby horses of mine – I've always been a fan of the Tiger ARH, possibly because I spent a week with a French unit operating them in Afghanistan. You have mentioned the acquisition of Apache, but why not also keep the Tigers and thereby double the size of your attack helicopter fleet?

A: I spent a year in Afghanistan working with the U.S. and their Apaches, just to give you my frame of reference. It's a good question. The facts are that the Tiger is becoming less and less capable in the operating environment while Apache is becoming more capable because of its development program. It comes from a much, much larger global fleet – and it is operated by regional partner countries – including Indonesia, Singapore and others - as well as the U.S.

Very importantly, it offers us a waypoint for human-machine teaming as we move to having more uncrewed systems in the air.

Finally, I just can't afford to run two attack helicopter fleets.

Q: The last item I would like to explore are your views on the future of heavy armour, noting that this topic always stirs up a huge amount of interest whenever main battle tanks are mentioned, especially considering what we are seeing in the Russia-Ukraine war.

A: We could talk about this for a long time, but if we start with the proposition that Australia wants to be relevant and credible in all five warfighting domains, what does that look like when we focus on land operations? I've sketched out what our modernisation plan looks like – specifically it is designed to be part of the joint force to counter current and emerging threats. At the heart of Army's approach is the combined arms fighting system.

In my view, the most significant expression of national will and resolve is to put our young women and men in harm's way, on the ground, to prevent someon e else imposing their will on us. This is combined arms system and the ability to apply and contribute to joint and combined effects.

Those are the facts. Historically we have employed armour in our region: in places such as Vietnam and during the Second World War in Papua New Guinea. Every one of our partner nations in the South East Asian region has armour – and are continuing to invest in it, including main battle tanks. The only country that didn't make that investment is the Philippines and after their very sobering experience in Marawi they are now acquiring armour.

In terms of mobility, the M1 Abrams tank has slightly better ground pressure than a family minivan



An Australian Army ARH Tiger from the 1st Aviation Regiment hover-taxis to taxiway November during a Weapons and Tactics Instructor course held during Exercise Griffin Eagle at Arizona USA. Credit: CoA / Gavin Partridge

often done among populations – and it is often to protect those populations.

If there was another way of doing that – another way of guaranteeing mission success – and to meet my obligation to do everything possible to bring our soldiers home safely, I would be first in line to consider it. But I think there are some unrealistic expectations about how far technology has come – I hope it gets there, but we aren't there yet.

If we need to put our young women and men in harm's way, the best way to do that is to ensure that they have the protection, lethality and mobility that they need. They need a connection to the broader - its tactical mobility is excellent. In terms of strategic mobility, we work with the U.S. – and one of their LSV's can take up to 24 armoured vehicles – and in addition our navy is increasing its lift capability.

Another point is that a battle group today – or even historically – in terms of its operational and combat effect can be replaced by smaller teams. This means that armour represents a smaller proportion of the Army, but at the end of the day we still need the capability for operations.

If we need to go into combat, I don't want Australian soldiers to go into a fair fight – I want them to have an advantage.

ABRAMS TANKS – DO WE NEED TO BUY THEM?

Why, for goodness's sake, would Australia be wanting to buy more tanks? Is it a distant memory of World War 2 and fighting in North Africa, or deployments more recently in the Middle East?

The die appears to be cast with purchases going ahead for the moment.



An Australian Army M1A1 Abrams Main Battle Tank fires its main armament during Exercise Gauntlet Strike at Puckapunyal Military Training Area in Victoria. Credit: CoA / Dustin Anderson

hen APDR asked Defence about the current Abrams tank situation their spokesperson gave an unequivocal answer "Defence will invest \$3.5 billion in the Main Battle Tank Upgrade (LAND 907 Phase 2) and Combat Engineering Vehicle (LAND 8160 Phase 1) projects with approximately \$2 billion approved in acquisition and \$1.5 billion in sustainment.

"Upgraded M1A2 SEPv3 Abrams Main Battle Tanks and Combat Engineering Vehicles are being acquired via the United States Government Foreign Military Sales program."

The author of this article considers there can be no basis for requiring tanks for any military operations in South East Asia, our most likely engagement area in the near future. Hopefully the Defence Strategic Review currently underway will agree.

Interested readers know the love of firepower goes all the way back to Oliver Cromwell, at the Battle of Edgehill in 1642, who is supposed to have told his Roundhead troops in that opening fight of the English civil war, "Put your trust in God, my

boys, but mind to keep your powder dry.'

Have those who plan future equipment requirements for the ADF not even noticed the trend for a lightly armed adversary to use loitering small aerial vehicles, similar to the AeroVironment Switchblade kamikaze drone, to fly and hover over tanks, descend onto them, then explode their onboard munitions causing destruction of the tank including killing all of its crew.

Not only are there those small aerial threats, but what about ones available to U.S. forces such as the Stormbreaker? This is an air-launched tank-killing precision weapon, able to track and destroy moving targets from ranges as far as 40 nautical miles. Now, it can be fired from the F-35, but similar weapons are likely to be in the hands of potential adversaries within a few short years.

The new Phoenix Ghost is a loitering munition produced by AEVEX Aerospace, and is similar to Switchblade which means that it will almost certainly be easy to transport and launch from the field. Ukrainian operators, already familiar with kamikaze drones will need little if any training to use new aerial weapons like the Phoenix Ghost.

Whilst exact details about the system are unknown, loitering munitions have already proven themselves extremely effective so far in the Ukrainian conflict with the Switchblade 300 being utilised to conduct surveillance and anti-personnel operations.

Additionally, Ukraine is using Polish Warmate loitering munitions, which have a range of around 30km and anti-armour capabilities. Ukraine has two domestically produced loitering munitions – and whilst production capabilities have likely been destroyed, the remaining stock pose a significant

threat to Russian forces.

Loitering munitions main utility is that they enable rapid reaction times against targets which only emerge for short period of times, allow for selective targeting without risking high-value platforms.

What is the rationale being used by Australia's defence equipment planners to want to order new tanks?

Australia's modest \$2.5 billion upgrade to the Army's tank fleet will see its 75 M1A1 Abrams tanks replaced with the most up-to-date model, the M1A2 SEPv3, as well new engineering and recovery vehicles based on the M1 Abrams chassis.

The SEPv3 model boasts a suite of new hardware, including a 'smart' gun that can fire programmable munitions, better sensor and communications equipment, and a remote-controlled turret.

Another modification not in existing tanks includes a new type of explosive reactive armour, which deflects hits by exploding outwards when impacted. The new tanks also include the Trophy active protection system which detects and intercepts incoming threats with a blast of small projectiles.

The question has to be asked "When did Australia last use tanks in warfare actions? The answer is "More than fifty years ago during the Vietnam War."

Nearly all analysts who have looked at the question of where the Australian Army might use tanks in the future have concluded that it is highly unlikely. Any engagements in the Indo-Pacific where Australian forces might be involved are likely to be mainly dependent on naval and air assets. Any future attack on Australia's North can be met by air attack.

Even if unmanned versions of these tanks become available in the future, the same arguments are likely to prevail on the unlikely relevance of tanks in any future military actions where Australia is likely to be involved.



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KOREA OFFERS FULL TRANSFER OF MULTIPLE LAUNCH ROCKET SYSTEM TECHNOLOGY TO AUSTRALIA

Australia seems highly likely to purchase the US High Mobility Rocket Artillery System (HIMARS), which is being used with devastating effect against the Russian invaders of Ukraine - but there is an alternative. South Korean company Hanwha is also at the forefront of rocket artillery systems and says that if Australia is interested, it would transfer all technology – allowing for local production not only of the launchers but also more importantly the precision guided missiles that they fire.

odern rocket artillery systems emerged from the Second World War and the success of the 'Katyusha' used in huge numbers by the Red Army for saturation bombardment of the battlefront. The concept was fairly simple – mount between 14 and 48 unguided rockets with explosive warheads on rails on the back of a standard truck, point them in the general direction of the enemy and ripple fire the lot within a few seconds. The individual rockets were not accurate, but this was compensated for by huge numbers of them arriving from multiple launchers onto a target area almost simultaneously.

While in widespread use in the Soviet bloc and with allied nations such as China – and North Korea – they were relatively unknown in the west until the 1980s. This is where HIMARS originated, starting life on a tracked chassis rather than the current lighter, faster, wheeled version. In parallel, the same concept was being explored by South Korea, which



Chunmoo MLRS firing (Hanwha photo)



U.S. Marine Corps High Mobility Artillery Rocket Systems with 3d Battalion, 12th Marines, 3d Marine Division, conduct a simulated fire mission during a HIMARS Rapid Infiltration event as a part of Exercise Talisman Sabre 2021 at RAAF Base Amberley, Queensland. (U.S. Marine Corps photo by Lance Cpl. Ujian Gosun)

had to counter the North launching a massive surprise attack involving human wave tactics and sending huge numbers of technologically inferior vehicles swarming across the DMZ.

In such a nightmare scenario, relatively slow firing conventional artillery risked being overwhelmed, but a truck mounted MLRS could deliver volleys of missiles, drive away and quickly reload. It would also be able to target concentrations of North Korean artillery while remaining beyond the range of enemy shell fire. This was the genesis of the multi-calibre South Korean 'Chunmoo' system, introduced into service in 2015.

MLRS technology has evolved greatly with the addition of precision guided munitions. While they still have the ability to fire massive salvoes of rockets, they are now also being used – as by Ukraine – for long range precision strike missions,

greatly adding to their usefulness and their lethality. With hydraulically controlled launchers, they can shoot successive missiles in widely different directions, pack up and drive away before counter battery fire arrives.

Each HIMARS vehicle carries a pod of six launch tubes, each containing a GMLRS 227mm rocket – with the G being for Guided. Each Chunmoo vehicle carries two pods of six tubes able to carry three different calibres of missiles: 12 227mm unguided rockets; 12 239mm guided rockets; or 40 131mm unguided rockets. While precise details are not public, the GMLRS lands within 10 metres of a target. Officially that's the same for the Korean 239mm rocket – but unofficially accuracy is 2 metres, which is fairly much a direct hit every time one is fired. Ranges for both missiles are +80km, with much more than that coming in future versions.



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Both the U.S. and South Korea have programs for 610mm guided missiles for HIMARS and Chunmoo that will have ranges of +400km.

People should not be concerned about the Hanwha system that fires various calibre missiles – they are all pre-packed and quickly loaded into the launch pod featuring an identical form factor, with targeting computers and fire control systems taking care of the details. A trained crew can reload two packs of Chunmoo missiles in about seven minutes. On paper, this system delivers a greater number of missiles than HIMARS – featuring two pods rather than one - and possibly more accurately, if we compare the 239mm Hanwha rocket with GMLRS.

An advantage Hanwha enjoys is for technology transfer because the company owns the IP not only for the launchers but also the missiles. It even builds the trucks – though any chassis will do - and so can offer an entire turnkey solution to a customer. Discussing this with no less a figure than Mr Jae II Son, President and CEO of Hanwha Defense, he explained that if a customer such as Australia wanted to build and support their own MLRS, all of the technology could be transferred from Korea

Mr Son explained that some international users of Chunmoo simply wish to make a direct purchase of the hardware with no interest in having local industry content. These customers cannot be named for commercial-in-confidence reasons but are probably

found in the Middle East. However, in keeping with Hanwha's corporate objective of rapidly growing their defence export base, all options for technology transfer are on the table – especially for an allied nation such as Australia.

It is unclear how much of HIMARS could be sourced locally because of U.S. ITAR restrictions.

Returning to Australian reality, Defence outlined the process here:

"Defence has released Letters of Request to the United States Government for the procurement of the High Mobility Artillery Rocket System (HIMARS) launchers and associated munitions to inform the procurement process for Project LAND 8113 Phase 1 – Long Range Fires. As a result of that Letter of Request, the United States' Defence Security Cooperation Agency has published a notification of approval by the United States' Department of State of the potential sale, which is standard practice under the US Foreign Military Sales process.

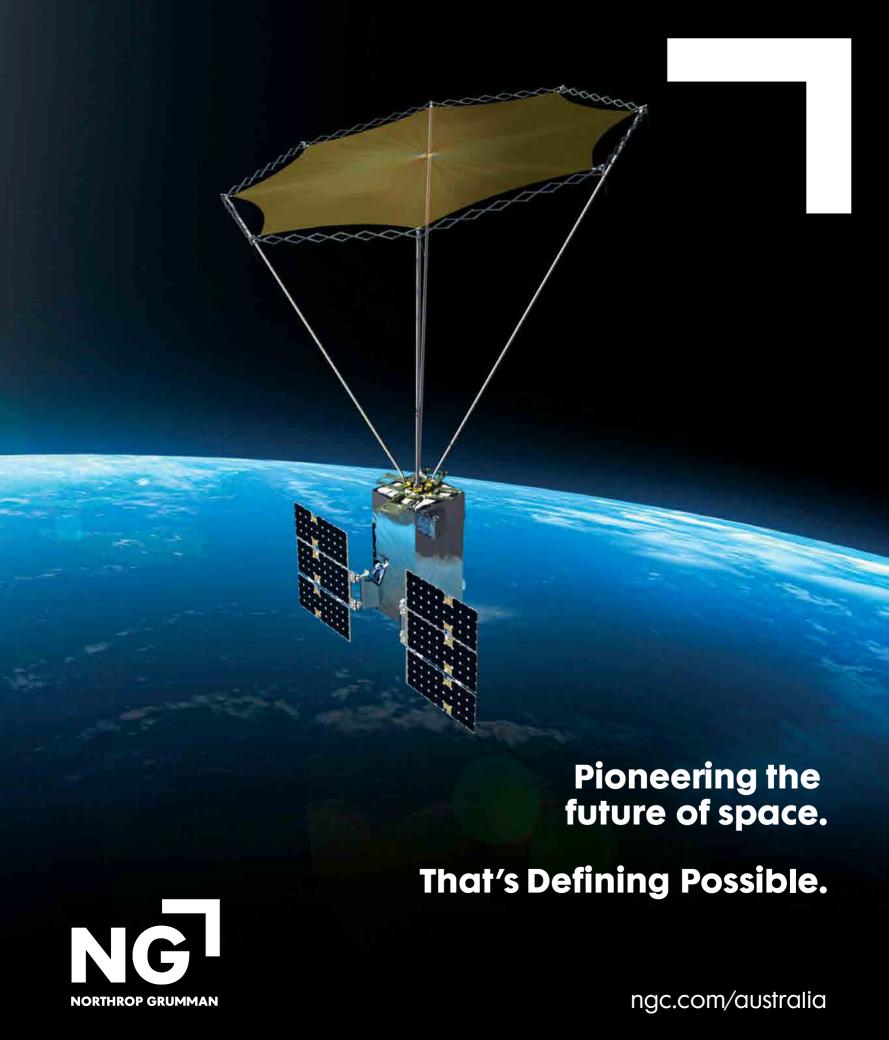
"Later this year, the Government will consider LAND 8113 Phase 1 for approval. If approved by the Australia Government, the Project will deliver a land based, mobile, long range strike capability for the Australian Defence Force.

"As part of the Project 'Risk Mitigation and Requirements Setting' phase of the One Defence Capability System (formerly Capability Life Cycle), Defence conducted an independent market scan that considered a broad range of options to meet the Long Range Fires capability need.

"As a related body of work, in 2021 the ADF and the US Armed Forces entered into a co development program for future increments of the precision strike missile that will seek to incorporate technology that allows ships and air-defence systems to be engaged. The first increment of the precision strike missile is planned to be in service with the US Army late in 2023. The surface-to-surface, all weather, precision strike missile will be capable of destroying, neutralising and suppressing diverse targets at ranges from 70 to over 400 kilometres."

It might be too late, but if there is an opportunity for Army to familiarise themselves with Chunmoo there would be no harm in doing so. Defence contacts between Australia and South Korea are expanding rapidly, but even more importantly the billion-dollar Guided Weapons & Explosive Ordnance Enterprise seeks to massively improve our military self-reliance. The local manufacture of Chunmoo – the launchers and especially the missiles – would fit in perfectly with that objective.

(Disclaimer: the author travelled to South Korea as a guest of Hanwha. He would like to particularly thank Katherine Ziesing.)



ANDREW MCLAUGHLIN // SYDNEY

MORE C-130Js COMING FOR RAAF

The ADF is set to fast-track the acquisition of an expanded fleet of new Lockheed Martin C-130J Hercules transports to replace the current C-130Js that have been in service since 1999.



A No. 37 Squadron C-130J Hercules aircraft prepares to land at Mount Bundey Training Area in the Northern Territory, during Exercise Diamond Storm 2022. Credit: CoA / Sam Price



C-27J Spartan aircraft on the hardstand at No. 35 Squadron, RAAF Base Amberley, Queensland. Credit: CoA / Jesse Kane

he RAAF's 12 current C-130J-30s entered service between 1999 and 2001 and replaced the 12 C-130Es Hercules of 37SQN which had entered service in 1966. Australia's C-130Js were built to an early US-common specification without many of the more advanced cargo-handling, navigation, and other systems that have since become standard fit on the Hercules.

The RAAF has enjoyed 64 years of accident-free Hercules operations, operating 12 each of the C-130A, E, H, and J models, and it looks likely that will continue with as many as 30 new-build C-130Js planned to be acquired under Project AIR 7404. The current C-130Js have been worked hard, with an almost continuous deployment to the Middle East of two aircraft at a time from 2008 to November 2021, and expanded roles at home.

The 2020 Force Structure Plan FSP said, "an expanded replacement fleet for the C-130J Hercules aircraft to improve the lift capacity of the ADF in response to growing demand for these assets," would be acquired, with funding of between \$8.8bn and \$13.2bn planned to commence in at the end of this decade. But this appears to have been accelerated.

Industry sources indicate the expanded fleet will not only cover the expanded air mobility requirement, but may also see the Leonardo C-27J Spartan replaced in the battlefield airlifter role for which it has been proven unsuitable. As an 'orphan' operator of the C-27J in the cancelled US Joint Cargo Aircraft (JCA) configuration, the 10-strong Spartan fleet has suffered from configuration-management, integration, and availability issues which has seen it essentially relegated to domestic peacetime tactical transport duties, and HADR and diplomatic support missions in PNG and the southwest Pacific region.

The expanded Hercules fleet will reportedly include between six and eight KC-130Js which will provide a hose and drogue refuelling capability for RAAF Super Hornets and Growlers as well as allied hose and drogue capable fixed and rotary-winged aircraft. While current and planned ADF helicopters are not air-refuellable, it may be a future



USMC KC-130J in Harvest Hawk configuration (U.S. Marine Corps photo)

option to retrofit Army's UH-60M Black Hawk and CH-47F Chinook helicopters with the capability, or may shape forward planning for any Future Vertical Lift capabilities the ADF may acquire.

The KC-130J also has a strike role in US Marine Corps service in its Harvest Hawk configuration, with a sophisticated sensor and communications suite and a palletised roll-on roll-off fire control console. This gives it an ability to provide armed-overwatch of forces on the ground, and employ precision AGM-114 Hellfire, or AGM-176 Griffin and GBU-44 Viper strike missiles against vehicles and non-hardened targets from wing racks and a 'Derringer Door' launcher mounted in the side paratroop door respectively.

With the implementation of the Defence Strategic Review in July, it is understood a Foreign Military Sales (FMS) request will likely go through the US approval process before the end of 2022, and a government decision and announcement on whether to proceed with program has been deferred until the Review reports in early 2023.



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SHOULD THE AUSTRALIAN ARMY PURCHASE 120MM MORTARS?

120mm mortars have been discussed as future Army weapons for at least the last 20 years, but no action has been taken. The concern has been that they are too heavy for personnel to handle, particularly since the distances obtained and other characteristics of the latest generation of 81mm mortars have improved significantly.



Australian Army soldiers from 3rd Battalion, Royal Australian Regiment, prepare to fire an 81mm mortar during a live-fire training activity at Townsville training area, Queensland. Credit: CoA / Daniel Sallai

he attraction of mortar systems is that they provide close-range, quick response, indirect fire when involved in tactical combat. They can launch high explosive, smoke and illumination mortar shells all in high trajectory, which can also be beyond direct line of sight.

They are typically co-located with infantry which means their responsiveness to infantry support requests is very rapid and the time of flight to their target is brief compared with classic large artillery pieces usually located at a greater distance from the fighting front.

AUSTRALIAN ARMY'S CURRENT POSITION ON MORTAR WEAPONS

APDR asked a Defence spokesperson for the current Army situation with regard to mortar weapons now and in the future. They responded in writing that:

"LAND 136-1 Land Force Mortar Replacement completed delivery of a modern, digitised 81mm M252A1 mortar system to Army and Full Operational Capability (FOC) was declared in December 2021. This included the digital integration of in-service 81mm F2 mortars into the M113 mortar variant (M125AS4) to avoid obsolescence in ballistic computation equipment.

"This integration work has ensured interoperability with the US for both 81mm mortar ammunition and digital fires systems.

"The M252A1 mortar system delivered by LAND 136-1 uses 'M-series' ammunition, manufactured in the United States and purchased through a Foreign Military Sales (FMS) case. CASG is in the process of assessing industry proposals for the Large Calibre Munitions Supply Initiative, which is focussed on domestic manufacture of 81mm ammunition to strengthen the resilience of ADF ammunition supply lines. The US Government has shown interest in Australian manufacture of US M-series ammunition.

"Where possible, interoperability with the US is a priority for the ADF, including for Army's indirect fires systems. Army is watching US mortar capability development with the intention to align as closely to the US baseline as possible.

"Army's replacement of the in-service M113 Armoured Personnel Carrier Mortar variant is planned to be delivered under LAND 400 Phase 3, with tenderers offering a 120mm Armoured Mortar Variant as part of their response to Army's requirements. Confirmation of the inclusion of the Armoured Mortar Variant remains subject to Government decision at Second Pass.'

U.S. CONSIDERING 120MM MORTARS FITTED TO ARMOURED **VEHICLES**

It is instructive to look at what the U.S. Army is doing. They have been seeking to achieve greater distances with artillery and missiles, but mortar systems are also keeping pace with their own technology advances.

Commentary read by APDR noted that 'Improvements in technology and manufacturing have played a role in shifting mortars away from their historic role of bulk suppression of troop movements in favour of very precise fires. The use of digital fire-control helps to both reduce human error and increase accuracy.'

The U.S. Army has signed an agreement with Finnish company Patria Land Oy to determine the feasibility of incorporating their new mortar (NEMO) technology into U.S. systems.

The Patria NEMO is a turreted, breech-loaded, 120mm smooth-bore mortar system with both direct and indirect fire capability. In addition to being highly protected, Patria NEMO is light, compact and easily installable on wheeled or light tracked chassis armoured vehicles.

Should Defence be considering this as a weapon alongside the LAND 400 Phase 3 Infantry Fighting Vehicle? This self-propelled mortar option could be funded by reducing the number of IFVs being acquired. That is an option which would make a lot of financial sense since the Defence Review underway at the moment is sure to study the likelihood of Army being committed to fight on a large area of land where the currently planned number of IFVs could be of

The major difference between the 120mm Patria NEMO and Army's current 81mm mortars are the advantages created by a NEMO which is mounted on the vehicle as a breech-loaded mortar system. The muzzle is outside the vehicle.

Advantages noted by APDR include improved



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MORTARS

safety for the mortar crew who no longer have to be close to the weapon's muzzle when it is fired. Mortar bombs are stocked within the vehicle, reducing the effort required of carry them when

loading the weapon.

Breech loading gives more flexibility inside the vehicle where some processes can be automated including control of the weapon with regard to

direction and altitude, amongst other factors. There is a choice between direct and indirect fire depending on the situation and placement of the

While having the mortar within the vehicle with its muzzle outside, and being able to fire almost horizontally, does offer some self-protection capability for the vehicle and its crew, this mortar is not intended to replace conventional guns mounted on such vehicles.

Readers are asked to indulge this article's author as he made a trip down memory lane while writing on this Australian Army mortar topic!

While having the mortar within the vehicle with its muzzle outside, and being able to fire almost horizontally, does offer some self-protection capability for the vehicle and its crew, this mortar is not intended to replace conventional guns mounted on such vehicles.

Many years ago, the author, after completing basic military training, then RNZ Sigs corps training, a few months later was tasked with attending a two-week field exercise with the NZ Army's 5 Light Regiment. His role was as the CO's radio operator. The Regiment was equipped with 36 4.2-inch (107mm) mortars. These had a maximum range of approximately 4000 yards (3.7km).

In his role, the CO's verbal fire orders had to broadcast by radio by the author to the Regiment's batteries. That was exciting enough. During each day's live firing, after all 36 mortars were ranged in on their targets, the CO would issue a single fire order to the three batteries. After they had all fired, the next verbal order he gave was "Repeat". When the author radioed this order, the result was that all 36 mortars fired simultaneously. What a feeling of power this gave such a young man! (This was the only situation where the word 'Repeat' was allowed on any NZ Army radio network, apart from artillery fire networks. 'Say again' was always used in its place).



Australian Army soldiers Private Mathew Linden, Lance Corporal Austin Rhue and Private Jayden Greenhalgh from the 8th/9th Battalion, Royal Australian Regiment, fire an 81mm Mortar during Exercise Diamond Catalyst 2020, at Shoalwater Bay Training Area, Queensland.

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LAND 8710 THE AUSTRALIAN LANDING **CRAFT PROJECT**

On 3 February 2021 then Minister for Defence, Senator the Hon Linda Reynolds CSC announced LAND 8710 Phase 1 to strengthen the ADF's amphibious capabilities. This would require an investment of up to \$800 million to acquire new fleets of Australian-built amphibious vehicles and landing craft that would be able to transport land forces with enhanced speed and protection.



Australian Independent Littoral Manoeuvre Vessel (ILMV). (Artist's impression, courtesy of Raytheon Australia)

ith two separate fleets to be acquired by 2026, the watercraft will provide independent shore-to-shore, shipto-shore, and over-the-shore capabilities to better manoeuvre and sustain the ADF in littoral and riverine environments. They need to be able to be transported by and to operate from the Canberra Class LHDs as well as HMAS Choules.

Through the project, an Independent Landing Craft will be delivered to replace the Army's existing LCM-8 vessels. This will present opportunities for Australian industry in the detailed design, build, maintenance and support elements of the project. One challenge is that the required new landing craft will be so much larger that the LCM-8s cannot be carried inside the LHDs and will need to connect with the LHDs rear landing ramp to load from, or unload to, the LHDs.

After an initial solicitation from potential bidders, Defence's formal Invitation to Tender was issued 19 December 2021 and closed 14 June 2022.

An Amphibious Vehicle will also be built to replace Army's current LARC-V which will offer significant opportunities for Australian industry in the vehicle's design, build, maintenance and through-life support phases.

The Commonwealth has a requirement to replace the existing fleet of Lighter, Amphibious Resupply, Cargo 5 tonne (LARC-V) amphibians currently serving with the Australian Army with a new Amphibious Vehicle (AV). This Invitation to Register (ITR) is seeking respondents to demonstrate their willingness, capacity and capability to provide an AV with an Australian Design and Australian Build.

Delivery will depend on the resultant contract however Initial Operating Capability is expected by 2026.

A Defence spokesperson advised APDR that: "Defence approached the market for tenders for the delivery of both LAND 8710 Army Littoral Manoeuvre Phase 1 platforms, up to 18 Littoral Manoeuvre Vessel - Medium (LMV-M) landing

craft and up to 15 Littoral Manoeuvre Vessel -Amphibious (LMV-A), in December 2021.

"The LMV-M open tender submissions have closed and are awaiting evaluation outcomes while the LMV-A restricted tender submissions closed on 6 September 2022.

"The future phases of LAND 8710 that will deliver a heavy landing craft (LMV-H), riverine patrol craft (LMV-P) and new facilities are currently in the strategy and concept phase of the One Defence Capability Model."

As far as APDR has been able to establish, the four syndicates that submitted LVM-M tenders were Australian Maritime Alliance (Serco/Civmec): Birdon Australia; Navantia Australia/UGL; and Raytheon/ Austal/BMT.

INDEPENDENT LANDING CRAFT REQUIREMENTS

Looking at the AusTender formal Invitation to Tender project description issued on 19 December 2021 it describes the landing craft requirement for up to 18 craft as being a steel hulled Littoral Manoeuvre Vessel - Medium (LMV-M) which 'Will provide independent shore-to-shore and ship-to-shore capability, to enable manoeuvre and sustainment of the amphibious Joint Force over extended ranges in restricted littoral and riverine environments.'

Clearly these vessels will need to be capable of operating with a full combat load of personnel, their equipment, two remote weapon stations, two 0.50 calibre machine guns, and armoured ADF vehicles, through relatively high seas for multiple days.

These missions may be at significant full load ranges of up to five hundred nautical miles from their operating base without requiring refuelling, while then retaining a 20% fuel reserve.

These LMV-Ms will be built to conduct open beach landings when the surf is up to 1.5 metres high, with alternative relatively calm rocky landing sites with up to 1.0 surf waves.

LANDING CRAFT



An Australian Army LCM-8 Landing Craft and Royal Australian Navy LHD Landing Crafts carry M1A1 Abrams Main Battle Tanks, M113 Armoured Personnel Carriers and Australian Light Armoured Vehicles, during an amphibious beach assault, as part of Exercise Sea Explorer, Cowley Beach, Queensland, Credit; CoA / Daniel Strutt

AUSTRALIAN MARITIME ALLIANCE (SERCO/CIVMEC)

When about to submit their team's tender documents, Civmec announced in May 2022 that it had formed an alliance arrangement with global defence contractor Serco in joint pursuit of the LAND 8710 contract.

Civmec and Serco are leading an Australiawide team in solution development and industrial mobilisation in pursuit of the LAND 8710 Phase 1A program. Over the past year, the design of the new 'Oboe' Littoral Manoeuvre Vessel Medium (LMV-M) has been optimised and refined to meet the needs of the ADF and now represents the next generation in amphibious capability.

Civmec CEO Pat Tallon was excited to progress Civmec's credentials in demonstrating a sovereign naval shipbuilding capability, saying:

"I am proud that Civmec is evolving to be a solid option for the Commonwealth as it seeks to expand on the Sovereign shipbuilding and sustainment capability. We are committed to the charge and look forward to forging strong relationships with Serco and others that are integral to meeting the demands of the ADF.

"Civmec's Henderson facility offers unmatched shipbuilding capacity to deliver for the Commonwealth's naval shipbuilding programs and combined with our new state-of-the-art ship assembly hall, we operate the largest fabrication workshops in Australia."

"This project builds on our experience gained through the ongoing delivery of the SEA1180 Arafura Class Offshore Patrol Vessel program. The LMV-M platform will allow us to continue to demonstrate our innovative approach to shipbuilding."

Serco Defence Managing Director Clint Thomas AM, CSC, said the alliance demonstrated the importance of delivering local industry resilience, facilitating workforce and workload predictability, and providing assured supply chain access to build a trusted and sustained Australian shipbuilding sector.

"Serco and Civmec share a vision to provide the crucial leadership that the Australian shipbuilding sector requires, signalling an industry-led strategic approach to deliver and support essential sovereign military capabilities and sustainable workshare outcomes," Mr Thomas said.

"With Serco and Civmec's complementary capabilities and shared community values for realising the sustained growth of Australia's Shipbuilding Industry, our alliance is set to deliver proven benefits through uplifting Western Australian industry capabilities, matching Serco's global shipbuilding expertise and reach with Civmec's superlative workforce skills, proven technology and infrastructure capacity."

The combined size of Civmec and Serco's workforce is 19,000 strong, with their local talent having proven themselves on numerous successful shipbuilding and infrastructure projects around the world.

The 'Oboe' will heavily rely upon and maximise the use of Australian Industry Capability to advance Australia's sovereign shipbuilding capability. Civmec, Serco and their nation-wide industry team stand ready to deliver for the Commonwealth, bringing Australian industry skills and expertise to the forefront, and positioning Australia to drive forward in establishing a sustainable and vibrant shipbuilding

In July 2022 the Class Certification Society DNV granted 'structural approval in principle' for the AMA's 'Oboe' design.

BIRDON AUSTRALIA

Birdon Australia is a wholly Australian-owned, international engineering and maritime business with over forty years' experience in Australian industry. It has over ten years' experience in the international defence market where the company is currently a major supplier to the US Army, US Navy, US Coast Guard, and other foreign defence forces.

Birdon has provided many and varied services to the Australian Defence Force including having previously delivered specialist vessels for the Army.

Early contracts included the refurbishment of the Army's Vietnam-era LCM8 landing craft, helping establish the company's amphibious warfare credentials. A 2004 contract with the Australian Army for 24 watercraft to help provide wet gap crossings for trucks and armoured vehicles was pivotal for the company and led to Birdon's expansion into the US.

Joe Smith, General Manager Defence told APDR that "Birdon is Australia's most experienced provider of Army watercraft, both here and in the United States, so LMV-M is a natural fit for the business.

"The function and performance specifications for LMV-M requires a significant step-change in capability from its forerunners. There really is no COTS or MOTS solution that will completely meet the Army's requirements for LMV-M, so existing designs will require significant modification.

"Given the uniqueness of the requirement set, we see it as an advantage that we were not encumbered by a legacy landing craft design. That enabled us to design a fit for Australian purpose mission and support system that has not compromised on the specifications and will deliver the Army a globally superior capability.

"In Australia, Birdon is the leading specialist military vessel designer and manufacturer with a proven history of supplying end-to-end solutions for Defence projects, and exporting that capability worldwide.

"We have assembled an extremely capable, experienced, and committed Australian team that strengthens the Naval Shipbuilding Plan and Australian industrial capability. Consistent with the maturity of our design, which utilises a proven hullform and has undergone extensive analysis and tank testing, our equipment, system and component selections are well-advanced.

"If successful we will be building the LMV-M at our partner shipyard in Henderson, WA. We have vast experience of partnering with shipyards internationally to meet our customers' requirements and look forward to applying that same expertise

LANDING CRAFT



Australian Army soldiers and officers from the 2nd/14th Light Horse Regiment (Queensland Mounted Infantry), conduct a beach landing with the new Boxer Combat Reconnaissance Vehicle (CRV) from an LCM-8 during Exercise Sea Wader 2020 at Cowley Beach Training Area, Far North Queensland. Credit: CoA / Jonathan Goedhart

locally in support of LMV-M."

NAVANTIA AUSTRALIA/UGL

Navantia Australia and CIMIC Group company UGL announced on 11 May 2022 they have partnered to jointly bid for the Australian Army's LCM-8 replacement project, LAND 8710 Phase 1 Littoral Manoeuvre Vessel Medium (LMV-M). This was shortly before they submitted their tender for this project.

Navantia Australia and UGL both have a demonstrated track record of delivering successful ADF projects and together, claim to offer the leading Australian LMV-M solution in terms of outstanding Australian Industry Capability, including an Australian sovereign design, Australian construction, and an Australian supply chain.

Navantia Australia Managing Director, Israel Lozano, said "The partnership between Navantia Australia and UGL offers combined experience in collaborating with both Navy and Army, to deliver superior results.

"Together we offer Defence a highly compliant design, cost effective delivery, surety of supply, contribution to the Naval Shipbuilding Plan and maximum Australian content."

UGL Managing Director, Doug Moss, said "I'm pleased that UGL has teamed with Navantia Australia to bring our substantial Australian heavy manufacturing expertise and genuine Australian sovereign capability to enhance the Australian naval shipbuilding capability."

As a major Australian services and manufacturing company, UGL has significant experience in complex project delivery. Its Australia-wide 6,700 strong workforce offer extensive manufacturing and support capabilities on both the east and west coasts of

As a leading Australian project-based organisation, Navantia Australia this year celebrates its tenth year in providing sovereign engineering, design, sustainment, and supply chain services to the Australian Defence sector.

RAYTHEON, AUSTAL, BMT

The AusTender documents described the planned landing craft as the Australian Littoral Manoeuvre Vessel-Medium (LMV-M). Raytheon Australia will lead a team, with Austal and BMT as the other partners. The syndicate says its solution is based on a proven design and has been tailored for the Australian environment. BMT will design the LMV-M, which will then be built by Austal at their Henderson WA shipyard.

When asked to comment on this project, Raytheon Australia's managing director Michael Ward noted in a media release that:

"Raytheon Australia knows how complex it is to bring a ship design to life - from training to operational testing and evaluation to sea trials and certifications. Our experience has taught us that this is a complex endeavour, requiring unique expertise that we have invested in developing over the past 22 years of delivering large-scale defence projects on time and to budget.

"The Australian LMV-M is a resilient and flexible vessel that meets Army's requirements. It is robust and capable, and future ready with clear growth

and upgrade opportunities to ensure our solution supports the Army in Motion as they respond to accelerated warfare."

Austal CEO Paddy Gregg stated his company's strengths in shipbuilding. He said "Austal is Australia's proven defence prime contractor that has designed, constructed and sustained multiple naval shipbuilding programs for Australia, and export markets around the world, for more than 20 years,"

Mr Gregg said:

"Our track record is proven. Working successfully with the Australian Border Force, the Royal Australian Navy and the Department of Defence since 1998, Austal has delivered 42 ships to the Australian Government, including the Bay, Armidale, Cape and Guardian-class Patrol Boats.

"Austal is currently partnering with more than 1,200 businesses across Australia to deliver projects like the 21 x steel-hulled Guardian-class Patrol Boats, which alone is achieving over 68% Australian Industry Capability (AIC) content - and is on time and on budget."

Austal Australia has established vessel manufacturing and service facilities in Henderson, Western Australia, as well as shipyards in Cairns and Brisbane, Queensland, and a dedicated service centre in Darwin, Northern Territory that are ready to support defence operations.

BMT's senior business development manager Trevor Dove believes that their customised Australian LMV-M design optimises stability, speed, endurance, fuel, stores, and accommodation for independent and in-company operations.

He has said that BMT's existing landing craft hull form is a mature design on which to base their LMV-M offering. He considers it is ready to be delivered, with the requested growth margins for the future ready Army.

IN CONCLUSION

LAND 8710 Phase 1 is obviously a very important project which will enable the ADF to operate around Australian shores as well as further around South Pacific islands and the coasts of East Asian countries.

With the first two landing craft due to reach Initial Operating Capability in 2026, just a little over three years away, the group that wins this tender will need to hit the ground running.

This project also provides a great opportunity for small and medium Australian enterprises to play an important role, not only in supplying components systems, but also at the construction and testing phases, before providing geographic support from locations around this great continent.

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RESUPPLYING COMBAT UNITS IN THE FIELD

Army logistics make the difference between winning a war or losing it. The most obvious example of a war that has developed unlike the leaders who initiated it is the current Russian invasion of Ukraine.



Rex Mk 2 (IAI photo)

he experts at the Israeli Defence Forces (IDF) are still analysing Russian failures but there are already some initial conclusions. One is based on research of the Russian support systems in Ukraine made by LTCOL (reserve) Eyal Ziz, commander of the logistic department of the IDF's 98 battalion.

In a paper he wrote for the official IDF magazine the officer says that an army prepared for long combat must prepare to feed its troops beyond the planned duration of combat:

"The Russians probably did not imagine that the fighting would last weeks or months, and the Russians had a great dependence on logistical planning: in Western armies it is customary to supply according to demand, while the logistics in the Russian army are built on supply according to advanced planning."

According to the IDF logistic expert, instead of the strategy dictating the logistics in the campaign - the logistics dictated the strategy. He points to another planning failure that apparently contributed to the poor organisation - the attempt to maintain the element of surprise:

" The decision to hide the army's plans for invasion was intended to generate disinformation experts agree that the basic system offered, will in the future enable the centralised autonomous operation of unmanned systems on the ground and in the air for combat missions.

Rafael recently demonstrated to the MoD an end-to-end system for planning and managing logistic resupply for units deployed on the battlefield. This solution was subsequently selected for a contract for experimentation activity under Lot 1 of Project THESEUS - a Joint Tactical Autonomous Resupply and Replenishment (JTARR) operation.

The end-to-end system is directed by a single operator mission control and management system. By employing fully autonomous UAVs and UGVs, it provides a groundbreaking solution to the challenge of battlefield logistic resupply.

With an added focus of minimising the number of forces in the combat arena through reducing

The execution of the mission is carried out autonomously by each of the platforms, without the need to risk human life.

and confuse the enemy but among those surprised were the Russian soldiers who were required to fight it."

The IDF itself is now engaged in what is dubbed "the war between wars" referring to the operations against the Hamas in Gaza and the Hezbollah in Lebanon. However, the IDF is getting prepared for a major war that will require a very well prepared logistic plan.

In this effort the IDF is using the technologies developed by Israeli defence companies.

These technologies have recently been selected by the UK Ministry of Defence (MoD) to demonstrate an advanced AI based combat logistic system. The two companies - Rafael and Israel Aerospace Industries (IAI) - have been selected after a long competition in which more than 100 companies took part.

The they have proposed systems that are based on the combat experience of the IDF. All the

the manpower requirement, the system relies on fully autonomous unmanned air and ground platforms. These components are managed and controlled by a master mission management system, which is based on modern technologies including COMBAT AI, GPS-free navigation and advanced image processing.

The logistics system, whose purpose is to perform delivery tasks to the tactical level, draws on and gathers information from a variety of existing battlefield sources (such as BMS and various command and information systems) as well as from commanders and units in the field. The system then analyses the information and uses it to generate meaningful logistic resupply tasks.

Through Al algorithms, the main mission control and management system can select the most appropriate and efficient platforms for each task and then plan respective individual operations. Simultaneously, the system plans the task from a

systemic standpoint.

The execution of the mission is carried out autonomously by each of the platforms, without the need to risk human life. Moreover, mission success is enhanced by the built-in range of intelligent algorithms which allow the system to identify and autonomously adapt to deal with the wide array of obstacles and threats that can arise spontaneously on the battlefield.

Shmuel Olansky, head of the multi domain warfare directorate at Rafael, said that the

immediate resupply needs and puts all other factors to optimise the delivery safely and in the fastest way:

"The AI engine we developed at Rafael is the heart of the system. It's the most advanced of its kind and based on the company's vast experience in using AI in a great number of our advanced weapon systems."

According to Rafael, while other companies are focusing on the autonomous operation of a single vehicle, their approach has been to enable

He added that the aim of the systems that were selected by the British is to lower the danger to the logistic teams:

"Our system is based on a hub that receives the demands from the fighting units and then prioritise them according to the fast changing status of the fighting."

The IAI official said that the THESEUS concept is a perfect solution for what is dubbed "The last mile" logistic challenge – supplying what the front combat units need at all times under all combat conditions."

IAI not only developed an AI based logistic system but also the supply platforms. One is the Rex UGV, which IAI is offering the advanced version the MK 2. This, according to IAI, is a multi-session system providing direct support to maneuvering infantry units.

It can perform a variety of tasks: tactical logistic support, tactical ISR, operating lethal weapons through target acquisition, evacuating wounded soldiers. It includes "follow-me" driving mode adapted for infantry forces.

The company says that Rex supports up to a 1.25 tonne payload and is powered by an electric hybrid system. Its range is 300km - 70km on electric power only. The operation modes include Tele-Operation beyond Line Of Site, "Followme" mode and is fully automous. It can be easily transported by a MV-22 or CH-47F.

Mr Avni said that a vehicle like the Rex is used

And while the focus is now on logistics, it is obvious that such an advanced Al-based system is also capable of controlling the growing number of autonomous ground fighting vehicles currently being developed by several countries, including Israel.

solution developed by the company utilised the capability offered by autonomous platforms. This is supported by autonomous control system decision making that allows it to minimise the number of soldiers on the battlefield and to perform the logistical tasks more efficiently and more safely.

Talking with the program managers at Rafael, the scope of the program and its potential for more than supplying ammo and food to front line units becomes clear. Michal Vermouth head of land autonomous systems unit at Rafael explains that the currently used logistic systems are complicated and slow:

"Our systems allows unmanned ground vehicles (UGV) and drones to perform the mission."

She explained that the system's "brain" gets all the requests from the different units in the combat zones. Then it puts into the equation all the different ways to bring the supplies and the best platform to perform the mission:

"A drone can make its way to an isolated fighting unit in 90 seconds and fly back to be reloaded"

Golan B (surname protected for security), marketing and business development director for the land systems unit of Rafael explains that the very advanced algorithm decides what to send when and by what carrying platform:

"In certain conditions the mission will be changed after it is launched as more urgent resupply problems are identified in a different combat unit."

He explained that the algorithm calculates the

the use of a large number of different platforms.

These will work according to commands
delivered by an automatic operation centre.

"The AI based system will lower the cognitive burden on the soldiers and enable them to concentrate on fighting while the logistic missions are performed by the system," Golan B said

And while the focus is now on logistics, it is obvious that such an advanced Al-based system is also capable of controlling the growing number

"We bring into the overall competition our Al combat proven capabilities and our vast array of ground and aerial unmanned systems that will perform the logistic missions," Rani Avni deputy general manager land systems, head of robotics and autonomous systems directorate told APDR.

of autonomous ground fighting vehicles currently being developed by several countries, including Israel.

Turning to IAI, an official said that their system selected by the British is a centralised "tasking" one that is using different unmanned platforms for combat logistic missions.

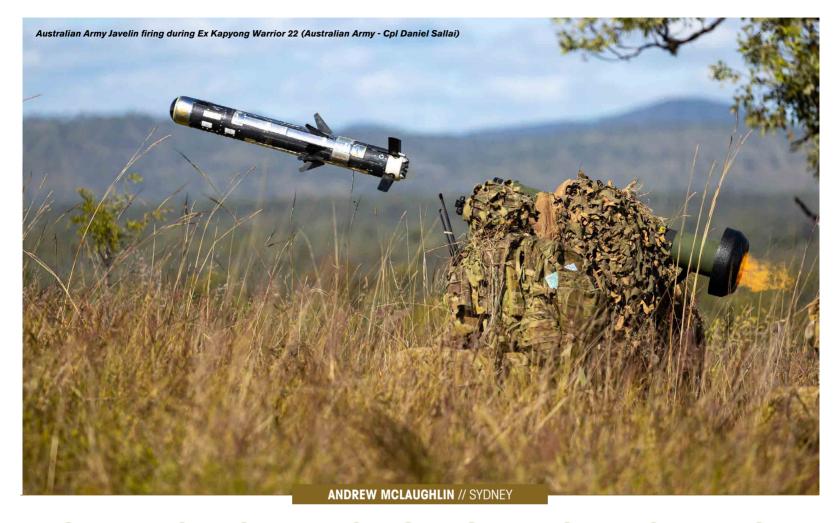
"We bring into the overall competition our Al combat proven capabilities and our vast array of ground and aerial unmanned systems that will perform the logistic missions," Rani Avni deputy general manager land systems, head of robotics and autonomous systems directorate told APDR.

when the cargo is heavy, but:

"When a lighter cargo like transfusion blood is urgently needed we offer delivery by a drone."

The IDF is implementing all of the advanced technologies developed by the Israeli companies. Some have already been proved their efficiency in combat during clashes on the Gaza and Lebanon fronts. As the threats to Israel become more serious the logistic issues are receiving a higher status in the IDF's priorities list.

This means that sightings of autonomous vehicles and other platforms are becoming more common.



ASIA-PACIFIC NATIONS HOMING IN ON ATGM **DEVELOPMENT**

Anti-tank guided missiles (ATGMs) are an essential component of modern warfare, as they offer relatively high capability for relatively low cost. Russia's invasion of Ukraine in February made it clear that man-portable missiles like the Javelin can stop the advance of far superior armoured forces. Thousands of Russian vehicles have been destroyed in the first seven months of the conflict (an estimated 1,800 tanks and 4,000 armoured vehicles), with a substantial portion of vehicle losses resulting from Western-supplied Javelin and NLAW anti-tank weapons, although Ukraine manufactures some of its own ATGMs like the Stugna-P (which has also successfully engaged helicopters).

ther recent conflicts have again highlighted the fact that relatively cheap to acquire and simple to operate ATGMs can destroy the expensive assets of a rival that are difficult and costly to replace. The Israel-Hezbollah war in 2006 in Lebanon, the Syrian civil war from 2011, and the 2020 Nagorno-Karabakh conflict between Armenia and Azerbaijan all saw ATGMs used with devastating results, and now developments in Ukraine have driven home the importance of ATGMs and other anti-armour

weapons like rockets and recoilless rifles.

The conflict in Ukraine and its economic and political fallout as well as lingering Covid-19 supply chain disruptions have put a squeeze on the global ATGM market. Providing arms to Ukraine has depleted the United States' weapons stocks by 20% in some areas and Lockheed Martin, for instance, warned in May that it could take up to a couple of years to increase Javelin supplies - it wants to double production from 2,100 a year at present. With massively increased demand and years-long production runup times, the need for independent local production of ATGMs - and other military equipment - has been deeply reinforced, and many countries in the Asia-Pacific are racing ahead with domestic manufacturing.

CHINA

China is making massive strides in modernising and expanding its military, and anti-tank weapons have not been excluded with more than half a

dozen ATGMs developed locally. China's first indigenously developed anti-tank missile to enter service was the HJ-8, which is analogous to the TOW and HOT second generation weapons (first-generation ATGMs possess a manual command to line of sight or MCLOS guidance system, requiring the user to manually guide the weapon all the way to the target; second-generation systems feature semi-automatic command to line-of-sight or SACLOS guidance; while third-generation systems are fire-and-forget types that use laser, electro-optical or radar seekers inside the missile).

The HJ-8 is tube-launched, optically tracked and wire-guided, and armed with a HEAT (high explosive anti-tank) warhead. Development began in the 1970s to succeed the HJ-73 (initially a copy of the Soviet 9M14M Malyutka/AT-3 Sagger but later improved locally and exported to countries like Bangladesh, and built in North Korea and Vietnam). The HJ-8 entered series production in the mid-1980s, with production by Norinco in China and Khan Research Laboratories in Pakistan (the HJ-8 has been mounted on Pakistani armoured personnel carriers and helicopters).

Numerous variants have been developed: for example the HJ-8E with a 4 km range can defeat explosive reactive armour (ERA) as well as penetrate 800-1,100 mm of RHA (rolled homogenous armour), while the helicopter-specific HJ-8B has a longer range; the HJ-8D has a tandem charge; the HJ-8FAE has a thermobaric warhead; the HJ-8L is a lightweight version; the HJ-8F has two warheads (HEAT and HE) for use against bunkers; and the HJ-8S carries an antiship warhead. The HJ-8 was developed into the semi-active laser guided HJ-11.

The HJ-8 equips WZ-9, Mi-17 and Gazelle helicopters, but Norinco has developed a turret launcher for armoured fighting vehicles and the missile can also be tripod-launched. Aside from People's Liberation Army (PLA) service, the HJ-8 has been exported to over a dozen different countries like Bangladesh and Malaysia, and used in combat in Bosnia, Sri Lanka, Syria and Iraq.

Norinco's HJ-9 is a third-generation man portable or vehicle/aircraft-mounted weapon that was developed from the early 1980s, and unveiled in 1999. Maximum range is 5.5 km, with SACLOS laser guidance. It is believed to offer 1,200 mm of armour penetration but can also be fitted with high explosive or thermal effect warheads. The HJ-9A features a radar guidance system using a semi-active millimetre wave radar while the HJ-9B offers top attack capability.

On the larger end of the scale is the HJ-10, also



HJ-10 ATGM launch (Zhang Haitao - China MoD)

A relatively new development is Norinco's man-portable HJ-12, which is a third-generation fire-and-forget infrared homing weapon (using a thermal/TV imaging dual mode seeker), and first unveiled in 2014.

developed by Norinco. This has a tandem HEAT warhead able to penetrate 1,400 mm of armour and a layer of reactive armour. Maximum range of the vehicle-mounted missile is 10 km. Guidance is either via fibre optic wire, semi-active laser and millimetre wave radar, or infrared homing. The HJ-10 has not been exported and is only in PLA service, where it is launched from a variety of vehicles.

A relatively new development is Norinco's man-portable HJ-12, which is a third-generation fire-and-forget infrared homing weapon (using a thermal/TV imaging dual mode seeker), and first unveiled in 2014. Target acquisition range during the day is 4,000 metres, but this drops to 2,000 metres at night. The HJ-12 can be fired from within buildings and bunkers due to its soft launch system and has a top attack capability – it can also engage low-flying helicopters. Armour penetration is estimated at 1,100 mm plus a layer of ERA (explosive reactive armour). The HJ-12 marks an important step in Chinese ATGM development as it is the nation's first highly

portable ATGM. In PLA service, it is also offered for export, and has been sold to at least one country (Algeria).

A new ATGM series offered for the export market is Poly Technologies' GAM-10X. This is an infrared homing weapon that features a nose-mounted seeker. As the missile is lightweight (the 200-2,500 metre range GAM-100 weights 13 kg), the weapon is highly portable, and can be mounted on platforms as diverse as all-terrain vehicles to tracked infantry fighting vehicles. A soft launch profile allows firing from confined spaces. Poly Technologies claims 1,000 mm armour penetration through a tandem warhead. Range of the GAM-102 is 300-4,000 metres.

INDIA

As early as the 1960s India looked at developing its own ATGM, and tested a missile developed by the Defence Research and Development Laboratory (DRDL). This was cancelled, and Bharat Dynamics Limited instead produced the Nord SS11 under license.

ATGM

India did not give up on plans to produce a domestic ATGM and the Defence Research and Development Organisation (DRDO) is leading development of India's largest and most important such project: the Nag (Cobra). A more than threedecade long programme, the Nag is manufactured by Bharat Dynamics and will be available in multiple variants for different applications. The Nag is a third-generation weapon that uses an imaging infrared seeker to lock onto a target before launch. A tandem warhead is able to defeat reactive armour.

wave active radar homing seeker, with a range of 15-20 km. Trials began in 2018, with the most recent in December 2021.

The lightweight Man Portable ATGM (MPATGM) has been developed by the DRDO and VEM Technologies as the man-portable version of the Nag using a miniaturised imaging infrared seeker. It has a range of approximately 2.5 km. The weapon system comprises a launching unit with a thermal sight and a 15 kg containerised missile that carries a tandem HEAT warhead. Development began in 2015 to replace the Indian

a substantially revised Amogha-III was revealed in 2020. This features a dual mode (imaging infrared and electro-optical) seeker for lock on before launch homing, and it can engage targets in either top or direct attack mode. The missile uses a tandem warhead able to penetrate 650 mm of armour plus a layer of ERA. The lightweight missile (around 15 kg) has a stated range of 200-2.500 m.

In a similar class, VEM Technologies has designed the AsiBal third generation fire-andforget ATGM. The man-portable weapon has a tandem HEAT warhead and weighs under 20 kg, including launcher. It has been under development for several years in association with the Ministry of Defence and Munitions India Ltd.

For its main battle tanks, India is developing the SAMHO gun-launched ATGM, which was originally intended to be fired from the Arjun main battle tank's 120 mm gun, but the Armament Research and Development Establishment (ARDE) is planning on compatibility with the T-90's 125 mm gun. The laser-guided missile has dual HEAT warheads and is also able to engage low flying helicopters. Trials began in 2020 and are ongoing.



Japan has been developing ATGMs for decades and in the late 1950s produced the Type 64 MAT MCLOS wire-guided ATGM which was manufactured by Kawasaki Heavy Industries. This weapon was largely replaced by the Type 79 Jyu-MAT and Type 87 Chu-MAT, but small numbers of Type 64 MATs are kept in reserve.

The Type 79 Jyu-MAT is a SACLOS weapon that entered Japan Ground Self Defence Force (JGSDF) service in 1984. Warhead is either a shaped charge for use against armour, or a fragmentation type with a delayed fuse for use against landing vessels. It can be tripod or vehicle mounted. Range is about 4,000 m. Whereas the Type 79 Jyu-MAT uses a lamp and optical tracker for SACLOS guidance, the Type 87 Chu-MAT is laser-guided and comprises a launcher and tripodmounted laser designator. Service entry was in 1989. Range is 2,000 m.

Significantly larger and heavier is the Type 96 Multi-Purpose Missile System, designed to engage tanks and landing craft. Each missile weighs around 60 kg and has a range of 10-25 km, with guidance via a fibre optic cable and infrared imaging seeker (the operator views the missile's seeker and adjusts the missile's flight accordingly). Its large warhead can destroy tanks



Konkurs launch (Olga Balashova, Vadim Savitsky - Russian MoD)

Japan has been developing ATGMs for decades and in the late 1950s produced the Type 64 MAT MCLOS wire-guided ATGM which was manufactured by Kawasaki Heavy Industries.

The Nag land version (Prospina) can b e carried by the Nag Missile Carrier (NAMICA) which is a specially modified BMP-2, and has a range of 4-6 km. Trials were concluded in 2020. The Helina (Dhruvastra) is a longer-range version (7 km) designed for air launch on Rudra and Light Combat Helicopter rotorcraft, and completed trials in 2021. The SANT (Standoff Anti-tank Guided Missile) is an air-launched variant with an electrooptical (EO)/infrared (IR) imager and millimetre

Army's legacy Konkurs-M and Milan systems that are locally produced by Bharat Dynamics - the MPATGM will also supplement the limited number of Spike-LR ATGMs acquired in the interim from Israel. Further testing in early 2022 indicated the MPATGM is ready for production by Bharat Dynamics.

Bharat Dynamics is also working on the Amogha man-portable ATGM. The Amogha-I was tested out to a range of 2.8 km in 2015, but

AKERON



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To meet current and future operational needs, both for dismounted combat and from land, aeronautical or even naval platforms, MBDA has developed AKERON, a unique family of fifth-generation tactical combat missiles, which includes the MMP and MHT missiles, renamed AKERON MP and AKERON LP respectively.

AKERON missiles incorporate the latest technologies in terms of high-resolution multi-band imagers, multi-effect warheads (anti-tank, anti-infrastructure, anti-personnel), data links and multi-mode guidance algorithms based on Al techniques. All ensuring robust and precise guidance at any distance, in all conditions. With AKERON, MBDA is offering a family of missiles that can be adapted as closely as possible to the needs of collaborative tactical combat.













COMMANDING







Type 79 Jyu-MAT launch (JGSDF)

The largest regional militaries in the Asia-Pacific have or are developing their own ATGMs, but many still rely on imported weapons like the BGM-71 TOW.

or low flying helicopters. Service entry was in 1996. Fielded in larger numbers and at a lower cost is the Middle range Multi-Purpose Missile (Chu-MPM), also designed to take out tanks and landing craft. Guidance is either semi-active laser homing or infrared imaging.

On the smaller end of the scale is the Type 01 LMAT, which since 2001 has met the JGSDF's requirements for a man-portable fire-and-forget ATGM. Manufactured by Kawasaki Heavy Industries, it replaced recoilless rifles in frontline service. The tandem HEAT warhead is fired by a launch unit that can be reloaded multiple times. Maximum range of the infrared homing weapon is 4 km.

SOUTH KOREA

Competing with the Javelin and Spike-MR is LIG Nex1's AT-1K Raybolt man portable thirdgeneration ATGM. Entering service with the Republic of Korea Armed Forces in 2017, it has also been exported, including to Saudi Arabia and seen combat in Yemen. An imaging infrared seeker offers a fire-and-forget capability while a tandem warhead is able to defeat ERA and 900 mm of armour. The Raybolt has top attack and direct attack modes. The missile and observation/ launch unit can be vehicle-mounted or carried by two soldiers, and the missile can be fired from within a building. Range is about 2.5-3 km.

South Korea is also developing the Chungum air-launched ATGM for its Light Armed Helicopter (LAH); each rotorcraft will be able to carry four missiles. Development of the 8 km range missile began in 2017, with mass production planned for 2023. It is being developed by the Agency for Defence Development and Hanwha Defence and will be offered for export.

NORTH KOREA

North Korea has for some time produced copies of the Fagot and Kornet-E ATGMs as the Bulsae series, and deployed them as single launchers or part of vehicle-based weapon systems. It appears either the Fagot or Kornet-E has been upgraded with a laser guidance system as the Bulsae-3.

North Korea has exported the Fagot/Bulsae-2 to Hamas, and the older Malyutka to Iran. At a military parade in April this year, a new Javelin-like man-portable ATGM was displayed for the first time, but little is known about this new weapon other than hundreds were paraded by North Korean soldiers.

RUSSIA

Russia offers a vast range of ATGMs, with one of the most popular being its laser-guided 9M133 Kornet (AT-14 Spriggan), with the tripod-mounted system having a range of 5.5 km (nearly 10 km for the Kornet-EM). It is armed with either a tandem HEAT or thermobaric warhead, the latter designed for targets like caves and bunkers. Unlike most Western tandem warheads, where the HEAT charges are stacked behind one another, the Kornet has the rocket motor in between the two charges, allowing for better penetration (1,000-1,200 mm behind ERA). Entering service in 1998, the Kornet is the Russian military's primary ATGM and has been widely exported. It has been used in many conflicts, including Syria, Egypt and Ukraine - in Lebanon and Iraq Kornet missiles penetrated Merkava and M1A1 Abrams tank armour.

The relatively heavy and costly Kornet supplements the lighter 9M111 Fagot (AT-4 Spigot), 9M113 Konkurs (AT-5 Spandrel), and 9K115-2 Metis-M (AT-13 Saxhorn-2). The Fagot and Konkurs are similar weapons as they are both SACLOS guided ATGMs, and both entered service in the 1970s. Armour penetration for the man-portable Fagot is 400-600 mm depending on variant, with a range of 2.5 km. The Fagot has been widely exported, including to India and Vietnam, and been used in multiple conflicts. The slightly larger Konkurs is designed mainly for vehicle launch and has greater range than the Fagot and greater penetration of 750-800 mm of armour (the 9M113M Konkurs-M has a tandem HEAT warhead). Amongst its many export customers are Indonesia, India, Pakistan, and Vietnam.

The Metis-M man portable second-generation system (with wire guidance) entered service in the early 1990s. Designed to be cheap and portable, the Metis-M can penetrate 800 mm of armour behind ERA (over 900 mm for the Metis-M1), but a thermobaric warhead is also available. Range is 1,500 m for the Metis-M and 2,000 m for the Metis-M1. Asia-Pacific operators include Bangladesh, Malaysia, and South Korea.

Russia also offers a range of air- and vehiclelaunched ATGMs like the 9K114 Shturm (AT-6





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AIM-120 AMRAAM

AMRAAM Extended Range (ER)

AIM-9X Sidewinder



India's MPATGM during a test flight fom the Ahmednagar range in 2018 (Press Information Bureau)

Rafael's fire-and-forget imaging infrared-guided Spike has gained a significant number of orders, with tens of thousands of missiles exported to 35 countries.

Spiral), 9M120 Ataka (AT-9 Spiral-2), 9M123 Khrizantema (AT-15 Springer), and 9K121 Vikhr (AT-16 Scallion). These have found their way to Asia-Pacific militaries such as India (Shturm and Vikhr) and Indonesia (Shturm), mainly for helicopter applications. Russian manufacturers have also produced various tank gun-launched ATGMs like the 9K112 Kobra (AT-8 Songster), 9M119 Svir/9M119M Refleks (AT-11 Sniper), and 9M117 Bastion (AT-10 Stabber and AT-12 Swinger).

IMPORTED OPTIONS

The largest regional militaries in the Asia-Pacific have or are developing their own ATGMs, but many still rely on imported weapons like the BGM-71 TOW. Although man-portable, this relatively heavy missile is usually found on vehicles. In service for more than half a century, the latest variants feature wireless guidance, tandem warheads and a top attack mode amongst other improvements. Well over half a million TOW missiles have been produced for customers

around the world, and this includes Japan, Singapore, South Korea, Taiwan, Thailand, the Philippines, and Pakistan.

Raytheon and Lockheed Martin's joint venture FGM-148 Javelin, in service since 1996, continues to enjoy popularity with NATO and allied partners. The imaging infrared-quided top attack weapon has a range of 2.5 km and has been acquired by

that cover ranges between 1.5 and 32 km: Short Range (SR), Medium Range (MR), Long Range (LR), Long Range 2 (LR2), Extended Range (ER), Extended Range 2 (ER2), air-launched Aerospike, and Spike Non-Line-of-Sight (NLOS). Singapore was the first regional user, manufacturing the Spike-SR under license through an ST Engineering subsidiary. South Korea is another Spike customer, while the Philippines acquired the Spike-ER for its MPAC patrol craft, and Thailand acquired the Spike-MR version in 2020. Elsewhere in the region, France has supplied MILAN missiles to Australia and Singapore, and HOT ATGMs to China, while Sweden has delivered NLAWs to Indonesia and Malaysia.

Although ATGMs are vastly cheaper than acquiring armoured vehicles, they are still relatively expensive, typically costing thousands of dollars apiece (a Javelin system costs around US\$200,000, with an individual missile around US\$80,000). As a result, there is great demand for simpler and cheaper weapons like rocket launchers and recoilless rifles as a useful complement to increasingly sophisticated ATGMs. Apart from price (an NLAW costs around US\$40,000, for example, and a Carl Gustaf US\$20,000), rocket launchers typically offer the ability to choose from multiple warhead types for greater flexibility.

More advanced fire-and-forget ATGMs (sometimes marketed as fifth-generation systems) are coming onto the world market and although they enable soldiers to shoot and scoot, they can be more susceptible to electronic countermeasures than second-generation systems. But despite the advance of vehicle countermeasures, modern armour and active protection systems, ATGMs are becoming more lethal, especially with better artificial intelligence and machine learning, making them just as

Although ATGMs are vastly cheaper than acquiring armoured vehicles, they are still relatively expensive, typically costing thousands of dollars apiece.

Australia, New Zealand, Indonesia, Taiwan, and

Rafael's fire-and-forget imaging infrared-guided Spike has gained a significant number of orders, with tens of thousands of missiles exported to 35 countries. The Spike comes in numerous variants

effective as the day they were first fielded, and lethal for aircraft as well as vehicles. Although the ATGM is not a magic bullet, recent combat experience suggests ATGMs and other shoulderfired anti-armour weapons have a very bright future.





GEOFF SLOCOMBE // VICTORIA

CYBER SECURITY FOR THE AUSTRALIAN ARMY

In 2018 Major General Marcus Thompson AM, then Deputy Chief Information Warfare, wrote 'Developing defensive and offensive cyber capabilities in Army will demand focussed attention on information warfare operations and cyber-security as a necessary function of network operations. Army is actively pursuing a path to cyber-readiness, but many questions remain unanswered.



The new Australian Signals Directorate cyber and foreign intelligence facility in Canberra, ACT. Credit: CoA

n the ensuing four years, what progress has been made?

Strategically, the most important development has been the 3 August 2022 announcement of an independently-led review that will consider Defence's force posture and force structure.

Two Independent Leads, former Minister for Defence, Professor the Hon Stephen Smith and former Chief of the Defence Force, Air Chief Marshal Sir Angus Houston AK AFC (Ret'd), have been appointed to lead the Review. They expect to provide their interim report by 1 November this year and final report by 1 March 2023.

Surely how to identify needs and actions to be taken to provide cyber security for the ADF will be among the most important findings. They must recommend extra investment and staffing in the Defence Science and Technology Group as it undertakes the research and development of new and novel concepts, technologies and techniques. This is to enable autonomous, resilient and effective cyber capabilities with an operational edge in the face of ubiquitous encryption, untrustworthy ICT and a highly dynamic and sophisticated threat environment.

As importantly for the Australian Army's cyber security it has introduced pathways through ADF recruitment programs which allow Army to recruit and train Cyber Analysts who will be promoted after gaining experience to become Cyber Specialists. They also have a recruitment avenue through the ADF's Cyber Gap Program for tertiary students in their last year of study.

The Government's 2022 Budget committed to increase funding by

\$9.9 billion over 10 years to 2030-31 and staffing in the Australian Signals Directorate (ASD) by 1,900 over the next 10 years through Project REDSPICE.

ASD is very active in supporting Army for both defensive and offensive cyber operations.

A Defence spokesperson informed APDR that:

"Army is accountable for its own cyber security. Chief of Army is the capability manager and has appointed Cyber Security Executives to manage cyber governance at all levels. Army has a Land Cyber workforce that manages the 'cyberworthiness' (military term for managing information assurance) of our defensive cyber based mission systems.

"Army also has a number of rolling cyber hygiene and maturity uplift programs that are continuously updating our people, processes and technology to meet the emerging threats and trends in cyber.

"Australian Signals Directorate is a key contributor to Army's cyber security operations."

In addition to this valued contribution, APDR knows from its own sources that the ASD's Australian Cyber Security Centre (ACSC) supports Defence by providing technical cyber security advice and assistance to system owners in Army, Chief Information Officer Group and Capability and

Sustainment Group.

The ACSC also supports cyber security assurance activities through the Information Security Registered Assessors Program, which is available to Defence.

The ACSC can provide cyber security incident response assistance to Defence should it be requested. Separately, ASD is the national cryptographic authority for highly classified systems used by Army and other government organisations, including other ADF services.

ASD is also responsible for providing approval for Army to use cryptographic devices on its systems, and for producing cryptographic key material which is used to secure Australian government systems, including those used by Army.

AUSTRALIAN SIGNALS DIRECTORATE

ASD states that 'REDSPICE is the most significant single investment in the Australian Signals Directorate's 75 years. It responds to the deteriorating strategic circumstances in our region, characterised by rapid military expansion, growing coercive behaviour and increased cyber attacks'.

Through REDSPICE, ASD will expand the range and sophistication of their intelligence, offensive and defensive cyber capabilities, and build on already-strong enabling foundations. REDSPICE is expected to lead to a doubling of ASD's defensive cyber capabilities and a tripling of its offensive cyber capabilities.

Key predictions are for

- Advanced AI, machine learning and cloud technology
- 4x global footprint
- 1900 new analyst, technologist, corporate and enabling roles across Australia and the world
- 40% of staff located outside Canberra ASD defends Australia from global threats, and advances the national interest through the provision of foreign signals intelligence, cyber security and offensive cyber operations.



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CYBFR

ASD's foreign signals intelligence operations support a range of activities that protect the lives of Australians. These include providing support to Australian Defence Force (ADF) operations across the globe, tracking the foreign communications of extremists who pose a threat to Australians and Australia's interests, and supporting the safe release of Australians who have been taken hostage overseas.

ASD's unique offensive cyber capabilities have conducted a number of offensive cyber operations in support of the ADF.

DEFENCE SCIENCE AND TECHNOLOGY GROUP (DSTG)

As the premier defence research organisation in Australia, DSTG is heavily involved with research and development of analytical tools and practical methodology to support the ADF's defensive and offensive capabilities in the cyber warfare area.

DSTG has three main arias which are focussed on this task which include Contested Communications, Cyberwarfare Operations and Cyber Sensing and Shaping.

Now to look briefly at each of these research areas, starting with Contested Communications. Within this branch there are teams working on protected satellite communications, survivable networks, wireless protocols, together with position, navigation and timing technologies and systems.

The Cyberwarfare Operations branch undertakes the research and development of new and novel concepts, technologies and techniques in order to enable autonomous, resilient and effective cyber capabilities with an operational edge in the face of ubiquitous encryption, untrustworthy ICT and a highly dynamic and sophisticated threat environment. Teams here are working on trustworthy military systems, countering cyber threats, cognitive cyber security and mission protection and effects.

The Cyber Sensing and Shaping branch develop concepts, technologies and techniques for assessing, characterising and shaping communication networks to enable cyber operations in support of Defence and national security. They concentrate on access technologies, communications network research, communications signal processing and cryptomathematics research (this latter group is embedded in the ASD).

ARMY CYBER WARFARE STAFF

Cyberspace is a dynamic and complex area of combat that demands agility and flexibility. As Australian Army Cyber Analysts it will be their job to provide swift and precise solutions to identify and defend against cyber threats.

They will integrate with joint, agency, intergovernmental and multi-national organisations to support combined arms operations. This means operating at tactical, operational and strategic levels, and conducting cyber activities to defend and assure the integrity of Australia's systems.

These analysts can be promoted after gaining relative experience to Cyber Specialists who defend networks from complex threats as well as intercept and disrupt enemy communications. In that position, they are trusted to manage and provide sensitive and highly classified information to support operations.

The Australian Defence Force Cyber Gap Program, already mentioned earlier in this article, may expose participants to careers in the following areas:

- · threat emulation
- cyberspace operations planning
- · discovery and counter-infiltration
- incident response
- network vulnerability assessment
- protecting and hardening networks
- data collection and analysis
- network recovery
- · incident mitigation strategy development.

CYBER THREATS FOR THE **AUSTRALIAN ARMY**

A cyber-attack on the Australian Army is any attempt to gain unauthorised access to a computer, computing system or computer network used by the Army with the intent to cause damage.

Damage in such an attack can be to disable, disrupt, destroy or control Army's computer systems and is usually readily detectable. Not always so easy to identify is the alteration, or manipulation of the data held within the end-user or a network's major data storage computers.

Several recent high-profile cyber-attacks, such as the Russian/Georgian conflict in 2009 and Russia's invasion of Ukraine from February of this year, have been publicly documented and concluded that cyber-weapons are an important force multiplier today. For deliberate attacks with accurate planning and good lead times, cyber effects can have a significant impact on the outcome of any conflict. The use of cyber-weapons at a tactical level of conflict without good planning and skilled operation are likely to have minimal impact.

The ADF's adaptation to the effects of the information revolution by using digital networks has varied across the three services. The Royal Australian Air Force and Navy both have histories rich with experience in information operations ranging from early cryptographic endeavours to electro-magnetic spectrum operations. They are both experienced computer network users, meaning adoption of new capabilities has not been such a steep learning curve as that experienced by the Australian Army.

An Army Special Operations Group deployed against an adversary's cyber or wider hybrid threat could make a major difference to either the "grey zone" tactics employed by that adversary or in actual conflict.

The original saying "amateurs talk tactics, but professionals talk logistics" was credited to General Omar Bradley, who was well known for his quick, but apt, wit. Cyber-attacks on logistic supply chains can completely disrupt a military campaign through loss of readiness to start at the optimum time to create subsequent delays and loss of services.

WHERE TO FROM HERE?

Any cyber attacks which affect the Australian Army, ADF, Government or the wider community will always favour the attacker initially, for a relatively longer time if new technology is involved.

Disruptions can be expected and reliable fallback communications must always be planned, tested and available in the event of digital military networks being blocked.

Increasingly we will see state and non-state actors initiating hybrid warfare attacks, the so-called "grey zone" warfare. Cyber will be one element of this, both for blocking messaging but also spreading dis-information.

Is there any hope of new technologies coming along which will help deal with cyber security attacks? Fortunately, there are.

Because the range of potential cyber attacks on defence forces and the wider community is huge, dealing with them requires more that straightforward human intervention.

Artificial intelligence (AI), machine learning and cloud technology are now becoming essential tools for information security, as these technologies are capable of swiftly analysing millions of data sets and tracking down a wide variety of cyber threats.

An enormous amount of research work worldwide, including in Australia by ASD, is now going into the use of AI and machine learning to instantly detect, then foil cyber-attacks.

These technologies continually learn and improve, drawing data from past experiences and the present to pinpoint new varieties of attacks that can occur any day now, or in the future.

ARIE EGOZI // ISRAEL

LOITERING MUNITIONS

Loitering weapon systems, that until some years ago were conceived as a "nice to have" combat tool, are now mainstream killer systems with very advanced capabilities. Without any doubt, Israel has taken this segment of combat technology ahead by leaps and bounds. While some of the systems are classified the unclassified technologies tell the story very well.

or example, the Israeli Defence Forces (IDF) have been attacking Iranian-related targets in Syria on their way to Lebanon to be used by the Hezbollah, Iran's main proxy in the region. According to reports from Syria, in some of the attacks, fighter aircraft were not detected over the targets. Israel remains silent about the weapon systems used for these very accurate attacks but the IDF has a variety of them in its tool box. One is loitering weapon systems.

Loitering weapons system are in big - very big demand and Israeli defence companies are working hard to answer that need.

It can be said without any doubt, that a big technology leap started some years ago. Until that time the only operational loitering weapon system made in Israel was the Harop developed by Israel Aerospace Industries (IAI). This loitering weapon system - the successor to the well-known Harpy anti-radar drone - was very active in the recent conflict between Armenia and Azerbaijan over the disputed Nagorno-Karabakh region.

The Harop has been developed to destroy high quality targets. It consists of the munitions unit, transportable launcher and a mission control shelter which provides real-time access to control the Harop by a man-in-the-loop. The Harop can be launched from various transportable platforms including sea and ground based canisters or air-launched to navigate towards the potential target area. It can be launched at any angle, horizontal or in a vertical trajectory. The sealed container ensures protection from harsh battlefield environmental conditions.

Each one is armed with a 16 kg warhead and is equipped with a very advanced day/night payload (POP-250) made by the Tamam division of IAI. Harop has an operational range of 6,230 miles and an endurance of six hours.

It is big and heavy and built to destroy major targets but when a trend begins, sizes get diversified - and that is exactly what is happening. Two years ago, IAI unveiled the Mini Harpy, based on two systems: the Harpy and the Harop.

According to a very senior IAI official, the Mini



Hero-30 (Uvision image)

a shaped charge of approximately 8kg, operates in a mission range of 90km for a duration of two hours and has a total weight of 45kg. It is operated by a single soldier using simple point and click commands on a tablet controller, similar to the one operating the Green Dragon - yet another loitering munition from IAI.

When it was clear that there is a big market for loitering weapon systems, other Israeli companies joined the effort. Some years ago, identifying the big sales potential of the U.S market, Uvision formed a U.S subsidiary, Uvision US, that has already secured some contracts with U.S armed forces.

The first product offered to the Americans was the Hero-30. The current version of the Hero-30 weapon system weighs a mere 3kg armed with a 0.5kg warhead. It is carried in a canister that is also used as a pneumatic launcher. After launch the electric motor is turned on.

The Hero-30 is equipped with a day/night sensor and has an endurance of 30 minutes. After it is launched it locks onto the predesigned target and transmits the video to the operator using a hand held

The the munition loiters at altitudes between 980 and 2000 feet above the ground. The data link that was developed for the system can control it in ranges of 10km or 40km depending on the antenna used. The company says that the demand for small

According to a very senior IAI official, the Mini Harpy is designed to neutralise radiation emitting threats such as radars and additional systems. He added that the Mini Harpy has a dual sensor – EO and Electromagnetic.

Harpy is designed to neutralise radiation emitting threats such as radars and additional systems. He added that the Mini Harpy has a dual sensor - EO and Electromagnetic. The system was designed to provide operators with control up to the last moment, including cessation of attack at any stage.

Electrically powered, it is extremely quiet, carries

loitering munitions systems has increased in recent years mainly due to the operational lessons from the war against international terror.

The U.S market was hungry for more and in May 2021, the company was awarded a multi-year contract, to supply the Hero-120 OPF-M systems to the United States Marine Corps (USMC) together

LOITERING MUNITIONS



The two companies will work to share their technological knowledge: UVision with its proven knowledge and experience in loitering munition systems, and Spear with its expertise in Al based tactical drones for ISTAR missions.

with its multi-canister launcher tailored to the specific requirements of the USMC and integrated onto armored vehicles and maritime platforms.

The Hero-120 is a mid-range, anti-armor, beyond-line-of-sight weapon system which meets the complex requirements of modern battlefield challenges. The high-precision, smart, loitering munition system has a unique aerodynamic structure that carries out pinpoint strikes against anti-armor, anti-material and anti-personnel targets, including MBTs, vehicles, concrete fortifications, and other soft targets in populated urban areas, while ensuring minimal collateral damage. According to the company its wide range of multi-purpose warheads enable the operational user to effectively engage all

That is the trend, and Israeli sources say it already led to an effort to develop more such systems. Some are in a very advanced stage of development while others are only on computer screens - but there is no doubt that the variety of loitering weapon systems is about to grow dramatically in the near future.

This effort has resulted in many new systems and last year Uvision has unveiled its new loitering weapons system the Hero-400 EC.

The larger system has a unique cruciform aerodynamic design which according to the Israeli company delivers high accuracy and reduces collateral damage.

Uvision says that the Hero-400 EC's electric motor enables it to loiter silently above a target, ready to instantly respond to pop-up threats.

According to the company, the system was developed to answer a growing operational requirement for a loitering weapons system that can remain in the air for extended periods of time, provide a substantial warhead effective against a wide variety of targets, and also deliver missilelevel pinpoint strike capabilities. "The Hero-400EC answers these critical needs," the company source

The company says that the Hero-400EC is a revolutionary product using man-in-the loop technology and advanced Electro-Optical/Infra-Red

(EO/IR) payloads that can locate, track and strike static or moving targets with pinpoint accuracy and surprise. The system features a low noise and thermal signature modular multi-tube launcher that is adaptable to a wide range of platforms, thereby offering air, land, and sea capabilities.

Uvision says that the abort capability allows automatic reentry into the loitering mode, re-engagement of the enemy, or return to the recovery area using a parachute.

The Hero-400EC has a maximum take-off weight of 40kg and a warhead weight of 11kg, with an endurance of up to 2 hours.

Another in the series is the Hero-120, which can be fitted with a range of powerful multi-purpose warheads. Its unique aerodynamic structure enables pinpoint strikes in populated urban areas or remote locations with minimal collateral damage. Its extended endurance of over an hour and a loitering range of up to 40km enables independent operation by frontline forces with precision strikes of time-sensitive targets. Featuring low acoustic, visual and thermal signatures and fully gimbaled and stabilized day/night tracking, the Hero-120 delivers critical situational awareness with its advanced data link and real-time intelligence. Recoverable using a parachute, the system is also cost-effective.

The growing market has also seen some new joint ventures formed. In May, Uvision revealed its strategic investment in SpearUAV, another Israeli company that has developed an autonomous, Al-based technology for encapsulated SWARMbased UAS.

The two companies will work to share their technological knowledge: UVision with its proven knowledge and experience in loitering munition systems, and Spear with its expertise in Al based tactical drones for ISTAR missions. The synergy between the companies will make it possible to offer a comprehensive solution for varying operational needs from micro-tactical forces and brigade level, to the division level.

"This investment in Spear comes as a direct continuation of the company's expansion in the international defense market," says Major General (Ret.) Avi Mizrachi, CEO of UVision. "Just recently, UVision was selected by the U.S. Marines to provide its advanced loitering munition system, Hero-120, as part of a multi-year installation for all armored vehicles. Spear offers a unique ISTAR solution that can be easily deployed by any soldier in the field. Together, we are creating a broadspectrum solution, tailored to any operational need of our customers - at sea, in the air, and on land."



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LOITERING MUNITIONS



Aeronautics says that the 1K can get to its designed target by pre-loaded way points or using its optical sensor.

And the joint ventures continued. In June UVision has presented an integration of its high-precision Hero Loitering Munitions to Rheinmetall for next generation manned and unmanned infantry fighting vehicles.

According to the companies, the integrated solution provides frontline forces with a new independent ability to locate, track and accurately eliminate heavily-armored targets from long ranges, in challenging battlefield conditions, including GPS-denied environments and communication jamming, without the need for external support.

Aeronautics, another Israeli UAV manufacturer, has also joined the development effort and some years ago unveiled its new loitering weapon system the Orbiter 1K.

The Orbiter 1K is based on the structure and properties of the company's Orbiter 2. This is the first time Aeronautics is developing a loitering system. According to the company the Orbiter 1K is launched from a catapult, and can fly for 2-3 hours, carrying a multi-sensor camera with day-and-night channels. The system is compact and easily controlled from a personal GCS.

Aeronautics says that given a specific waypoint, the weapon can detect and destroy a moving or a stationary target. The system can also operate on the basis of a given position: the Orbiter 1K independently scans the area, detects and destroys the target - moving or stationary. In case the target wasn't detected or in any change of plans, the system's recovery capability allows it to return to its base camp and land safely using a parachute and an airbag.

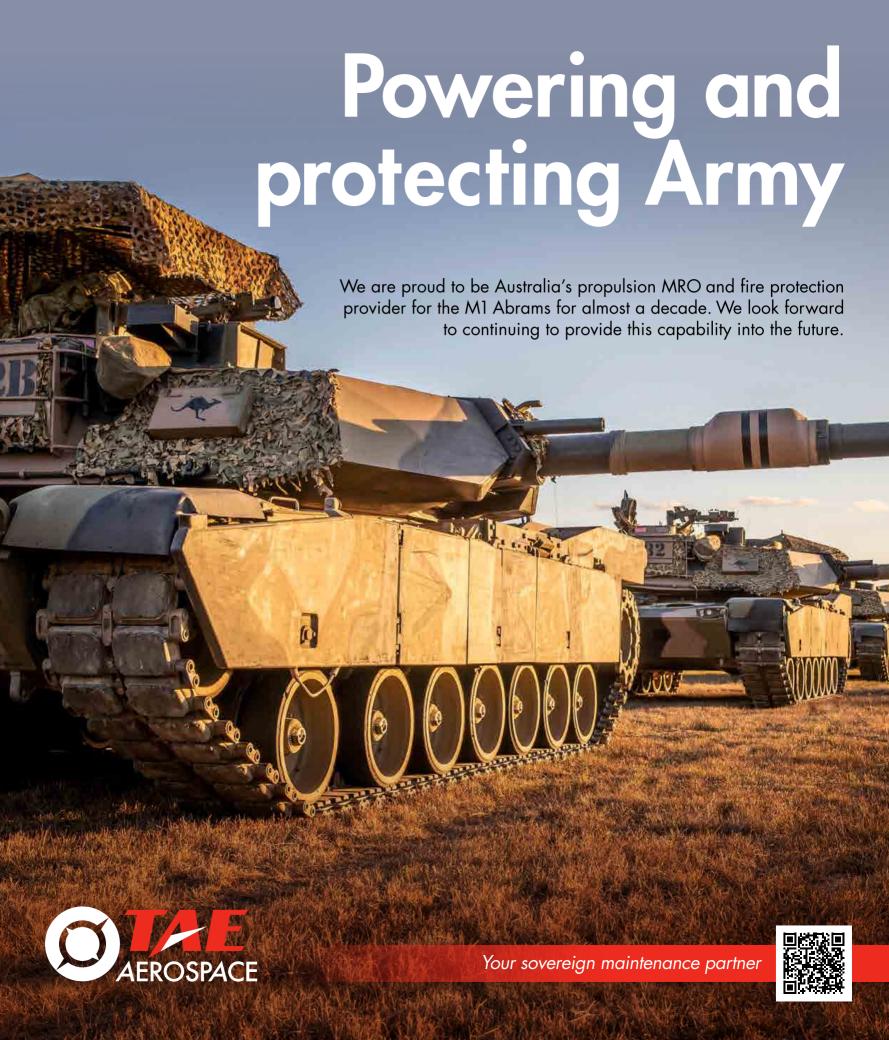
Aeronautics says that the 1K can get to its designed target by pre-loaded way points or using its optical sensor. The company says that the system has a shoot and forget mode but if the target - moving or stationary, is not detected, the ground operator can bring it back to a safe landing.

The system has an endurance of 30-45 minutes and a soldier can carry 3-4 such systems and control them buy using a tablet size control unit. It is also equipped with an acoustic sensor to avoid collision with obstacles in the area of operation.

Aeronautics has recently been acquired by Rafael and it is expected that this acquisition will result in, among other things, new loitering weapon systems. Operational demands are increasing. Some of the existing systems are combat proven and commanders not only in Israel but also internationally want more of them - and fast.



Hero-30 launch (Uvision photo)



MODERNISING THE INDIAN ARMY

The Indian army, the largest ground force in the world, is presently facing its biggest challenge in nearly six decades. After the humiliating debacle in the 1962 border war with China, it is facing the same adversary in an eyeball-to-eyeball confrontation in the northern Himalayan border since early 2020.



Ceremonial Indian troops Credit: PIB-Indian government

owever, unlike in 1962, the Indian army is now a much powerful force, with the intent and ability to face any eventuality that comes its way. The 1.19 million strong force is armed to the teeth with some of the best weaponry available in the world. More significantly, with the ongoing reforms, its combat potential is set to take a giant leap forward.

Huge efforts are currently underway to modernise the army, as indeed the other two services, through a compressive package of reforms that include right-sizing the number of uniformed personnel, improving border infrastructure, enhancing joint warfighting capability, and importantly upgrading firepower.

SECURITY CHALLENGES

The Indian Army, which traces its origin to the British rule in India, has been at the forefront of dealing with numerous security challenges that the country has faced since independence in 1947. Unlike many armies in the world, it faces one of the toughest security environments. The biggest challenge emanates from two nuclear adversaries,

Pakistan and China, with which it has so far fought five wars, and engaged in numerous other military skirmishes.

With the border dispute remaining unresolved with both neighbours - and given the increasing strategic nexus between Islamabad and Beijing the Indian army has the herculean task of preparing for a possible two-front collusive war. While doing so it has to remain vigilant in thwarting the proxy war imposed by Pakistan, which has used terrorism as a state policy to foster instability in the state of Jammu and Kashmir (J&K)-which was bifurcated into two Union Territories through a constitutional amendment in August 2019.

Defeating left-wing extremism in the hinterland and separatism in the north east, providing aid to civil authorities in a time of large-scale civil unrest and natural disasters, participating in bilateral and multilateral military exercises and contributing to the UN peace keeping missions also remain an important task for the Indian army.

Until recently, it has been primarily preoccupied with Pakistan with which India has fought four of its five wars-the last one in 1999 in the Kargil heights after both countries became nuclear powers over a year before. Post the Kargil war, it has found itself in a number of military stand-offs and cross-border firings in response to unabated border infiltration attempts by Pakistan.

In a major reversal of India's strategic restraint, in September 2016 the Army conducted surgical strikes on several terror launch pads in the Pakistan Occupied Kashmir (POK). These were in response to attacks on an Indian army base in Uri (J&K) by Pakistan-based Jihadi groups in which 18 Indian soldiers were killed. Although a ceasefire has been agreed upon between the two countries since February 2021, the Indian side has little time to relax as Islamabad holds a grudge against India's 2019 constitutional amendment and continues to infiltrate terrorists into the area.

Compared to the western front, the one with China had been relatively peaceful for a long time since New Delhi and Beijing normalised their post-1962 relationship through resumption of high-level political visits beginning in the late 1980s, and several border-related agreements and protocols signed subsequently. However, since the ascendancy of Xi Jinping as the head of Chinese Communist Party, the long peace held along the 3,488 km Line of Actual Control (LAC)-the notional demarcation line that separates Indiacontrolled territory from China-controlled territoryhas given way to mistrust and conflicts.

The armies of both countries ended up in an ugly fight in 2017 over China's development of border infrastructure in Doklam (Bhutan), which India perceived as a major threat to its security because of the proximity of the area to the narrow Siliguri Corridor that connects the bulk of India with its northeastern region. The 73-day confrontation ended through a mutual troop withdrawal agreement.

The post-Doklam peace proved to be short-lived as another major crisis followed in early 2020, when Chinese troops entered the Indian side of the Line of Actual Control in eastern Ladakh. The border intrusion, which took the Indian army by surprise. led to a bitter fight on June 15, 2022, leading to the deaths of 20 Indian army personnel and at least four Chinese troops-the first fatalities in 45 years. As of July 2022, 16 rounds of high-level military talks have been concluded between the two sides, but the status quo is yet to be restored.

The ongoing crisis in Ladakh, the longest between India and China, has severely strained the bilateral relationship, with New Delhi making it clear that peace at the border is sine qua non for normalisation of bilateral relationship. While periodic talks are in progress, the Indian army has deployed about 50,000 troops along with heavy weaponry to meet the Chinse challenge. As a negotiated settlement remains a remote possibility, the army along with its sister services will be preoccupied with the Chinse challenge for the foreseeable future.

RESOURCES FOR ARMY

Being the largest service among the armed forces, the Indian army has the biggest share of defence

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expenditure. In 2022-23 it was allocated INR 1,970 billion (US\$25 billion) or 51 per cent of the total allocations meant for all the defence services. On top of that, it was allocated a further INR 1,028 billion (\$13 billion) to pay for benefits, mostly to army veterans.

However, an overwhelming portion of its budget is consumed by salary and pensions - leaving very little for procurement of arms and maintenance of the existing equipment. The manpower-heavy budget has been a source of concern for a long time, with some observers demanding a thorough overhaul of the army's human resource management. As explained later, the recent manpower reform undertaken by the government is intended to save on salary and pension expenditure and redirect the resultant savings to other purposes.

CHIEF OF DEFENCE STAFF AND JOINT WARFIGHTING

Although the Army and other services have valiantly fought India's past wars, joint warfighting involving two or more services has been a grey area largely because of the absence of a unified command and control system. To address this gap and promote tri-service integration in planning, doctrine, logistic management and training among others, the government in December 2019 appointed then army chief, Gen. Bipin Rawat as the first Chief of Defence Staff (CDS) and created, under him, a new Department of Military Affairs (DMA) within the MoD.

Gen. Rawat led a major effort to reorganize the existing 17 commands of the three services into what may eventually become 4-5 integrated headquarters. However, after the tragic death of Gen. Rawat in a helicopter crash in December 2021, and due to the delay in appointing his successor, progress on the integration front has slowed down.

But his work is likely to be continued by his successor, which the government has promised to appoint 'very soon.' Given the geographical proximity with the traditional adversaries, it is a foregone conclusion that the Army will have a major role in any theater commands that will be established.

MANPOWER REFORM

With a strength of 1.19 million, the Army alone accounts for 84 per cent of total uniformed personnel serving in the armed forces. Its total manpower is distributed in three broad categories: the officer cadre of 53,569 (or 5 per cent), that includes 10,513 officers deployed in the medical, dental and nursing services; Junior Commissioned Officers (JCOs) of 111,606 (9 per cent) and Other Ranks (ORs) of 1.02 million (86 per cent).

It has been bogged down by a heavy burden of salary and pension expenditures. While many in the past had advocated right-sizing the force, CDS. Gen Rawat had informed the Parliamentary Standing Committee on Defence (2021-22), of the government's intention to cut back about 100,000 personnel and channel the savings to acquire new technologies. Though he did not elaborate, the army was clearly in his sights.

Significantly, the CDS's reference to the cut was just a small hint of the bigger reform that was to be announced in June 2022, albeit after his sad demise. In what is touted as a transformative reform of defence manpower, the Indian government announced the Agnipath (path of fire) scheme for recruitment of soldiers into the armed forces.

The scheme is a major departure from the previous scheme under which soldiers were required to serve for a minimum 17 years before retiring with a lifelong pension. Under the new scheme, through which the Army alone plans to recruit 40,000 soldiers in 2022, the new recruits, to be known as Agniveers, will be inducted for four years. After this only 25 per cent will be retained for the regular cadre to serve at least 15 more years. In other words, 75 per cent of soldiers would demobilise after a brief four-year tenure without pensionary benefits.

The scheme has been designed to tackle several problems being faced by the army in particular. The scheme is likely to improve the age profile of the force, which is presently unfavorable in comparison to several other countries. According to the Ministry of Defence, the average age of the forces will be reduced from presently 32 years to 24-26 years after the implementation of the scheme.

The biggest advantage of the scheme pertains to financial savings. Because 75 per cent of Agniveers (the new recruits) will be discharged after four years, the government will save a massive amount on pension benefits - though such savings would accrue only in the long run. As per one estimate, by the end of two decades or so, only about 34 per cent of the soldiers will be eligible for a pension (compared to nearly 100 per cent under the earlier scheme), thus saving a huge amount of money that could be devoted for modernisation of the armed forces.

BORDER INFRASTRUCTURE

For many decades after the 1962 war with China, successive Indian governments avoided developing border infrastructure for fear of a Chinese invasion. However, owing to China's own massive infrastructure built-up along the Line of Actual Control, India has shunned its 'defensive' approach and undertaken construction of strategic infrastructure-roads and bridges-along the border areas.

The present government in particular has spent a huge sum on key projects, especially since the Doklam incident of 2017. In the last five years, it has spent INR 208 billion (US \$2.61 billion) in completing a total 3,595 km of roads, of which 2,089 km is along the India-China border (built at the cost of INR 155 billion) and 1,366 km along the India-Pakistan border (INR 42.4 billion).

Furthermore, it has approved a revised five-year road building plan for the border areas consisting of 257 projects entailing a length of 13,525 km. Some analysts believe that India's border infrastructure development is one of the reasons why Chinese troops entered the LAC to deny India's army any first mover advantage. Be that as it may, the border infrastructure has been a big boon for the Indian Army's ease of movement in accessing and defending far-flung territories which were difficult to monitor earlier.

MODERNISATION AND INDIGENISATION

Given that many of India's external security challenges are land-centric, modernisation of the army has been an imperative for defence mandarins. The urgency of this modernisation has further been heightened because of increasing Chinese belligerence and military aggression along the LAC in recent years.

To meet the immediate needs of the force, as well as the two other services, the Indian government has taken a number of measures, including devolution of greater financial powers to the armed forces to sign "emergency and critical contracts." The powers were first granted to the forces in 2016 in the wake of the Uri attacks carried out by Pakistan based terrorists in Jammu and Kashmir.

It was extended in the aftermath of the Chinese military aggression in Ladakh in May 2021. The Indian army is believed to have signed 71 capital procurement contracts (worth INR 69.18 billion / US \$870 million) and 113 revenue contracts

(valued at INR 90.0 billion) by using emergency powers. Some of the big items it has bought include Spike anti-tank guided missiles (ATGM) and Heron Mk-II uncrewed aerial vehicles from Israel, and assault rifles from the US.

In a further move to boost the combat capability of the army, especially to face the Chinese challenges in Ladakh, India's defence minister, Rajnath Singh, on August 16, 2022, handed over a large number of indigenously manufactured items. These include: the Infantry Soldier as a System (F-INSAS), Anti-Personnel Mines, Hand Held Thermal Imager (uncooled), Commander Thermal Imaging Sight for T-90 tanks, Downlink Equipment with Recording Facility, Semi Ruggedised Automatic Exchange System M-II, Upgraded Radio Relay (Frequency Hopping), Solar Photovoltaic Energy Project, Landing Craft Assault (LCA), Mini Remotely Piloted Aerial System (RPAS), Infantry Protected Mobility Vehicle (IPMV), and Quick Reaction Fighting Vehicle (Medium).

While the above are part of the efforts to meet the immediate requirements for the evolving challenges in the border areas, the army is also on a mission to modernise its entire inventory. These efforts have led to signing of new contacts for and induction of a wide variety of new weapons platforms and other items that include bulletproof jackets, modern assault rifles (AK-203, SIG SAUER), artillery (K9 VAJRA-T and M777 Ultra-Light Howitzers)), tanks (MBT Arjun), air defence missiles (Akash).

It is, however, worth noting that the army has often struggled to procure items in a timely manner, for a variety of reasons including inadequate planning and overambitious technical specifications. This has led to a retraction of many tenders and underutilization of procurement budget. The latest fallout of the army's lack of a robust procurement system is the tender for procurement of air defence gun missile system (ADGMS) to replace the current inventory inducted in late 1960s.

The cancellation of certain procurements notwithstanding, the army has shown a keen interest on local equipment of late—not a small development considering its past proclivity for imported hardware. In line with the government's Make in India initiative, the army has procured several items (Extreme Cold Weather Clothing System, Bulletproof Jackets) which were earlier imported and actively encouraged the domestic

industry, including technology start-ups, to develop high-end technology.

Presently, it is working with industry to develop a lightweight tank to meet operational requirements in mountainous regions. Earlier, it has worked with a start-up to successfully develop an advanced secured communication (over a distance of over 150 km) through Quantum Key Distribution systems. In late August 2022, it deployed two sets of Swarm Drones in its mechanised forces, by working with Indian companies.

CONCLUSION

With an active manpower strength of 1.19 million, a budget of \$25 billion and an inventory of some of the deadliest weapons, the Indian Army is a force to reckoned with. Unlike many other armies of the world, it is battle-hardened, with experience of fighting five wars, including one that had the potential for a nuclear exchange, and a number of border skirmishes. The ongoing reforms along with infrastructure development, and technology-intensive modernisation will further enhance is combat readiness. However, it has to get its act together on the procurement front so as to quickly induct much-needed equipment.

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CHEN CHUANREN // SINGAPORE

FULL SPECTRUM MODERNISATION FOR SINGAPORE'S ARMY

In an unpredictable 2022, Russia invaded Ukraine and China fired ballistic missiles over Taiwan. While these geopolitical events prompted kneejerk actions to pour in extra defence dollars and revive national military service, overall Singapore maintained its steady march towards modernization - as it has done over the last 57 years. For fiscal year 2022, the Singapore Armed Forces (SAF) will have a budget of S\$16.3 billion (AU \$16.9 billion), a 6.5% year-on-year increase.

efence leaders and political office holders have often said that the SAF must avoid large and sudden spikes in spending and has called for steady, gradual investment. This has always had strong backing by the parliament.

Prime minister Lee Hsien Loong said in his national day rally, as the country emerges from the pandemic, and faces external geopolitical tensions in the East and West:

"We must take National Service seriously and keep the SAF and Home Team strong and credible. If we do not defend ourselves, no one is going to defend us on our behalf."

In mid-2021, the Army wrapped up its so-called third generation modernisation, capped off by full operational capability of a combined-arms division (CAD) to muster all army formations to fight as a single unit. It then entered the next generation army modernisation program, aimed to increase the capability to sense, move and strike at a faster pace and the ability to muster greater volumes of precision firepower.

A majority of these efforts are done beyond the acquisition of hardware, but rather novel technologies ranging from artificial intelligence powered command and control systems to new branches and services to exploit these capabilities.

SENSE AND STRIKE

In mid-2021, the Army stood up HQ Sense and Strike (HQ SS), a reorganisation of Headquarters Army Intelligence and Headquarters Singapore Artillery. The Ministry of Defence (Mindef) says HQ SS will "spearhead cross-domain expertise to integrate the Army's tactical intelligence and fires capabilities with manoeuvre capabilities."

"One key enabler is the ability for the Army to leverage on whole-of-SAF sense and strike capabilities. The Army will have the capability to dynamically employ sensors and shooters as required by mission demands to enable manoeuvre



The H225M helicopter is expected to drive the Army's air projection capabilities. Credit: Chen Chuanren

Defence leaders and political office holders have often said that the SAF must avoid large and sudden spikes in spending and has called for steady, gradual investment.

forces to bring the full weight of the SAF's combat power to bear on the adversary." It added.

One example is the application of AI in command and control systems, which was demonstrated in SAF capstone integration and strike exercise Forging Sabre. Al was able to identify and classify targets picked up by UAVs and predict the enemy's movements based on terrain and speed. It will also provide recommendations on suitable strike assets, along with a strike window for inflicting maximum damage.

THE DIGITAL AND INTELLIGENCE **SERVICE**

As the Army attains new network capabilities through cyberspace, it is expected to gain a new service counterpart when the Defence Minister Ng Eng Hen announced in March 2022 that Mindef will set up a fourth arm known as the Digital and Intelligence Service (DIS).

Recognising threats from cyberattacks and the digital domain, the DIS will be the frontline force to



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The Army's new standard issue personnel equipment, with high cut helmets and new uniform materials. Credit: Chen Chuanren

Other projects include a Next-Generation Howitzer (NGH), a truck-based self-propelled howitzer to replace the Primus tracked SPH and FH2000 towed gun.

deter and respond in the digital realm.

Ng said in the Parliament hearing and it will be "prudent" to start and build up the fourth service as a deterrence to any actors that may plan cyber and disinformation campaigns against Singapore:

"In fact, cyber threats, disparate in form and source, occur in the thousands, even millions each day. However, they should be differentiated from the ones that have the most pernicious intent and seek to undermine our nation's sovereignty or security."

The parliament passed amendments to the SAF Act and Constitution allowing the DIS to be formed, which is expected by the end of this year, and will comprise various C4I units such as the Defence Cyber Organisation, C4 Command and Cybersecurity Task Force, including military intelligence. DIS will be a key enabler and defender of the military networks with the SAF and at the

same time, be a provider of intelligence for the SAF to fulfil its missions.

PLATFORMS FOR THE FUTURE

A key Army platform introduced is the ST Engineering Hunter Armoured Fighting Vehicle, touted as the world's first drive-by-wire protected vehicle. Designed with network centric operations and a hatch closed concept, the Hunter features a crewless Samson turret with 30mm cannon and two concealed Spike anti-tank missile launchers.

Cameras and an SAF-wide battlefield management system gives the crew all round situational awareness - something that is particularly useful before deploying its eight armed

Co-designers the Defence Science and Technology Agency (DSTA) said the all-digital nature of Hunter allows plug and play of future

systems such as pairing with an unmanned ground or aerial vehicle concept, which is concurrently undergoing trials. It also allows the gathering of data of the vehicle's health status, complemented with data analytics to be managed under a fleetwide system for predictive maintenance and just-in-time inventory management.

The new Hunter Armour Battle Group is likely to be put through its paces and together with the entire Army during the annual Exercise Wallaby in Queensland, Australia, or Exercise Panzer Strike in Germany.

From late 2024, the Army will get its hands on the first ST Engineering Bronco 3 armoured tracked carrier to replace existing 'classic' Broncos, part of modernisation of the armour combat support and combat service support fleet.

Other projects include a Next-Generation Howitzer (NGH), a truck-based self-propelled howitzer to replace the Primus tracked SPH and FH2000 towed gun. Little is known about the design of the NGH but will likely follow the BAE Systems Archer, with a fully automated self-loading gun and small crew of 2 - 4. ST Engineering will likely be the prime contractor if it is developed locally, and deliveries will take place from 2024.

The NGH is parallel to the Army drive to motorise its forces in a high tempo environment. 2011 marked the start of operations for its first motorised infantry battalion with the Terrex Infantry Carrier Vehicle (ICV) and in 2016 the introduction of the Belrex protected vehicle, developed by ST Engineering and South Africa's Paramount Group.

With around eight variants developed for engineers, signals and logistics, the latest is the mortar carrier version, mounting a 120 mm Super Rapid Advanced Mortar (SRAM) Mk II on its rear. It requires 30 seconds to deploy, and can fire four rounds per minute for 20 minutes, or a maximum of ten rounds per minute for three minutes using a range of munitions including XM395 Accelerated Precision Mortar Initiative rounds.

The drive for dynamic and network centric warfare is also seen in its next generation helicopter programs. It is in the process of replacing its Super Pumas and CH-47SD with the H225M and CH-47F, both equipped with SATCOM communications and with greater range and carrying capacity. These features will allow the Army to conduct either specialised or mass missions beyond the horizon and the ability to conduct tight coordination between strike and attack assets, such as the SATCOM-enabled Apache and transport helicopters.

The change in doctrine and fighting style is also

SINGAPORE



Inside the all-digital Hunter AFV. Credit: Chen Chuanren

evident in personnel equipment design. The Army is in the process of issuing new uniforms and load bearing vests aimed to dissipate heat and improve troop mobility and endurance. These include a new high cut helmet that provides better integration with other equipment such as night vision googles, communication headsets and ear mufflers.

In mid-2020, the Army's Centre of Excellence for Soldier Performance (CESP), which houses the Soldier Performance Centre and Soldier Systems Integration Lab, was videoed testing out Canada's Mawashi exoskeletons which the manufacturers says can transfer 50-80% of the load from a soldier's shoulders to the ground.

REALISTIC TRAINING

The Singapore Army currently has the Murai Urban Training Facility to hone its Fighting in Built Up Area (FIBUA) techniques, but with limited size of a small village and few two-three story building. The SAF has decided to develop the SAFTI City to ensure training remains relevant and realistic in modern high-rise, built-up environment.

First announced in 2017, SAFTI City will feature over 70 buildings, including three 12-storey blocks, simulated underground facilities, and urban training structures. With a total estimated gross floor area of 107,000 m2, Phase 1 of SAFTI City will be able to accommodate brigade-level training. The pandemic has delayed the completion of the project from 2023 to 2024.

Many of these buildings will resemble a shopping centre and underground passages with multiple exits for challenging and realistic training. A transport hub will house buses and subway trains to train solders to fight in these

city environments.

Roads and buildings will be configurable using swing panels, and smart robotic targets are able to 'shoot back' or retreat according to scenarios, and results are digitalised and collected real time for instant feedback.

The SAF is forging ahead with the Australia - Singapore Military Training Initiative (ASMTI), which will allow SAF to have 14,000 personnel to conduct unilateral training for up to 18 weeks a year, up from six to seven weeks. Part of the plan is the expansion of the Shoalwater Bay Training Area

to include the Townsville Training Area, completed with Instrumented Combined Arms Air-Land Ranges and Urban Operations Live-Firing Facilities.

NATIONAL SERVICE

All the above advances are a cause and effect of a major institution better known as National Service (NS), which marked the 55th year since the policy began in 1967. All able-bodied Singaporeans from aged 18 are required to serve for two years across all three services, including civil defence and police.

NS has ensured that the SAF maintained a steady stream of manpower and more importantly it is the constant intake of educated and technology savvy teenagers that enable the Army to introduce complex weapon systems yet at the same time, new doctrines to cater to modern warfighting concepts and soldiership.

Like most developed societies, Singapore is also facing a lowering birthrate and it is estimated that there will be a 30% decline in national servicemen intakes by 2030. The Army therefore is turning to technology and automation to equip itself for the future population.

More importantly, the entire Singapore population understands the need for NS and a strong SAF. It is with this collective commitment of defence that has allowed the government to continue its steadfast investment into the modernisation of the SAF.



The Hunter AFV. Credit: Chen Chuanren

FORGET COLLINS LOTE - BUY NEW SUBMARINES FROM KOREA INSTEAD

One could never accuse South Korean companies of lacking in vision. DSME - one of the world's premier ship and submarine construction companies - has developed a strategy that could see brand new, long-range, highly capable submarines starting to be delivered to Australia by 2033. This date could be brought forward because they have based their schedule on that for the Collins Life Of Type Extension, which is due to start in 2026.



KSS-III Batch one sea trials - front on view (DSME photo)

f an order were placed with DSME before then, then delivery of capability would be even earlier. The company takes seven years from contract signature to delivery of their latest 3,750 tonne ocean-going submarines, so if Australia gave the go-ahead next year, the first one would reach us in 2030. This strategy would eliminate the risk of a capability gap before the arrival of nuclearpowered submarines and take schedule pressure off that program. It would also allow continuity of ASC's workforce and avoid a "valley of death" in submarine construction expertise.

However, there are several important assumptions in this calculation. The most important is that the first one, two or three submarines would be built at the company's gigantic yard at Okpo in Korea and during this process construction would be transitioning to Osborn in Adelaide. The second is that many of the subsystems would also be Korean - though, according to their experts the U.S. AN/BYG-1 combat system could be included without schedule delay and from the first of class onwards. The further a customer moves from the current DSME Military Off The Shelf (MOTS) design, the greater the impact on schedule and risk - but that can be managed by constructing in batches.

Two important disclaimers: DSME have made their calculations entirely on public domain information and have been extremely cautious about any data relating to operational matters. Secondly, all of the intellectual property for submarines is owned by the Republic of Korea (RoK) government in the form of the Defense Acquisition Program Agency (DAPA) and that

detailed discussions about exports to Australia can only take place with their knowledge and agreement.

However, as APDR has reported, the head of DAPA, Minister Donghwan Eom, visited Australia in July on a fact-finding mission to identify areas of cooperation beyond the purchase of 155mm self-propelled howitzers for the Army from Hanwha - another South Korean manufacturing giant. At that time, he indicated a very positive view of increased defence technology cooperation between the RoK and Australia. He was accompanied by several senior officials including RADM Youngkyu Jun, the head of the South Korean submarine force. That was followed by a visit of Defense Minister Lee Jongsup in early August.

The logic is compelling: the Collins Life Of Type Extension (LOTE) is technically risky, expensive - and will only add 10 more operational years to each submarine. A new submarine will have a life of 30 years. The schedule for the LOTE is that each submarine will be out of service for two years for the hull to be cut open and for a number of major machinery items to be removed and replaced with new equipment. These include the huge main diesel engines and the electric motors. Every expert believes that this process will actually take much longer than planned especially for the first of class, which might be out of the water for three or more years.

Major refits of submarines are always complex and fraught with risk. Near universal experience is that it is only when the submarine is pulled apart that the true scope of what needs to be fixed is discovered. New equipment has to be installed in such a way that does not compromise the noise signature of the submarine, which means new resilient mountings have to be designed, installed and tested. Similarly, a great deal of old piping and cabling has to be torn out and replaced,

SUBMARINES

which is exceptionally time consuming because submarines have limited margins regarding space and weight, unlike surface ships.

Government-owned ASC has done a good job of supporting Collins - after a very rocky beginning - but it has no experience in conducting an overhaul of this magnitude and complexity. The Swedish designer, Saab Kockums, has the necessary experience but for the moment is being held at arm's length from the process for reasons that are opaque. The cost of the LOTE is still being calculated but is likely to be several billion dollars, hence the question: does it represent value for money?

DSME have crunched the numbers and argue that a far better approach is to retire the Collins as scheduled and instead fast track a new class that would give Australia cutting edge conventional submarine capability in the early 2030s. The design that they propose is their latest generation KSS-III Batch II Dosan Ahn Changho class that contains cutting edge technologies - and which is one of the world's most modern and quiet conventional submarines.

This is a proven design, with the first Batch 1 commissioned by the RoKN in August 2021 and another four under construction, with a sixth about to be contracted. These are three each of KSS-III Batch I and KSS-III Batch 2. Some basic characteristics of Batch II, construction of which started in August last year, are:

- Displacement: 3,750 tonnes
- Length: 89 meters
- Crew: 50 personnel (additional crew can be
- Endurance: classified
- Range: classified but believed to be in the vicinity of 20,000km
- Six 533mm bow mounted torpedo tubes
- Vertical Launch Missile System (capacity is classified but could be 6-10 cells)
- Propulsion: MTU-4000 diesel engines; MTU generator; AC Permanent Magnet Motor (possibly using High Temperature Superconductor technology); Air Independent Propulsion (AIP) using fuel cells manufactured by DSME; Li-ion batteries (produced by Hanwha)

N.B. This is the only known western conventional submarine with AIP able to fire ballistic missiles. If Australia did not require the VLS it could be omitted and replaced with additional fuel, or extra accommodation - or both.

The RAN has had a strange aversion to both Li-ion batteries and AIP. It is high time to revisit



KSS-III starboard bow view. (DSME photo)

Government-owned ASC has done a good job of supporting Collins – after a very rocky beginning – but it has no experience in conducting an overhaul of this magnitude and complexity.

both issues. These types of batteries are now in service with the navies of the RoK and Japan, so they can be considered reasonably mature. The commercial use Li-ion technology is growing exponentially and they are now in everything from mobile phones, cars and even instruments on the international space station. They outperform traditional submarine lead acid batteries on almost every metric - and using them also removes the need for cooling and acid circulation systems.

Replacing conventional lead acid batteries with Li-ion and making no other changes doubles underwater endurance and halves recharging time. Going the next step and adding AIP is a further major increase in the number of days needed before the submarine must come close to the surface to run the diesels.

One of the RAN hang ups about AIP appears to be the trade-off between the space occupied by the system and the amount of use it will receive during a mission. To put it another way, given long transits from Freemantle to operational areas, for most of the time it would just be sitting there doing nothing. Using the same logic, one could argue that torpedo tubes are also largely

unnecessary, but let's move on.

This is another classified field, but the DSME solution appears to take up a relatively small space - perhaps less than a hull section - and is able to produce 600kW of power, putting it well ahead of rival systems. It is completely silent and is not limited by operating depth or water temperature. Korea developed this solution as an improvement over German technology that came with previous generation KSS-II submarines and is based on a methanol steam reforming approach.

If anyone is in any remaining doubt and wants to see for themselves, DSME has Land Based Test Sites (LBTS) for both the propulsion train at the Okpo shipyard and a separate one for the AIP system. There is also a full KSS-Batch 2 combat system LBTS owned and operated by the ROKN.

The submarines have six masts:

- Attack optronic mast (non-penetrating)
- Search optronic mast (non-penetrating)
- Electronic support measures
- Communications

The optronic masts are from French company

SUBMARINES



Republic of Korea Navy submarine ROKS Shin Dol-seok (SS 082) sails in formation during Rim of the Pacific (RIMPAC) 2022. Credit: CoA / Aleksandr Freutel

The company has exported three submarines to Indonesia and has completed a Transfer of Technology (ToT) package that will see a further three constructed by PT PAL Surabaya. DSME has also modified, overhauled and modernised 25 submarines - including two Indonesian Type 209s. This is a volume of work on a scale greater than that of European naval shipyards - and has all been achieved in just the last 25 years.

At first glimpse, the idea of South Korea building a new generation of submarines might seem improbable. However, even a cursory objective examination of the facts shows that the idea needs to be studied - and fast. The strategy only works if the government ditches the idea that everything needs to be built locally and accepts that in the interests of time and risk reduction, starting in the RoK and migrating the project to Australia makes sense - particularly since the nation has frittered away the previous decade in a series of flip-flop decisions.

There will be at least a 20-year wait until nuclear submarines can be delivered to us via AUKUS. Deteriorating strategic circumstances

Safran and had been selected for the Attack class program before it was cancelled.

Speaking of which, a decision to purchase the KSS-III Batch 2 would allow Australia to recoup the almost \$3 billion spent on the future submarine project, which otherwise will be totally wasted - to the anger of Australian taxpayers. In 2018, KBR won a contract to design a new construction site at Osborn; presumably this work is still valid. The huge effort put into developing an Australian industry supply chain for the Attack program is still valid and could save DSME time and effort in transitioning to a local build.

Perhaps the biggest benefit would be to use the work done by Lockheed Martin Australia developing the combat system for the Attack class. At the time of contract cancellation, the combat system was well advanced - far more so than the Naval Group platform design - and hopefully that expertise could be applied to migrating the first Korean-built submarines to a configuration much closer to the RAN's requirements. Some compromises might be necessary, but far better to have a highly capable new submarine in the water around 2030 rather than continue down the current path, which is a slow-motion train wreck.

While the KSS-III is about 80% Korean - itself a remarkable achievement given that 30 years

While the KSS-III is about 80% Korean - itself a remarkable achievement given that 30 years ago a submarine industry didn't exist - there are overlaps with suppliers for Collins and Attack.

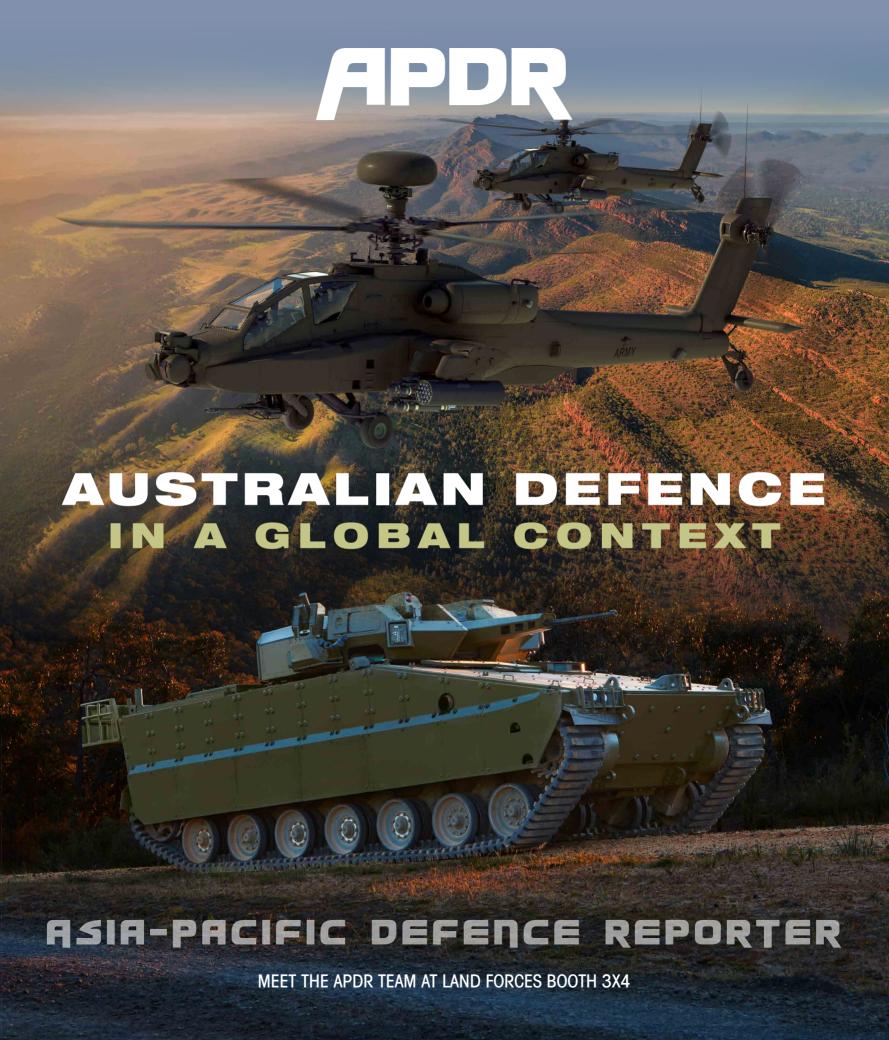
ago a submarine industry didn't exist - there are overlaps with suppliers for Collins and Attack. These include but are not limited to: MTU (diesel engines); Babcock (torpedo discharge systems); and Safran (non-penetrating masts). Another factor is the skill and experience of the DSME itself, which not only manufactures and consolidates the hulls of the KSS-III Batch 2 and integrates all the equipment, but it also manufactures the VLS, torpedo tubes and AIP system.

Since the RoK started its domestic submarine program in the 1980s - at about the same time as Australia commenced Collins - DSME has delivered all nine first generation KSS-I submarines based on the German TKMS Type 209. These were followed by three of the KSS-II class - a Korean adaptation of the far newer TKMS Type 214 - leading to five of six KSS-III platforms, including all Batch 2 production. The other Korean supplier is industrial giant Hyundai Heavy Industries (HHI).

make it foolish for the nation to be completely dependent on the Collins LOTE being carried out on schedule - and even if it were to succeed it would only give Australia an inadequate fleet of six platforms until at least the early 2040s. What DSME is suggesting solves several major problems simultaneously.

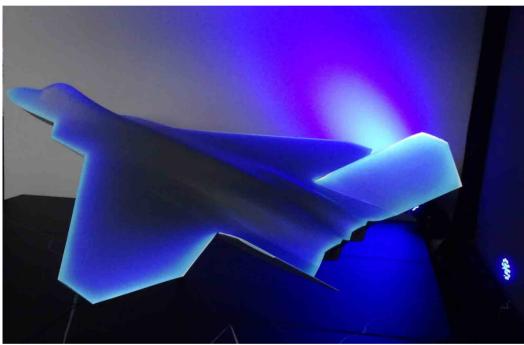
This financial year Australia will spend \$48.6 billion on Defence - and for that huge amount receive a poor return in terms of hardware. The nuclear submarine task force has a staff of more than 200 - and growing - with some of them presumably ricocheting between Canberra, London and Washington on a semi-permanent basis.

Surely some of these resources could be far better applied by sending a dozen experts to the RoK right now for a week to see what can be achieved in this decade. There is no more time to waste. Maybe it is time to ditch old paradigms and assumptions and look instead at how one of the world's most dynamic economies achieves such stunning results.



6TH GENERATION TEMPEST AIRCRAFT COOPERATION WITH JAPAN

The skies around the historic airfield of Farnborough in the UK are no longer filled by new aircraft types, but after a fouryear absence, this year's Farnborough International show was a trade-only event - and by far the biggest week-long global gathering of aerospace and defence companies. In the multiple exhibition halls, national pavilions and company chalets there was much to interest the thousands of visitors as developments across a wide variety of new programs were announced, indicating where and how next generation aircraft, missiles and systems are being actively brought forward.



The latest iteration of what the Tempest flight test aircraft might look like. (R. Gardner photo)

large number of special themed conferences and briefings were also included, covering subjects from maintaining air domination in contested air spaces to space access for military assets, new hypersonic air platforms and weapons, and preparing for and sustaining future operations in an era of transition to cleaner fuels. On the show's opening day, the biggest news was focused on the UK-led Tempest program, and the announcement that Japan was joining in the international partnership aimed at bringing forward a sixth generation Future Combat Air System.

Featuring radical new manufacturing methodologies and other features that exploit advanced technology solutions at every level, this development has an additional strategic importance as it provides more evidence of a much closer defence relationship between the UK and Western

supporting countries in the Asia Pacific region. It demonstrates that long-term defence relationships on a global scale can be strengthened and given more substance as a counter to expanding Chinese

UK Defence Secretary Ben Wallace said:

"I am delighted that the UK, alongside Italy, Japan and Sweden are working on the same combat air journey together. Our work with Japan and Italy on cutting-edge technologies like this shows the benefit of our alliances across the world."

He also announced that a flying 6th Gen demonstrator aircraft is already at an advanced design stage and is being given a high priority so that flight trials can start in 2025. This, along with other test aircraft, will be used to help define all key aspects of the platform concept and design and the highly integrated information "mesh" in which

it will be a central node, operating in a piloted configuration but alongside other piloted and unmanned air vehicles.

The building of a flying test platform is seen as an important element in the risk-reduction phase of Tempest, even though every aspect of the design is also to be evaluated using advanced computer modelling techniques. In much the same way as the Typhoon fighter design (Eurofighter 2000) was preceded in 1986 by an EAP test aircraft to confirm the configuration and general handling performance, the Tempest flight test air vehicle will inform decisions yet to be made before an initial production standard is finalised.

This might even look different to the test aircraft, but the growing capability to make rapid progress incorporating changes in the design and development stages will undoubtedly be a key feature, and the Tempest team claims this will be truly game-changing compared to current generation combat air production programmes. The ambitious target for production aircraft entering operational Royal Air Force service is 2035. This is claimed to be half the typical development timescale to bring highly advanced combat aircraft, such as the current Typhoon, into service.

SAFEGUARDING SOVEREIGN **CAPABILITIES**

In discussion with senior team leaders at a limited access briefing at the start of the show, APDR heard how discussions with Japan on sharing aspirations on a next generation combat aircraft have been underway since 2018. This is when Team Tempest first emerged in public as a core element in the UK's Combat Air Strategy.

The words "sovereign capability" were mentioned many times. Both the UK and Japan were anxious to safeguard their industrial and commercial aerospace capabilities beyond today's military air

production activities, where in addition to national projects, both are deeply committed as customers and partners to the US-led F-35 program, as is Italy.

As explained by Richard Burthon, Director Future Combat Air, at the UK MOD, there are four priority areas of activity on Tempest:

"First, building a flying demonstrator to help develop new techniques which can be incorporated into the development programme later. Secondly, International partnering is important to inform requirements decisions leading to the new programme. Thirdly, people skills development.

"We call this the Tempest Generation Initiative and in the UK it includes government, UK industry (BAE, Leonardo UK, MBDA UK and Rolls-Royce) and other partners, with new recruitment which has already started. A Tempest academy extends across industry and networks.

"Fourthly, we are developing and demonstrating how new technologies can deliver, and which areas need to be addressed."

He added that the UK was already discussing joint concept analysis with Japan and Italy. Possible realignments of both military and industrial requirements were underway. He said:

"We share similar threats and need similar capabilities. We have a fantastic shared mission and are now exploring levels of ambition (within the partnership.)"

Herman Claesen, Managing Director, BAE Systems Future Combat Air Systems, said that Tempest is designed to leap-frog the 5th generation air combat aircraft, which were designed 40 years ago, and to provide a genuine step change in military capability. It was important to ensure that the UK developed the necessary technology, skill sets and warfare capability to maintain operational advantage and safeguard UK air defence and security for the next generation.

He said the Tempest vision would safeguard crucial combat air capability and maximise overall national value by investing in innovation, harnessing a supply chain that will transform processes through digital engineering and agile approaches such as model-based systems engineering and digital automation, to do things better and quicker. Already there are over 2,000 people working as part of Team Tempest and since 2018 over 1,000 apprentices and graduates have been recruited.

But international partnering was an important part of the solution to safeguarding future capabilities. He said that over 100 digital flying hours have already been flown by company and RAF pilots in simulated Tempest flights and new ways of working

together, using model-based systems were inspiring a new generation of engineers. Already over 50 new patents have been generated to inform decisions as the activity moves forward. He suggested that Tempest will represent as big a step forward in aerospace technology as was Whittle's early jet engine or the Concorde SST.

SIGNING UP

Having embarked on a cooperative journey with Japan at both a government and industrial level, BAE Systems subsequently became more actively involved in helping with sub-systems development for Japan's own future fighter project. This continued to the point where a memorandum of cooperation was signed between the two countries in December 2021.

This is to collaborate on future technologies applicable to a 6th generation combat aircraft and subsequently was ramped up following agreement between former UK Prime Minister Boris Johnson and Japanese Prime Minister Fumio Kishida earlier this year. The international flavour has continued to expand to encompass not only the stealthy, supersonic Tempest airframe but also new radar, electronic warfare and communications equipment, weapons and a new propulsion system.

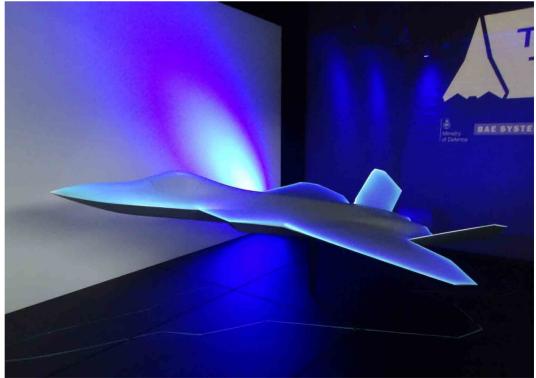
The approach has a "whole solution" perspective and the end result will be one of the most deeply integrated air combat systems ever. This will

comprise both piloted and unpiloted aircraft linked throughout the battlespace to other platforms, nodes and weapons. It will have robust real-time theatre and global connectivity delivering the best possible situational awareness and the means to deliver effects in the most appropriate manner. That might be identifying at long range targets that can be dealt with by on-board weapons, or weapons launched from other air, sea or land effectors.

The specific weapons requirements and performance details are understandably highly classified at present. The operational timescale for Tempest will reach out well into the next half century and there will be provision embedded in new engine technology for generating sufficient electricity, with an intelligent power management system, for future air vehicle electrical needs.

That may extend to directed energy weapons as well as internal carriage for hypersonic missiles. Rolls-Royce is leading on the propulsion system for Tempest and sees the program as a basis for transformational advances to be introduced. It has been engaged in an experimental project known as Orpheus, which has already shown a new pathway for carrying out engine development and testing in half the previous best timings and at 60% of the cost.

Digital modelling combined with 3D printing has reduced the overall development cycle by no less than 80%. Such aspects as modelling the future carbon footprint and re-examining the design of the



Forward view of possible Tempest design. (R. Gardner photo)

TEMPEST



combuster and fuel system for using sustainable fuels is being fed into the work going on with partners on the future needs and specifications for a new generation propulsion system. Rolls-Royce believes that it can reduce the number of energy exchanges and maximise the potential of gas turbines as the primary power source. The company believes that a major advance in electric power generation will also offer significant wider-reaching benefits into adjacent market sectors, including civil aerospace.

FUTURE-PROOFING

MBDA, the weapons provider for Tempest, has pointed out that "gold-plated solutions" add cost, so there is a need to exploit spiral developments that allow for new weapons to become available quicker during the operational life of the airframe. This is one area where tomorrow's technologies are being considered at the outset.

The challenge of keeping aircraft updated to benefit from the faster pace that digital solutions can provide has been recognised. Tempest forward planning aims to create a breakthrough level of future-proofing the systems architecture and functional weapons software to avoid the huge

costs and disruptive timescales that have become so familiar in recent times.

Future weapons need to be of the right size and this will inform decisions on the scale of what is required for carriage on the aircraft. Speaking at the briefing, Andrew Howard, Director of Major Programmes at Leonardo UK, described how deep fusion of integrated sensors, allowing a triangulated information flow, was a game changer. He said the closer relationship with Japan was adding a very valuable new factor in taking the radar and associated systems developments forward.

Mitsubishi Electric and Leonardo are looking at a high-power digitisation of a radar head that will be using gallium arsenide components to greatly reduce the size of the sensor unit, which in turn allows aerodynamic design advantages. Joint work on the Tempest radar is flowing on from another Anglo-Japanese partnership agreement in the Jaguar program (Japan and Great Britain Universal Advanced RF), a universal radio frequency sensor technology initiative.

This in turn is part of a wider Integrated Sensing and Non-Kinetic Effects and Integrated Communications System (ISANKE). This will integrate all the aircraft on-board sensors and will include networking data and communications to other off-board platforms, such as "loyal wingman" type unmanned platforms, yet to be determined.

Separately, BAE Systems is working closely with Mitsubishi Heavy Industries on Japan's indigenous fighter program on sub-systems developments as well as looking at Japanese expertise in robotics in manufacturing. BAE also has over 100 company personnel in Turkey, supporting that country's own future fighter development activity, and a full-size mock-up of the Turkish Aerospace TF-X was on show in the static aircraft park at Farnborough.

HIGHLY AUTOMATED

The BAE Systems factory at Warton has already set up an advanced "Factory of the Future" where it is trialling a variety of next-generation manufacturing and assembly technologies - all highly automated. The company chalet contained a display showing how artificial intelligence and highly automated robotic systems program can radically reduce physical manufacturing and assembly on a future production line. This will drastically reducing build timescales, guaranteeing component and assembly accuracy, reducing materials wastage and increasing productivity.

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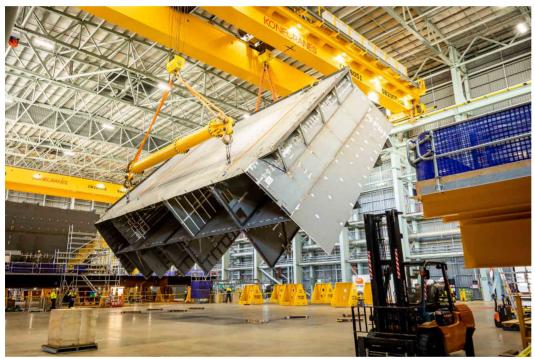




KYM BERGMANN // OSBORN & CANBERRA

HUNTER CLASS FRIGATE PROGRAM COULD BE ACCELERATED

Given that we are surrounded by water, one of the big headaches for Australian strategic planners is the number of naval combat platforms that will be in service during the critical period of the 2030s. This is the decade when it is assessed China will be at its most capable and most aggressive, after which profound demographic issues and leadership changes may see Beijing more internally focussed. With the cancellation of the Attack submarine program, there is understandable nervousness about what is happening with surface ships.



Partial block being lifted (BAE Systems photo)

n August 26 there was good news during a media briefing in Adelaide by BAE Systems Australia - Maritime CEO Craig Lockhart. This is that the Hunter class frigate program has been making better than expected progress and there is now a strong possibility that the build schedule can be accelerated. However, this increase in pace has not yet been confirmed officially - at this stage it is the assessment of the prime contractor. Given unexpected events such as Covid and Russia's invasion of Ukraine, everyone is wary about making promises that will subsequently need to be broken.

Unusually, the briefing also included representatives from the Defence customer, including RADM Tony Dalton who is responsible for National Naval Shipbuilding within the

Capability Acquisition and Sustainment Group, and Sheryl Lutz, First Assistant Secretary Ships from the same organisation. Another noteworthy participant was Vice Admiral Tim Barrett (retired), who is now an advisor to BAE Systems.

Without for a moment wishing to sound ungrateful for the positive news, it is still short of what the government of the day stated on November 18, 2018, when announcing the selection of BAE Systems as the combat system integrator for the project. In the final sentence of his media release, Defence Minister Christopher Pyne stated without ambiguity or qualification:

"Construction will begin at Adelaide's Osborne Shipyard in 2020 and the program will employ around 4000 workers."

Earlier when BAE Systems and the UK Type

26 design were selected on 29 June, 2018, Prime Minister Malcolm Turnbull, Finance Minister Matthias Cormann and Minister Pyne said in a joint statement:

"The Hunter class will begin entering service in the late 2020s replacing the eight Anzac Frigates. which have been in service since 1996."

We will return to this history shortly, but nothing should detract from the efforts of BAE Systems and their Osborn workforce to recently accelerate the program, which will deliver a complex, exceptionally powerful platform to the RAN. Nine of the 10,000 tonne anti-submarine warfare (ASW) ships will be acquired, with the first batch of three under contract. They are being built to the highest possible standards and with a level of Australian Industry content that is tracking above expectations, and which is likely to increase further.

To understand how the schedule might now be brought forward it is necessary to canter through why it was initially pushed out. The start of construction in 2020 was always going to be difficult and as the date drew closer the story from the government changed slightly and the public were then informed that "prototyping" rather than actual shipbuilding would begin in that year. What that meant was that representative pieces of the ship would be cut, trimmed and welded for training and planning purposes, but they would be discarded when work on the real thing started.

In August last year an additional 18-month delay was agreed by all parties. This was caused by several events, most noticeably the global disruption of Covid. The factors directly related to the platform included the complexity of the Australian-specific changes - especially the radar and combat system that necessitated a slightly fatter hull of 0.6 of a metre - delays to the parent Type 26 program and a shipyard being developed. Nevertheless, work had already started as

HUNTER FRIGATES

promised on the prototype sections.

This has been moving along very well in the enormous new facility at Osborn that features several gigantic, interconnected construction, outfitting and assembly buildings with overhead cranes, welding machines as well as cutting and painting equipment. The final hall is large enough to accommodate an entire 150 metre long, 21-metre-wide Hunter frigate under full cover. In fact, it could include two Hunter frigates side-byside, but that will never occur in practise because of the need to have enough working space available to complete the job efficiently.

The protype blocks are huge - basically sections of the designed ship weighing up to 141 tonnes. The original plan was to discard all of the prototype blocks after they had served their training purpose. The first two would not be suitable in any case because they are built to the Type 26 design (the only design available when work started), which has different cabling and piping cut outs in the steel sheets. Because of the quality and speed of the work now being performed at Osborn, the later ones designed for the Hunters will be good enough to be incorporated in them.

Work on these enhanced prototype blocks is now scheduled to begin in May next year, which means that if everything goes to plan that will mark the date of the construction of the first of class. If none of the test sections had been suitable for inclusion, the build of the platform would have commenced at the end of 2024. Further to this, on August 29, BAE Systems announced that:

"Equal to the size of two houses and taking 45,000 hours, the first steel 'block' has been constructed by shipbuilders working on the Hunter class frigate program. The largest surface shipbuilding program in Australian defence history continues to make strong progress at the Osborne Naval Shipyard in South Australia.

"Shipbuilders are initially manufacturing five prototype ship blocks to test and refine the processes, systems, tools, facilities and workforce skills ahead of construction of the first Hunter class frigate. There are 22 blocks in each Hunter class frigate. The first prototype block, known as Block 16, weighs more than 140 tonnes and its construction involved the expertise of 35 different trades, including engineers, boiler makers, welders, fabricators and project managers."

BAE Systems Australia Managing Director -Maritime, Craig Lockhart, said:

"Throughout construction of the first prototype ship block, our highly-skilled workforce has



BAE Systems welders (BAE Systems photo)

been able to incorporate new, more efficient and effective ship-build methods and innovations into our processes. Already, the quality and productivity we are achieving is well above where we thought it would be at this stage of prototyping. This quality demonstrates the potential of a strong future for continuous naval shipbuilding in Australia.

"We are working towards achieving new benchmarks in manufacturing efficiency and quality and the new processes we are developing allow much greater engagement with Australian suppliers."

Work has also been taking place in parallel on the combat system, with radar hardware from Australian supplier CEA at Moorestown in the US for integration testing at a shore-based Aegis facility, which Defence says is going very well. At the same time, a prototype of the complex and distinctive aluminium mast is taking place at the BAE Systems facility in Henderson, WA, which successfully completed similar but smaller scale work as part of the ANZAC frigate ASMD upgrade.

It is probably coincidence, but the media visit took place against the backdrop of not only a lot of public criticism of the project - including by APDR - but more recently Navantia, the Spanish builder of the RANs three Air Warfare Destroyers, has made an unsolicited offer to supply more of this class to Australia. The argument goes: "Why

wait for the Hunters when we can have additional Hobart class in the water before the end of the decade." While it has no chance of success, the fact that the offer has been made might have ruffled a few feathers - especially as it was made directly to government, bypassing Defence and the RAN.

At first glimpse, the idea might have some appeal - and it has powerful backing. The two ships are approximately the same size and the Hobart class are in service with the RAN and they have 48 critically important VLS cells compared with 32 for the future Hunters. The list of specific Australian changes that BAE Systems need to make to the Type 26 parent design are:

- the Aegis combat management system with the Saab Australia developed Australian Interface;
- the Australian designed and built CEAFAR2 phased array radar;
- integration of systems to support Australian weapons;
- integration of the Seahawk Romeo Maritime Combat Helicopter;
- Australian communications systems; and
- Australian legislative requirements.

The Hobart class already incorporates the final four points on that list - and a lot of work had already been done by Navantia on the first two since a modified version of the ship was one of three contenders that was part of the Competitive Evaluation Process for SEA 5000.

Despite this, the task of installing and integrating the new CEAFAR mast and the Aegis Baseline 9 combat system would have been considerable. In addition, the Type 26 will incorporate the large Thales variable depth, active, towed array sonar that is an essential tool for ASW operations, while the Hobart class have a much smaller system. Replacing it would have required a redesign of the aft of the ship.

Anyway, it is all academic because Defence has as usual circled the wagons and will protect the Hunter program from competition, no matter what. Life tells us that sometimes we get things wrong that's why divorces occur and why appeals courts exist and why journalists write corrections - but apparently that's never the view from Russell Hill. Perhaps a lesson from this is not to create unreachable expectations for a program, though to be fair that is often the speciality of Ministers responsible for the portfolio.

(Kym Bergmann travelled to Adelaide as a guest of BAE Systems. He would particularly like to thank Kaye Noske for her help.)

GEOFF SLOCOMBE // NEW ZEALAND

NEWS FROM ACROSS THE TASMAN

NZ ARMY ONCE AGAIN IN AID OF THE CIVIL POWER DURING **FLOODING**

In mid-August the NZ Army again provided support to communities in the north of New Zealand's South Island following severe weather. Army Unimog vehicles, HX60 MHOV trucks (with cranes) and personnel, have assisted with the delivery of supplies, weather barriers, sandbagging and an evacuation.

The Unimog and MHOV trucks have enabled military personnel to access areas unreachable by other vehicles, while transporting equipment with their large load capacities.



Army personnel erect a flood barrier. Credit NZDF

RNZAF ORIONS BEING REPLACED BY **POSEIDONS**

Despite a number of Orion maritime patrol aircraft upgrades since first coming into service in the 1960s, the RNZAF's six P-3K2 Orions are now reaching the end of their life. Their replacements, four Poseidon P-8As, are currently being built by Boeing in the United States and will start arriving in 2023.

New Zealand aircrews have been training on USN Poseidons in Florida since 2020, including flights there by all-RNZAF crews since July 2021.

Orion NZ4204 is the latest aircraft to be retired from active service. This was after a ceremony and a 'Formation Thunder' flypast, in which an RNZAF Boeing 757 led Orion NZ4204, on its last flight, at RNZAF Base Woodbourne.

Because the P-8A is a larger, heavier aircraft than the P-3K2s it is replacing, the RNZAF has been strengthening runway and taxiing areas at RNZAF Base Ohakea, in the lower North Island, where the new aircraft will be based.



NAVY RETRIEVES A CRASHED UNDERWATER AIRCRAFT BODY

When HMNZS MANAWANUI's crane lifted a battered yellow aircraft body from the sea near Whitianga last month, it was hard not to have a sense of déjà vu.

Six years ago, MANAWANUI's predecessor, a dive tender (MANAWANUI II) with embarked divers, recovered the crashed plane of a NZ businessman and his wife. Fortunately, in this latest retrieval, the recovery was an exercise.

The airframe, from a genuine plane crash, had been deliberately placed on the sea floor to test the locating and recovery expertise of the Ship's Company and the embarked personnel from HMNZS MATATAUA.

While MANAWANUI's Commanding Officer, Commander John McQueen and his crew knew the area where the plane had been lowered to the seafloor, 30 metres down, the MATATAUA Search, Salvage and Recovery detachment of hydrographers and divers were kept in the dark. They were then given a narrow search area and tasked to locate the plane. Within hours, the multibeam echo sounder aboard MANAWANUI, combined with the specialist knowledge of the hydrographers, identified the outline of an object that matched the characteristics of the missing plane.

The next step was for the divers to launch the ship's Remotely Operated Vehicle (ROV)

to conduct a detailed search with its cameras. On gaining visual confirmation of the plane, the operators could guide the ROV over the wreck, gathering detail to assist the divers. Using the ship's wet bell, a two-person dive team were lowered through MANAWANUI's moon pool.

MANAWANUI Bridge Watchkeeper Lieutenant Nicole Ruddiman says the diving detachment from MATATAUA can operate safely to 50 metres. "Divers 1 and 2 go down but only Diver 1 goes out to the airframe to attach strops," she says. "Diver 2 remains in the wet bell to manage the tether and is able to respond to an emergency if Diver 1 needs a rescue or assistance back to the wet bell.

Divers rotate around depending on maximum time at depth before needing to conduct stops for decompression on returning to the surface. We'll send rotations of divers down until the airframe has all strops attached, and is hooked onto the crane hook." After being given the signal to lift, the crane operator on the ship slowly and carefully raised the plane and gently lowered it onto the deck.

CDR McQueen said this was a major milestone for MANAWANUI and the culmination of significant training and system testing since the ship's arrival in 2019. "It has shown the benefit of well-trained people operating complex equipment with cohesion and within a dynamic underwater environment."

(APDR thanks the NZ Defence Public Affairs team for permission to reproduce this description of the crashed aircraft retrieval.)

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Cover: An M1A1 Abrams main battle tank from the School of Armour fires on target during a firepower demonstration at Puckapunyal Military Area in Victoria, on 17 August 2022.

Credit: CoA / Michael Currie

EVENTS

Land Forces

BRISBANE, 4-6 Oct 2022

Tel: +61 (0)3 5282 0500 airshow@amda.com.au

IndoDefence

JAKARTA, 2-5 Nov 2022

Tel: +62 812-8361-3827 corcomm.napindo@gmail.com

MilCis

CANBERRA, 15-17 Nov 2022

Tel: +61 2 6252 1200 milcis@consec.com.au

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