UNINHABITED SYSTEMS
– AIR, LAND AND SEA

INTERVIEW
TITOMIC CEO, HERBERT KOECK

C4EDGE
BATTLEGROUP AND BELOW C2 DEMONSTRATION

CHINA’S MILITARY BUILD UP CONTINUES
MULTI-DOMAIN VERSATILITY

General Atomics Aeronautical is proud to support the Royal Australian Air Force in delivering unmanned and autonomous capabilities that contribute to ADF Multi-Domain Operations. Now, always.

Learn more at ga-asi.com
Relations with China continue to slide

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Babcock preferred for JP 9101

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Thales sovereign munitions capability

BAE Systems welcomes new F-35 support contract

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The December 8 decision of Australia not to send officials to the Winter Olympic Games in China is no surprise following an identical announcement by the US. Beijing has reacted with predictable anger — though logically it should be pleased because this means there will be far fewer freeloaders attending but the athletes will still be there. However, symbolism is important and we will have to wait and see what retribution, if any, is coming our way.

Only two weeks previously Defence Minister Peter Dutton speaking at the National Press Club warned that China’s aggressive and expansionist policies are causing alarm not just in this region but around the world. Central to this is the issue of Taiwan and whether Australia should be involved more actively in the defence of the island in the face of Beijing’s on-again off-again threats to use force to reunify it with the mainland. This debate, in turn, was prompted by earlier remarks from former Prime Minister Paul Keating that Australia has no vital strategic interest regarding the future of Taiwan.

This is an extremely complex topic and at the risk of oversimplification, the position of Minister Dutton seems to be that if China invaded Taiwan then the US would certainly come to its defence and it is considered highly likely that Japan would also be drawn in. If this happened, should Australia also become involved? The answer from the Minister was an indirect yes, indicating that it would be in our national interest to do so for several reasons. These include the belief that China would not stop there but the Senkaku Islands — currently administered by Japan — would be next.

However, he also said that he does not believe that China is interested in invading other countries — it sees Taiwan as a renegade province - but prefers a system of being surrounded by vassal states. In this view he is historically correct. During those periods when China has been the dominant power in Asia — which is most of the time — that is how it has behaved. Attempts to invade Japan in 1274 and 1281 were massive disasters; other campaigns to subjugate variously the Koreans, the Burmese and the Vietnamese — to mention just a few — were only slightly less so.

In contrasting himself with Keating, he also mentioned that Taiwan — officially the Republic of China — is a vibrant, progressive democratic society. It is also an island, with a population of 25 million people — in both these respects identical to Australia, except for the difference in land mass and distance from the coast of China. He mentioned that other nations such as Lithuania — the new Ambassador to Australia was present in the audience — are stepping up their level of engagement with Taiwan.

But when asked if there was more that Australia should be doing, such as increased cooperation on policing, he was vague, saying that he wanted relations to remain exactly as they stand. There is a lot more that Australia could be doing to bolster Taiwanese morale that is low key and could be done in a carefully crafted way, such as having the country re-admitted to various international trade, health and law enforcement organisations. A case could be made that since relations between Canberra and Beijing are so poor there is not a lot left to lose and now would be a good time to go even further and lobby the US and Japan for Taiwan to be granted observer status at military exercises — to which China of course should also be invited.

As an aside, it is curious that foreign policy seems to be set by the Defence Minister and not the one responsible — Marise Payne — who typically is almost completely invisible. Politics, like nature, abhors a vacuum and perhaps Peter Dutton is filling it. If the Department of Foreign Affairs had been working effectively behind the scenes it might have been able to prevent the Solomon Islands switching diplomatic allegiance from Taiwan to China in 2019. This, in part, has been responsible for the recent rioting and widespread destruction that has once again led to Australia having to deploy troops and police to Honiara.

Returning to the main topic of defending Taiwan from invasion, this is a nuanced matter because it might depend on the circumstances at the time — and it could be that the positions of Paul Keating and Peter Dutton not as irreconcilable as they first appear. The former seemed to be following this chain of thought: China will never invade Taiwan — unless Taipei unilaterally declares independence. Taiwan will only declare independence if it is certain that it can count on the support of the US and other nations. The question for Australia would then be: should we be drawn into a war that Taiwan has caused?

This is why the US continues to pursue a policy of “strategic ambiguity” that implies Taiwan will be defended if China launches an unprovoked invasion — but if Taipei’s actions cause an attack, then all bets are off. This is to forestall the possibility of a few hotheads declaring independence only because they are absolutely certain of being protected by the US military.

If all of this sounds like: on the one hand this, on the other hand that — that’s exactly what it is. Until a few years ago it was expected that as China’s economy grew and as more people were lifted out of poverty the country would become more open, progressive and democratic. In time this process would lead to conditions were Taiwan and China were almost indistinguishable in terms of values and that time a peaceful merger would occur — but that isn’t happening.

Australia needs to move with great skill — supporting Taiwan where appropriate but not going so far as to encourage a declaration of independence.

FROM THE PUBLISHER

This is APDR’s final issue for the year. I sincerely thank my editorial team under the direction of Kym Bergmann, who have continued to deliver the very best news for our readers in the pages of APDR, and our Daily News Bulletin. The support of our advertisers has not been forgotten and I thank you for your trust in APDR and the team look forward to working with you once again in 2022. I wish you all the very best as we look forward to a much brighter and more stable 2022. Stay safe.

- MARILYN TANGYE BUTLER
THE FUTURE OF AUSTRALIAN DEFENCE SOVEREIGNTY

FIND OUT HOW NIOA IS ENSURING AUSTRALIAN DEFENCE SOVEREIGNTY

WATCH THE VIDEO NOW

NEW ARMY AVIATION COMMAND ESTABLISHED
2 December 2021

The Chief of Army, Lieutenant General Rick Burr, AO, DSC, MVO, today announced the establishment of a new Army Aviation Command, at a ceremonial parade and helicopter flyover at Blamey Square, Canberra.

Lieutenant General Burr said the formation of the Army Aviation Command was a significant achievement for the Australian Army and the Australian Defence Force.

“The alignment of Army’s aviation capability under its own command optimises Army Aviation to better support land, amphibious and special operations,” Lieutenant General Burr said.

“The Command will improve resilience and adaptability and ensure Army’s training system is agile and contemporary.

“The unity, sense of purpose and focus in a single command will support our land forces to achieve more tasks, in more difficult environments.

“The command also represents the delivery of another key milestone set out in the 2020 Defence Strategic Update and 2020 Force Structure Plan.”

Commanded by Major General Stephen Jobson, AM, CSC, Aviation Command will deliver aviation capability to support Army’s land power to enable the Joint Force.

“Aviation Command will coordinate the introduction into service of new helicopters and unmanned aerial systems, and enhance and assure the safety, effectiveness and sustainability of current aircraft,” Major General Jobson said.

“The changes to Army’s aviation command and control structure will simplify the management of Army’s helicopters—one of the most multifaceted and resource-intensive platforms used by the land forces.”

As of today, 16th Aviation Brigade and the Army Aviation Training Centre will transfer from Army Forces Command to Aviation Command.

Army’s aviation capability provides aviation reconnaissance, firepower support, air assault, and battlefield support and surveillance, in combined, joint and interagency environments.

Army operates various types of aircraft including the Boeing CH-47F Chinook, Eurocopter Tiger armed reconnaissance helicopter, NH Industries MRH90 Taipan multi-role helicopter and leased civil light utility helicopter.

BABCOCK PREFERRED AS CAPABILITY PARTNER ON AUSTRALIAN DEFENCE HIGH FREQUENCY COMMUNICATIONS
6 December 2021

Babcock Australasia will collaborate with Lockheed Martin Australia, and the Australian Defence Force (ADF), to deliver an upgraded system which provides effective long-range communications capability for Australia’s land, sea and air assets. The result is a robust sovereign solution that provides the ADF with a performance edge across its operations.

Building on Babcock’s proven Defence High Frequency Communications experience in the UK and New Zealand, this contract cements the long term commitment to Australia and underpins the strategic aim of developing the presence in the target markets. It also reinforces the core capabilities in delivering technology-led, cutting-edge solutions to support complex electronic defence programmes.

David Lockwood, Chief Executive, Babcock International said:

“I am absolutely delighted that we have been selected as preferred tenderer for this internationally significant capability programme for the Australian Government. Babcock has a strategic and expanding role in providing these critical services to three of the Five Eyes intelligence alliance partners, where interoperability and interchangeability are becoming vital.

“This selection reinforces confidence in our ability to grow our defence business in target international markets, and to build on Babcock’s capability in digital defence, an area of increasing importance to our global customers.

“Fit for today and ready for tomorrow, our collaborative approach will deliver a secure, resilient and advanced high-frequency communications solution for the ADF.”

Babcock will now enter a period of commercial discussions, and pending a final Australian Government decision, will achieve formal contract award.

HF radio towers Credit: Babcock
Giving Australia the ultimate high ground.

That’s Defining Possible.
Varley Rafael Australia (VRA) and Thales Australia have signed a Memorandum of Understanding (MOU) and commenced collaboration to explore future Australian production of the RAFAEL SPIKE family of guided weapon directly enabling the accelerated delivery of a Sovereign Guided Weapons manufacturing and sustainment capability in support of the Guided Weapons and Explosive Ordnance (GWEO) Enterprise.

The immediate focus of the collaboration is the review of manufacturing the SPIKE LR2 Anti-Tank Guided Missile’s advanced rocket propulsion system, warheads, Hot-Integration and associated storage requirements.

The SPIKE LR2 ATGM is a 5th generation precision guided weapon system, selected by Australia for the LAND 400 Program and the LAND 159 Lethality System Program. Already ordered by eleven other nations, the missile’s selection by the Australian Defence Force (ADF) will be augmented by an extensive Transfer of Technology (ToT) program that will upskill Australian industry to deliver domestic guided missile production and comprehensive in-service support to the ADF. VRA’s ToT leverage’s proven RAFAEL processes and experience in establishing local production and support capabilities delivering a Sovereign Guided Weapons Manufacturing capability, high technology local content jobs and upskilling of the Australian work force.

This collaboration reinforces both VRA and Thales Australia’s commitment to support acceleration of Guided Weapons and Explosive Ordnance Enterprise capability and Australian Content growth in key areas of advanced manufacturing and maintenance utilising Australian suppliers and ensuring the ADF receives a capability advantage through locally manufactured guided weapons essential for the defence of Australia.

VRA, from its facility in South East Melbourne, has recently completed the manufacture of SPIKE Integration Kits (SIKs) for LAND400-2 Boxer vehicles and is currently engaged by the Commonwealth to support Technical Certification of the SPIKE LR2 ATGM towards Introduction into Service of the missile.

THALES AUSTRALIA ADVANCES MANUFACTURE OF SOVEREIGN MUNITIONS CAPABILITY

2 December 2021

Following Thales Australia’s recent US Department of Defense qualification of its Australian-made TNT to military specifications, Thales is on schedule to commence production of the 155mm M795 Artillery Projectile capability in early 2022.

Production in Australia of the 155mm M795 Artillery Projectiles will take place in Benalla, regional Victoria, and will include the filling of...
steel projectile bodies with high explosive TNT, final assembly and completion of the rigorous quality inspections. The filled projectiles will undergo assessment to ensure they meet ADF and US military specifications.

Building upon more than a decade of exports to the USA of Australian-manufactured propellant, the US qualification of Australian-made TNT is a critical enabler in the development of Australia’s sovereign munitions capability in support of the Australian Defence Force (ADF) and our allies. It is an important step in building confidence in the USA that Australia has both the security and the industrial capability to handle both guided and non-guided munitions manufacturing.

The Australian TNT qualification follows announcements made earlier this year between Thales Australia and the US Army’s Development Command Armaments Center establishing a sovereign manufacturing capability for 155mm M795 HE projectiles in Australia. These agreements with the US have facilitated the technology transfer to Australia of US Intellectual Property, enabling the manufacture of critical munitions products to support the ADF including substantial work already achieved establishing a sovereign manufacturing capability for BLU-126 and BLU-111 aerial ordnance.

The 100% Australian-made TNT includes toluene supplied by Australian SME Viva Energy located in Geelong, Victoria. After undergoing almost two years of complex test and evaluation by US authorities, Thales’s US qualification attests to the high quality of the product, and provides an alternative source of TNT supply for the United States.

Dion Habner, General Manager of Thales Australia’s sovereign Munitions business said: “I am immensely proud of our highly skilled Australian team who have worked for over three years, working through the rigorous certification processes that have enabled the creation of a true sovereign manufactured munitions capability in Australia. This is an essential step in increasing Australia’s industrial capability in advanced manufacturing and self-reliance which is vital to delivering a capability advantage to the Australian Defence Force.”
BAE SYSTEMS WELCOMES NEW $80 MILLION F-35 CONTRACT
8 December 2021

BAE Systems Australia welcomed today’s announcement of a new F-35 Air Vehicle Support Services (AVSS) contract to establish sovereign maintenance and supply-chain support for the Australian fleet at RAAF Bases Williamtown in New South Wales and Tindal in the Northern Territory.

BAE Systems Australia Managing Director, Defence Delivery, Andrew Gresham, said:

“We are delighted to build on our contribution to the global F-35 program with this additional support for the RAAF. We will be leveraging our years of experience in fast jet sustainment working side by side with the RAAF to deliver aircraft availability and capability requirements.”

Maintaining and sustaining the global F-35 capability will create around 360 new direct jobs at BAE Systems Australia over the next 10 years and develop a specialist supply chain across Australia of more than 70 SMEs by 2025.

BAE Systems has provided fast jet maintenance and upgrades to RAAF aircraft from its Williamtown facility for almost three decades and employs nearly 460 people in the precinct.

The new AVSS contract will employ 46 BAE Systems Australia staff, providing direct, on-the-ground support to RAAF personnel sustaining the F-35. The company will have around 130 people working to support F-35 aircraft maintenance by the end of the year, having also recruited 25 former Jetstar technicians during the downturn in commercial aviation caused by COVID-19.

As a key partner and integral part of the industry team with Lockheed Martin, BAE Systems delivers up to 15% of each fifth generation aircraft globally. This includes the advanced manufacture of the aft fuselage, empennage, and crucial components from our facilities in the UK and Australia, and advanced electronic warfare capability from our US business. Parts of the vertical tail, corrosion prognostics and avionics are manufactured by BAE Systems in South Australia.
BECAUSE HOPE IS A CRITICAL MISSION

When you have people in need on the frontline, there is no option but to support. There is no airfield for miles. You need to reach a hostile environment in unforgiving terrain where the only options are short, unpaved airstrips. The multi-role Airbus A400M can carry 37 tonnes of aid, more than 100 people or even life-saving, heavy engineering equipment. It is capable of landing virtually anywhere, ensuring that civilians, units or communities who need support are never out of reach. With the A400M we can help them and protect our beautiful world.
A possible glimpse of the future took place near Canberra for three days from December 6 to 8 when the C4 EDGE consortium was able to demonstrate its 100% Australian solution for Army’s needs. The quick background is that in 2019, Defence paused the next phase of LAND 200 and the year before Army called on Australian industry to show what it could do in the C2 domain.

In response, Canberra-based EOS Defence Systems with a number of local industry partners submitted an unsolicited proposal offering to demonstrate a sovereign Battlegroup and Below C2 system – which it has now done.

Asked for a summary of the situation, Defence explained:

“The C4 EDGE program, sponsored by Army, aims to provide an understanding of Australian Industry’s readiness to contribute to future major acquisition programs by seeking to deliver world class, technologically competitive sovereign C4 capabilities. The demonstration will include elements of software, waveforms and cryptography, as well as friendly-force tracking, radio and other hardware manufacture. C4 EDGE involves a group of Australian small-to-medium sized enterprises.

“Since the C4 EDGE program commenced in mid-2020, the participants have increased from 18 to 30. The program comprises four phases; Phase 1 - System Design, Phase 2 - Software Build, Phase 3 - Hardware Build and Phase 4 - System Test. Phase 1 – 3 have been successfully completed up to November 2021. The demonstration was delayed to enable vendors to travel to the activity in the ACT after COVID restrictions were eased.

“Army is not seeking to augment or replace existing capabilities, or address any specific operational or tactical shortcomings through the C4 EDGE program. Rather, Army is exploring the extent to which Australian defence industry, as defined by the Defence Industrial Capability Plan, can potentially contribute to future Defence C4 projects. Of specific interest is the ability of Australian defence industry to rapidly respond to emerging technologies and threats through assured supply chains.”

Speaking to APDR after the conclusion of the trial, Brigadier Warren Gould, Director General Systems and Integration at Army HQ, said that the C4 EDGE team had demonstrated a considerable level of sovereign capability during the three days of field trials. He indicated that all of the objectives had been met and he was impressed with how much had been achieved in the relatively short timeframe of 18 months since the project began.

He said that the challenge was now for Army and Defence to find a way forward so as not to lose momentum and to take advantage of progress to date. He observed that the participating companies came from a variety of different backgrounds and that some of them were not previously known to Defence. His summary of the overall functionality of the system being shown was that it was highly capable – though still at a prototyping stage.

Matt Jones, CEO for EOS Defence Systems Australia, also believed that the trial met all formal objectives and demonstrated that local industry could work collaboratively to develop a state-of-the-art battlefield command system. He agreed that the activity was a proof of concept and that there is still some way to go before a fully mature product could be fielded – something that might take another two years of development.

In total, more than 100 Army, Defence and national security personnel viewed various demonstrations of the system, which culminated in an on-site visit by Major Generals Simon Stuart, Kath Tooley and Susan Coyle. The scenario that they viewed involved a battlegroup slice of capability through to dismounted infantry that allowed C4 EDGE to showcase a unified
network across multiple domains, including HF radios, SATCOM on the move; UHF mesh and L-Band mesh radio networks. This is a self-healing digital backbone that needs no external infrastructure and which automatically re-routes messages as people and platforms change locations.

The elements of the demonstration were dismounted infantry, manoeuvre support vehicles and headquarters all using the unified network concurrently for voice and data. The same network was also able to demonstrate the control of an uncrewed ground vehicle (UGV) and the delivery of ISR and range extension from an uncrewed air vehicle (UAV).

The demonstration site was too close to Canberra airport to allow the participation of an actual UAV so the trial involved the integration of video from the in-service Black Hornet operated by the company Criterion Solutions. All these various functions were able to be performed over the same mesh radio network.

This demonstrates that Australian industry has the capacity to provide deployed forces not only with the various subsystems they need but to bring them together over a unified, sovereign, secure network. This allowed command and control to take place with both voice and data using a product called CASM from Acacia Systems. The company has supplied specialist software to Australian Search and Rescue Aircraft and on Collins class submarines. Acacia built the C2 application for C4 EDGE in 6 months and it offers key message sets to support combat manoeuvre, blue force tracking and weapon integration to shorten sensor shooter engagement times.

The exercise also involved the use of sovereign high assurance encryption supplied by yet another Canberra company, Penten. The entire integrated demonstration was conducted over a fully secure environment with all devices using Australian developed crypto. The solution was designed to be accreditable by all relevant Australian security agencies.

Another feature was the ‘Warfighter’ uncrewed ground vehicle (UGV) from Brisbane-based Cyborg Dynamics Engineering. It was equipped with the new R150 remote weapon station (RWS) from EOS Defence Systems which proved to be a very effective force multiplier - especially as it was able to be operated over the same network as command voice and data rather than requiring a stand alone communications solutions.

This means that future dismounted infantry employing UGVs will not require separate radios or hand controllers, reducing the dismounted soldiers’ combat load while dramatically increasing firepower. Another consequence is that dismounts will be fully networked as part of the overall land force – an

**INSITEC HIVE CONNECTS THE BATTLEFIELD OF THINGS**

An Australian first software system, that replaces the need to manually connect tactical radio networks on the battlefield, has been unveiled by Defence ICT specialists Insitec following successful field trials in Canberra.

Insitec Founder and Managing Director Michael Branch said HIVE, developed as part of the Australian Army’s multi-million-dollar C4 EDGE collaboration, was a next generation communications and data network management system for the future of Network Centric Warfare.

The new system, developed through extensive research and testing with Australian Defence Force personnel, will connect the Battlefield of Things (BoT) and enable secure, faster decision-making for effective Joint All-Domain Command and Control – it is the glue that enables rapid and direct communication between all domain forces and Allies involved in any operation.

“The days of incompatible radio networks that are manually patched together to create inefficient, constrained networks are behind us. HIVE’s network architecture allows any node to interact with any other node on the network,” said Branch, whose company has been a trusted sovereign supplier to Australia’s Department of Defence for 20 years.

“HIVE’s operational interface, created with user-experience technology design experts fifty ZOO, is easy to use and ensures more effective and efficient command, control and communications (C3) by automatically optimising network management and performance.

“HIVE provides the ability to perform dynamic reconfiguration of interconnected networks to ensure that the commander’s intent is applied across the network’s communication systems.

“This means commanders can make quicker decisions thanks to reduced transmission latency and enhanced situational awareness. Furthermore, they can reliably and quickly communicate their orders to warfighters at the tactical edge.”

Insitec’s Military, Intelligence and Space Division (MIS) Chief Technology Officer Adam Wilson said HIVE’s Service-Oriented Architecture used situational awareness of the tactical electromagnetic environment to optimise the flow of data and communications.
outcome that has so far proven to be elusive.

The UGV and the RWS were controlled by applications available on the dismounted soldier control fold-down screen. These applications are distributed across the dismounted section, giving the unit commander flexibility and agility in who employs the UGV and RWS. Also available on the single screen are the radio controls, and the CASM C2. CASM is weapon integrated in both the mounted and dismounted environments, meaning that the RWS can slew to targets shared by the system. Additionally, targets can be generated into the CASM C2 from the RWS integrated optical sensor and laser rangefinder.

The UGV could be driven to a point and then either use its advanced optics for situational awareness – with a detection range of up to 10km – or use the weapon as controlled by soldiers. Carrying up to a .50 calibre heavy machine gun, it could engage ground and air targets with lethal accuracy out to a distance of 1km, greatly increasing the combat power of a section.

The data from the UGV could be shared across the network so that headquarters might view the location and reporting of what was taking place. Once a target has been acquired, other weapons on the system can be trained at it.

Covid severely limited the ability of the C4 EDGE partners to get together and it was only in the three week period prior to the demonstration that they were able to meet in person and finalise a fully integrated solution.
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Location</th>
<th>Description</th>
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<tbody>
<tr>
<td>Tectonica</td>
<td>VIC</td>
<td>Tectonica Australia is a leading Defence and Security systems integrator. Since 2002, Tectonica has developed fully integrated systems for armored vehicles, ground stations and soldiers.</td>
</tr>
<tr>
<td>Xtek</td>
<td>ACT</td>
<td>The XTEK head office is located in Canberra and manufacturing and R&amp;D centre in Adelaide. The South Australia office is primarily focused on the development of XTclave and lightweight composite technologies.</td>
</tr>
<tr>
<td>CISTECH</td>
<td>QLD</td>
<td>CISTECH provides intelligent multi-purpose devices with a sound architecture that scales. CISTECH’s contribution to C4 EDGE includes the MANET Command Environment (MaCe) application.</td>
</tr>
<tr>
<td>Outlander Solutions</td>
<td>ACT</td>
<td>Outlander Solutions builds innovative research and concepts into practical products and solutions to meet current and future customer needs ahead of the pack.</td>
</tr>
<tr>
<td>Cyborg Dynamics Engineering</td>
<td>QLD</td>
<td>Cyborg Dynamics Engineering are an experienced, highly motivated team and that constantly innovate in a variety of engineering sectors. Their core focusses are robotics and Artificial Intelligence. Cyborg’s contribution to C4 EDGE includes the UGV.</td>
</tr>
<tr>
<td>APC Technology</td>
<td>SA</td>
<td>APC Technology is a full spectrum tech manufacturing company capable of build-to-print through to build-to-specifications. Since 1984, APC has led the way in ruggedised hardware and software innovation, developing technology that is built to survive the impact of the elements.</td>
</tr>
<tr>
<td>Hutton Design Engineering</td>
<td>VIC</td>
<td>Hutton Design and Engineering brings over 21 years of experience in the Australian Army, culminating working at CASG in sustaining the current Combat Net Radio. HDE provides a low-risk solution by designing and developing a headset component for C4 EDGE program.</td>
</tr>
<tr>
<td>Dingo</td>
<td>QLD</td>
<td>Dingo provides predictive analytics solutions for asset-intensive industries. The predictive analytics help prevent major component failures, improve the reliability of assets, and safely boost production while decreasing maintenance costs. Dingo’s contribution to C4 EDGE is a logistics tracking dashboard.</td>
</tr>
<tr>
<td>Cognition Analytica</td>
<td>QLD</td>
<td>Cognition Analytica utilises 3D Systems Modeling to understand vulnerabilities and operational resilience. Cognition Analytica’s contribution to C4 EDGE is a demonstration of assessing various impacts to the battlegroup.</td>
</tr>
<tr>
<td>4 Design</td>
<td>NSW</td>
<td>With over 50 years of design and production experience, 4design is dedicated to the development of beautiful and functional products through the practise of exceptional Industrial design and product engineering. 4design’s contribution to C4 EDGE includes design, visualisation and fabrication of vehicle mounts and racks.</td>
</tr>
<tr>
<td>AVS (Applied Virtual Simulation)</td>
<td>NSW</td>
<td>Applied Virtual Simulation is a leading Australian simulation technology company. AVS delivers innovative training solutions for individual and collective training that provide soldiers, NCOs and officers with the skills and knowledge needed to succeed on the modern battlefield.</td>
</tr>
<tr>
<td>MMC Learning &amp; Development</td>
<td>NSW</td>
<td>MMCLD translates and links learning, knowledge and business requirements to established learning practices and technology options. MMCLD will be demonstrating some training previously developed for EOS.</td>
</tr>
<tr>
<td>Agent Oriented Software (AOS)</td>
<td>VIC</td>
<td>AOS is a software and robotics company specialising in autonomous and intelligent systems. AOS is developing its Kelpie range of autonomous, off road ground vehicles. AOS will be presenting their Hercules resilient radio communications for mesh networks.</td>
</tr>
<tr>
<td>Omni Executive Pty Ltd</td>
<td>ACT</td>
<td>Omni provides clients with customised solutions across all domains: physical, technical, human and cyber. Core services comprise: security, specialist project and program consulting, vetting, and a full aerospace capability. Omni Executive provides PMO staff for C4 EDGE.</td>
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<tr>
<td>Scipio Solutions Pty Ltd</td>
<td>ACT</td>
<td>Scipio Solutions provides business strategy development support for Government agencies and industry in the Defence and Security sector. Scipio Solutions develops the strategy and innovative tactics to simplify requirements and influence stakeholders in order to tackle wicked capability problems. Scipio Solutions provides PMO staff specialising in Australian Industry and Defence.</td>
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<tr>
<td>Systematix</td>
<td>VIC</td>
<td>Systematix provides professional consulting services to clients across the project lifecycle from strategy, procurement and planning, through to project delivery. Systematix consultants specialise in Defence, Rail and Infrastructure sectors within the government and the private sector. Systematix provides PMO staff for C4 EDGE.</td>
</tr>
<tr>
<td>Shoal Group Pty Ltd</td>
<td>SA</td>
<td>Across the defence sector, Shoal provides systems engineering support to both government and industry programs. Shoal delivers the digital thread from Defence strategy to detailed capability design; modelling and simulation of Defence systems, analytics for evidence-based decision making; and digital transformation. Shoal provides PMO staff for C4 EDGE.</td>
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The optimism surrounding the Airborne Teaming System (ATS) – the clunky name for Boeing Australia’s advanced, autonomous, jet-powered, fighter-like drone – seems fully justified, helped by the fact that these are the first combat aircraft designed and built in Australia since the Second World War. Two of them are conducting flight trials of increasing complexity and another four are under construction. Early flight dynamics results are apparently confirming parameters of speed, range and manoeuvrability.

Given the increasing fidelity and reliability of modelling and simulation, the predicted system performance of the ATS is also very encouraging. The basic idea is that the uncrewed aircraft will work in conjunction with their far more expensive and valuable – in terms of human life – platforms such as F-35s and Super Hornets – accompany them on missions, gather data, jam hostile radar and communications and ultimately attack targets. Being uncrewed and relatively low cost they could be sacrificed for the greater good – unless of course they ever become self-aware and turn on their human developers.

To be able to operate with crewed platforms they must be able to keep up with them – hence basic design decisions about a jet powered drone with a range of 3,700km and internal payload bay. Modelling is confirming performance expectations. On December 8, Boeing announced:

“Boeing Australia and the Royal Australian Air Force (RAAF) have advanced the operational readiness of the Airpower Teaming System aircraft, successfully demonstrating multiple payloads, semi-autonomous behaviours and crewed-uncrewed teaming in the digital environment.

“In a multi-day exercise that expanded upon a similar activity, RAAF operators worked with the digital twin to develop and test autonomous behaviours in operational scenarios and against threats provided by Defence.

“We are working closely with Boeing Australia on the integration of advanced payloads and operational requirements to ensure the Airpower Teaming System capability will be mission-ready to support air combat operations,” said Air Vice-Marshall Robert Denney, RAAF Head of Air Force Capability. “The state-of-the-art digital twin concept is allowing us to evaluate and integrate smart human-machine teaming systems in our force structure.”

“Testing included validation of the teaming aircraft integration and payloads as they operated alongside Defence crewed platforms, as well as the effectiveness of the distributed sensors across the Airpower Teaming System uncrewed team. The test scenario involved several aircraft operating in a threat environment, executing mission aims in co-ordination with crewed aircraft being operated by RAAF personnel, and builds on work to develop the crewed-uncrewed interface during earlier activities.

“This work also contributes to the development of the Boeing Airpower Teaming System being offered to global customers.”

Much of the program remains classified, which is fair enough other than to observe that far more is known on topics such as F-35 datalinks than those for the ATS. It is also too early to be certain about pricing other than it will be considerably lower than any equivalent crewed platform because without the need for things such as oxygen systems, canopies and ejection seats, drones are inherently far cheaper to build and operate. They are also potentially more manoeuvrable since a microchip or motherboard can withstand forces of 40g while the human brain definitely cannot.

Asked about the year ahead, Glen Ferguson, director Boeing Airpower Teaming System, said:

“We’re in the process of producing multiple aircraft
to support the test program, with ground and flight testing to continue into 2022 as we expand production capacity and deliver to RAAF commitments. These requirements continue to expand as we move towards our aim of developing an operational capability for Defence.

“We are incrementally expanding the aircraft’s flight envelope in each test event. This is a common flight test approach to validate the complete flight envelope. Boeing and RAAF are focused on the iterative R&D and testing of the Airpower Teaming System. Central to our development effort is getting the ‘right’ level of autonomy. Boeing has been testing this technology – both in the lab and in the field – on safe and trusted artificial intelligence and autonomous behaviours.”

“The flight test program is also validating the digital twin as we begin to move towards missionisation and operationalising the Airpower Teaming System capability. We will be seeking to demonstrate and validate air vehicle teaming behaviours that have already been developed in the digital environment, to examine the interaction of the ATS aircraft with other crewed and uncrewed assets.”

That is the exciting part of the story. Turning to those systems that still need a pilot sitting behind a desk to fly them – Triton and Sky Guardian – they seem to be moving at a glacial pace compared with the ATS.

Defence says that even facilities at Tindal to house Tritons are “still in the design phase”. This seems extraordinary. What needs to be designed? The parent operator the USN has already done all the hard work developing super-secure tempest rated buildings for their Tritons, so what could be stopping us acquiring the blueprints, awarding a construction contract, painting a red kangaroo on the side and having a ribbon cutting ceremony?

At this rate the Australian aircraft will come off the Northrop Grumman production line in Palmdale and will have to sit on the ground for years because they will have nowhere to fly to. It should also be noted that the RAAF has only contracted for three out of six or seven Tritons in a bizarre one at a time acquisition philosophy understood to be a result of the extreme cost of the program.

The situation with the MQ-9B is just as baffling. The decision to buy a mere 12 of these armed drones was announced in November 2018, a full three years ago. Asked what is happening, Defence says:

“The project is currently in the ‘Risk Mitigation and Requirements Setting’ phase, and it is expected that the project will be presented to Government for Second Pass Approval consideration in the second half of 2022.”

Four full years between the announcement and a procurement contract? Looking around the region, there are several nations that decided to buy MQ-9Bs well after Australia and they will have their aircraft in service before the first of ours arrive.

As well as requiring expensive, highly trained pilots to fly them, Triton and Predator B have something else in common – they are both considered to be vulnerable in high intensity conflicts. Neither are particularly stealthy. Triton has the slight advantage of operating at more than 40,000ft and travelling at high subsonic speeds but neither platform can defend itself with countermeasures and both tend to fly predictable courses in straight lines.

This is like being at a child’s birthday party when one guest turns up with some Lego and another brings a ball – and then a loud rich kid unloads a pony! Guess which one suddenly gets all the attention?
AUTONOMY

ARMY MAKING GREATER USE OF AUTONOMOUS AND ROBOTIC SYSTEMS

Despite proceeding at a much slower pace than their airborne equivalents, autonomous systems are beginning to make their way to the land domain, be it from unmanned aircraft systems used directly in the support of ground operations to actual unmanned ground vehicles that are being developed and, in some cases, tested by militaries.

S ystems have been, and are being developed, around the world to fulfil a range of missions in this domain, from Micro-Unmanned Aerial Vehicles (Micro UAVs) to autonomous systems which operate on the ground supporting armies from brigade or divisional levels right down to the individual platoon.

This has been made possible by significant miniaturisation of systems, and in the space of a decade has seen Unmanned Aircraft Systems (UAS) used in the land domain shrink from the General Atomics MQ-1 Predator providing battlefield overwatch down to handheld tiny handheld UAS that can be used to provide Intelligence, Surveillance and Reconnaissance at platoon or even squad level.

IN THE AIR

The Australian Army has embraced the use of tactical UAS over the past decade or so, breaking a lot of new ground in the use of such systems. Today it is one of the biggest army users of UAS in the world and is also the first in the world to proliferate this technology among its troops when it started issuing the FLIR Systems PD-100 Black Hornet at the platoon level.

This tiny helicopter-shaped Nano-UAS (NUAS) fits within a human palm, weighing a mere 18 grams including its onboard cameras and with a rotor disc diameter of 120mm. The NUAS can stay aloft for up to 25 minutes and its digital data link is able to work beyond 1.6 km away within line-of-sight.

The manufacturer also says that the Black Hornet’s nano sensors are inherently safe and pose virtually no risk to other air vehicles or personnel, allowing the system to be operated almost anywhere at any time without prior airspace coordination. Better yet, the small size of the Black Hornet means that it is virtually invisible and silent at all but the shortest distances.

The Army carried out trials with the NUAS in 2015 and 2016 with systems acquired under a Minor Project. These were employed by both the infantry and armoured corps on exercises, including at a May 2018 live-fire exercise by the 2nd/14th Light Horse Regiment at Shoalwater Bay, Queensland which marked the conclusion of the initial trials.

This came after the Army announced earlier in 2017 a decision to acquire 160 Black Hornet kits to be rolled out across the entire Army, which it calls the Personal Reconnaissance System (PRS). The Army has since validated its use at various exercises and training activities, including at Talisman Sabre.

While the Black Hornet allows platoon commanders to enhance their execution of the CT commanders plan, the provision of a UAS platform at company headquarters level has allowed greater support to the commander’s design for battle - an increasingly time-sensitive mission as more mechanisation reduces the time between the information gathering phase of the battle to the kinetic phase.

The Aerovironment Wasp All Environment (AE) is now being utilised in this role, and as a larger system than the PRS, it has greater endurance up to 50 minutes in ideal conditions, with a range of up to 5 kilometres depending on the antenna system utilised.

The Wasp AE also retains the ability to be launched by hand despite its larger size, and given its wingspan is just a shade above 1 metre wide it and can still fit inside a backpack when disassembled. Recovery is achieved using a deep stall landing method, meaning it can be retrieved in confined areas on land or over water. Wasp AE can be operated manually or programmed for autonomous operation, utilising the system’s advanced avionics and precise GPS navigation.

The Wasp AE was acquired under LAND 129 Phase 4A in 2017 following tests by the Army beginning in 2015, with long time ADF weapons and security solutions supplier XTEK selected as the preferred tenderer, supplying a total of 79 AeroVironment RQ-12 Wasp AE, associated items and support services under a Military-Off-The-Shelf (MOTS) program due to operational urgency.

XTEK was awarded a $2.8 million follow-on

Gunner Harrison Mabb (front) and Gunner Scott Fressard (rear), both from the 20th Regiment, Royal Australian Artillery, prepare to launch a Wasp III Small Unmanned Aircraft System (SUAV) near Gallipoli Barracks, Brisbane. Credit: CoA / Jonathan Goodhart
contract to supply additional Wasp AE UAS in July 2020, this after Defence signing a support contract with the company for spare parts, repair and maintenance of the fleet. The contract has an initial three-year performance period and includes options to extend until 2026, with XTEK stated that the contract could be valued at $5m per year, with total anticipated revenue of $35m if all options are exercised.

The Army’s largest unmanned aircraft currently in operation is the AAI RQ-7B Shadow 200 Tactical UAS (TUAS). Australia originally acquired 18 Shadows in 2010, along with two ground support segments and various training equipment for a reported cost of $175 million.

In Australian service the Shadow 200s are equipped with a day and night camera, laser rangefinder, laser target designator and communications relay payload concurrently for long range reconnaissance, surveillance and target acquisition tasks at brigade or task force level.

These started being used in support of troops deployed in Afghanistan from May 2012 and came under the 20th Surveillance and Target Acquisition (STA) Regiment, Royal Regiment of Australian Artillery. Part of Sydney-based 6th Brigade, the 20th STA Regiment is based at Gallipoli Barracks in Enoggera, Queensland and forms a significant element of the entire intelligence, surveillance, and reconnaissance (ISR) collection capability available within the deployed forces since it formed in 2006.

Both the Shadow and Wasp AE are being replaced under LAND 129 Phase 3 and 4B respectively. The former has seen Insitu Pacific, Leidos Australia, Raytheon Australia, and Textron Systems Australia shortlisted with the Integrator/RQ-21 Blackjack, Aeronautics Orhiber, Schiebel Australia S-100 Camcopter, and Aerosonde system respectively.

The RFI for LAND 129 Phase 4B was released in August this year, with the requirement calling for 60-80 man-portable 15kg class SUAS air vehicles to replace the Wasp AE "over the period FY24/25 to FY25/26". The air vehicle is also required to have a one-hour endurance and be able to be launched from a kneeling position.

Other launch requirements include the ability to operate from a 30 by 30 metre clearing with 10m obstacles or from a 10m x 10m clearing with 5m obstacles, as well as being able to be launched from an F470 zodiac boat. Defence has already specified that the Ascendent Vision CM62 EO/IR 'micro gimbal' with target designator, which weighs a mere 260 grams, is a “favoured payload” for the system.

The RFI closed on September 29, with one of the respondents to the RFI being Melbourne-based SYPAQ Systems. SYPAQ is a wholly Australian, veteran-owned and operated company which has provided technology solutions and services to the Australian Department of Defence since it was founded by current Chairman George Vicino in 1992.

Since 2017, SYPAQ has been awarded more than $20 million in innovation, systems integration, and R&D contracts by Defence, mostly for developing autonomous systems, sensor systems, military systems integration, power generation, and artificial intelligence solutions for the Navy, Army and Air Force.

SYPAQ has been one of the beneficiaries of Defence’s efforts to grow Australian defence industry and has secured funding through the Defence Innovation Hub and Next Generation Technologies Fund which, together with its own funding, has seen it grow its business and allowed it to develop and compete in the autonomous unmanned space.

The company currently employs 200 staff across SYPAQ’s intelligent swarming effects experimentation for the Navy, Army and Air Force.

SYPAQ is offering its CorvoX as a man-portable SUAS for LAND 129 Phase 4B, which it has developed specifically to meet the project’s requirements. The CorvoX is part of SYPAQ’s Corvo family of autonomous systems, which are all designed, developed, and manufactured in Australia.

The CorvoX is a twin-engined, Vertical Take Off and Landing (VTOL) SUAS that has a wingspan of 740mm and can hover and reach a speed of 100 km/h. It can stay in the air for up to 60 minutes and has a range of 10km and can operate in winds of up to 30 knots (55.5 km/h)

It has also developed the 180 gram Guarda 70DN micro-stabilised, multisensor payload that has 4K resolution Electro-Optical and 640x480 resolution, 30 frames-per-second Long Wave Infra-Red (LWIR) capability for the CorvoX.

The family also includes the Corvo NanoMR, a nano Multi-Rotor UAS (MRUAS) that forms the basis of SYPAQ’s intelligent swarming effects experimentation under its broader Artificial Intelligence (AI) program, the Corvo Alto, a MRUAS designed to meet the specific operational requirements for Defence and Law Enforcement customers that commercially available MRUAS fail to satisfy, and the Corvo Precision Payload Delivery System (PPDS).

The last is a unique “cardboard plane” that as its nickname suggests, is primarily made from prefabricated cardboard stock that comes flat-packed.

Australia in advanced engineering, computer science, project management and support services, and earlier this year established the Defence Autonomy Centre of Excellence located in Australia’s aviation heritage precinct in Fisherman’s Bend, Melbourne.

This 5000 sq metre facility has Zone 2, 3 and 4 secure areas as well as its own indoor 500 sq metre netted UAS testing area with the company fully certified and operating under CASA regulations with its own in-house flight operations manager and licenced UAS pilots.

The company is in the process of establishing a full-rate UAS production capability at the site, which is forecast to create 280 new jobs over the next five years and generate an additional $45m of annual expenditure when fully realised.

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BAE Systems has also worked with the Army to convert the M-113AS4 Armoured Personnel Carrier (APC) into an optionally manned vehicle.

4B's Request for Tender (RFT) on 10 January 2022 with a virtual industry brief four days later. The RFT response deadline is set for 4 March 2022, with a Preview Test and Evaluation (PT&E) Event scheduled for May 2022 with RFT completion expected on 17 June.

ON THE GROUND
Unmanned Ground Vehicles (UGVs) are also being experimented with to explore if they can be used to perform diverse mission sets. These include the obvious kinetic role armed with machine guns, light cannon or even guided missiles, with the Russians having used their Uran-9 UGV in actual combat in Syria a number of years back - although the results were reportedly less than stellar for a number of reasons.

However, other roles include reconnaissance, casualty evacuation, ordnance disposal or even to serve as a "pack mule", carrying heavy and/or bulky loads in support of friendly troops, in effect reducing personnel requirements for such tasks.

In Australia, Defence has been taking steps in this direction, with Queensland based company Praesidium Global contracted in June 2018 to supply four UGVs to the Army for a 12-month user evaluation trial at a total cost of $2 million.

Praesidium Global offers a range of UGV technologies, including M.A.P.S (Mission Adaptable Platform System), a medium sized semi-autonomous unmanned platform capable of supporting a variety of missions; Scout, a small UGV designed specifically for internal carriage in armoured vehicles; and Pathfinder, touted as the world’s first air-droppable UGV system designed to conduct tasks in denied or non-permissive areas.

BAE Systems has also worked with the Army to convert the M-113AS4 Armoured Personnel Carrier (APC) into an optionally manned vehicle. The project started in 2019 with the announcement that the company would convert an initial two APCs for use in Army experiments to explore the potential use of autonomous vehicles on the battlefield in areas such as intelligence gathering and logistics support.

They have also been used as test vehicles for technology developed by the Commonwealth’s Trusted Autonomous Systems Defence Cooperative Research Centre (TAS-DCRC), which was announced by the Australian Government in 2017 under the Next Generation Technologies Fund to deliver “game-changing autonomous systems that ensure trusted, reliable and effective cooperation between people and machines during military operations.”

The vehicles were converted by installing hardware and software in them to allow autonomous operations, and according to BAE will operate within existing rules of engagement with humans still involved in the decision-making loop.

The project has since been expanded in 2020 with 20 of the vehicles, known as the Optionally Crewed Combat Vehicles (OCCV) having been delivered. The Army recently took four of the OCCVs to Exercise Koolendong, a high-end live fire warfighting exercise in the Northern Territory, and ran the vehicles through combat environments.

The next phase of the trials will see the OCCVs put through a range of battlespace activities, with BAE planning on collecting data and feedback to improve autonomous capabilities.

While autonomous wheeled or tracked vehicles will certainly see their uses in a future battlefield in roles such as logistics support, troop movement or fire support, they will likely be assigned to higher level organisations such as at the brigade or battalion level.

They will also be limited to roads or relatively flat terrain. Another direction autonomous ground vehicles are also moving towards is aimed at addressing these limitations, in developing a UGV that can negotiate terrain and yet potentially able to be issued to lower-level units like companies and platoons.

This is where the highly dynamic quadruped robots such as those developed by American start up Boston Dynamics have a lot of potential. The company has released a number of videos of its robots in action, from negotiating complex terrain to opening doors while being overtly hindered by an armed person.

The capabilities of these robots lend to potential use by militaries as ground-based ISR platforms of pack mules in complex and even urban terrain that includes negotiating multi-storey buildings, making them potentially game-changing in terms of using autonomous systems in land warfare.

The company however is adamant that its systems will not be armed, with its terms of use explicitly stating that a violation of this clause would render its warranties void and render its user unable to update its robots.

However, Ghost Robotics, has already displayed a similar quadruped robot in the United States armed with a 6.5mm sniper rifle. The company has also signed an agreement with Singapore’s Defence Science and Technology Agency to identify uses cases involving legged robots for security, defence, and humanitarian applications.
Enhanced comfort via rubber tracks and independent suspension.

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READY. RELIABLE. RESPONSIVE.
As Australia’s Department of Defence continues to develop plans for manned platforms, like frigates and submarines, that are going to cost billions of dollars and not produce any increments in capability until well in the future, but are they planning to spend scarce project dollars on the wrong things? Many observers, including this one, believe that manned vessels should be command centres for hosts of small uncrewed autonomous vehicles which can overwhelm any antagonist.

Uncrewed vehicles does not mean “no crew”. Just as an aerial drone requires a ground-based pilot, flight planning and supervision, and a ground crew to marshal, arm and maintain an aircraft, uncrewed vehicles in the maritime domain will require a highly skilled support crew at sea and ashore.

The roles for navy operators will be changing and the roles for industry support must change also. A highly capable sovereign industry capability will contribute to availability of uncrewed systems though fast turnaround of planned maintenance and urgent defect repairs, constant attention and development of a local supply chain, and the capability to modify systems to meet unique Australian requirements.

**AUSTRALIAN DEFENCE INDUSTRY CAPABILITIES**

When APDR asked Darren Burrowes, co-founder and Chief Technology Officer of Australia’s Blue Zone Group (BZG) for his views on defence industry’s role with respect to supplying and supporting uncrewed vehicles. He told us:

“In the context of surface warfare uncrewed platforms are evolutionary not revolutionary.

“BZG is involved in a number of initiatives in both mine warfare and anti-submarine warfare, two key elements of uncrewed surface warfare as a whole. In both cases the company has learned that autonomous and automated platforms and systems are not a capability of and by themselves. They do not replace manned capability; they augment and amplify it.

“Therefore, it is essential to modify and adapt systems to work seamlessly with sovereign warfighters.

“This requires a strong, trusted and professional partnership between ADF operators and Australian industry. BZG has worked hard over the last 20+ years to establish such a relationship and now it can boast an unparalleled level of collaborative activity to design, develop and deliver maritime uncrewed capability across the ADF.”

In the context of Australian military needs, uncrewed vehicle capability is defined by the payloads not by the vehicles. Therefore, it stands to reason that the capability to develop payloads locally, and in close cooperation with the ADF, is an essential industrial requirement.

To achieve this a company like BZG has had to developed a wide range of technical skills across a range of OEM-supplied vehicles, a workforce skillset tailored to integrating systems, sensors and platforms against the ADF’s requirements and a supplier network that guarantees access to a proven, reliable and contemporary technology base.

**UNCREWED AERIAL VEHICLES**

SEA 129 Phase 5 Block 1 is Defence’s project to equip the future Arafura Class offshore patrol vessels (OPVs) with autonomous uncrewed aerial vehicles which may be either helicopters or fixed wing aircraft or both.

The choice of aircraft type depends on the characteristics sought, given the likely roles for these OPVs. Rotary types can carry heavier loads, be launched from a small area of deck, but have limited range.

Fixed wing types carry lighter loads, with much greater endurance, but have the challenge of how to launch and recapture them at sea.

In March 2021 Defence announced the five companies whose offers they will evaluate in the next phase of their Block 1 OPV maritime tactical unmanned (now uncrewed) aerial systems (MTUAS) procurement activity.

Those companies are BAE Systems Australia, Insitu Pacific, Northrop Grumman Australia, Raytheon Australia, and Textron Systems Australia.

While BAE Systems Australia has not revealed publicly what they have offered, their approach will leverage their experience and expertise in autonomous systems, sensors and the integration
of platforms and systems with major surface ships, while optimising Australian Industry Capability outcomes.

Insitu Pacific have proposed their ScanEagle2/Integrator® family, while the other three companies have all proposed helicopter platforms.

APDR took an opportunity to discuss the ScanEagle/Integrator® family with Andrew Duggan, managing director of Insitu Pacific, without reference to the MTUAS project since Defence could have a problem with that based on their normal strong reaction against journalistic probing.

Mr Duggan said:

“Insitu Pacific was pleased to have been shortlisted in March. We look forward to providing our proposal to support and sustain vital maritime domain awareness capability through our globally proven UAS solutions.”

ScanEagle is currently operating with the Royal Australian Navy’s 822X Squadron in Nowra as part of the Navy’s efforts to assess the effectiveness of UAS to support maritime ISR requirements.

ScanEagle 2 can carry a 5kg payload supported by up to 150W of onboard power, while the bigger Integrator® has 18kg maximum payload weight, combined with longer 24+ hours endurance.

Mr Duggan urged us not to concentrate on size but rather on how to pack more smarts into the chosen vehicle.

He explained that the ScanEagle 2 and Integrator® have the same avionics so the choice is really about capabilities for operational missions. Both use the same catapult launcher and pole system recapture.

For SEA129 Phase 5 Block 1 APDR understands that Northrop Grumman Australia will be tendering the Leonardo AWHero, Raytheon Australia will offer the Schiebel S-100 Camcopter, and Textron Systems Australia will propose Aerosonde Mk4.7/HQ.

UNCREWED SURFACE VEHICLES (USV)

Four Ocius Bluebottle autonomous uncrewed vehicles have been undergoing trials in the Timor Sea. In the past five months they have been making passages in an impressive display of their capabilities.

Commander Maritime Border Command, Rear Admiral Mark Hill responded to APDR’s questions with these comments:

“MBC’s area of operation is vast and resource rich, and I welcome technological advances, such as these autonomous sea vehicles, to advance our strong border protection arrangements.

“I am very happy to be part of this trial with the Royal Australian Navy, and while still subject to review, the initial results have demonstrated this technology works well with our existing capability and further enhances our ability to detect, deter and respond to on-water threats.”

Robert Dane, CEO of Ocius informed APDR that four Bluebottles have been operating in the Timor Sea since October. Darwin operations in the first 2 months had covering 6400 nautical miles (10 Sydney to Hobarts) in 2 months with zero carbon footprint.

The Ocius website also has a video which can be watched showing the routes taken by the trial vessels
HMAS Ballarat’s embarked MH-60R helicopter and S-100 Schiebel Camcopter on the flight deck, while sailing off the coast of Queensland during Exercise Talisman Sabre 2021. Credit: CoA / Ernesto Sanchez

so far.

When APDR checked with a Maritime Border Command spokesperson specifically on these trials, they told us that:

“Maritime Border Command recently participated in the Royal Australian Navy and Ocius Bluebottle trial of Uninhabited Surface Vehicles (USV). The trial, from August to December 2021, was conducted from Darwin and completed in the vicinity of Ashmore and Cartier Islands.

“The objective of the trial was to assess the use of the Bluebottle as a relatively persistent maritime surveillance system to support civil maritime security. Specifically, its ability to detect and assess small boats that pose a potential threat within its area of operation was tested, as was its capability to respond to requests from MBC to investigate areas of interest.

“The trial is still underway.”

When APDR asked Navy, their spokesperson told APDR that:

“The RAS-AL Directorate are the sponsors of the Defence Innovation Hub (DIH) project which is conducting the Bluebottle trials, operating from Darwin. Through the DIH, the Directorate has been kept informed of the trial progress. As the trial is still underway, no conclusions have been drawn thus far.”

Boeing’s Liquid Robotics Wave Glider made headlines when it undertook a solo passage from San Francisco to landfall near Bundaberg, Queensland. It started on 17 November 2011 and navigated on a pre-programmed route across the high seas battling shark attacks, overcame severe currents and navigated through Cyclone Freda (a Category 4 cyclone) to reach Lady Musgrave Island on 14 February 2013.

The Wave Glider’s revolutionary design converts wave energy into forward propulsion and uses solar energy to power the onboard sensor payload, communications and computing. No fossil fuels are used.

Another impressive surface vehicle is the Martac Mantas family, available through BZG, which can perform in environments and conditions where other USVs cannot. The family has a range of models from two metres up to 15 metres length overall.

Equipped with solar panels, it has electric or diesel electric propulsion, with lithium batteries for C5ISR and vessel operations. Short burst speed capability is up to 80 knots.

UNCREWED UNDERWATER VEHICLES (UUV)

Best known are the REMUS family – 100, 300, 600. BlueZone Group has supplied REMUS 100 & 600 and continues to supply parts, including replacement batteries and other components, as trials and development continue in Australia.

This experience has shown that original parts and sub-systems can be difficult to obtain as manufacturers rapidly develop and update products, continually improving function and performance. Manufacturers often do not retain stock of previous models and versions as they are motivated only to provide the most advanced functionality. The implications for Defence supply chains must be considered.

Boeing’s Echo Voyager is a fully autonomous extra-large uncrewed underwater vehicle (XLUUV) class that can be used for a variety of missions that were previously impossible due to traditional UUV limitations.

Echo Voyager is complete with an extensive internal and external payload volume and available energy capacity, expanding the parameters of what is possible in current uncrewed undersea systems.

The vehicle’s advanced autonomy enables it to perform at sea for months at a time, delivering a more affordable, mission-capable solution over traditional UUVs.

Boeing has designed and operated manned and uncrewed deep sea systems since the 1960s, including Rockwell International legacy systems and U.S. Navy support programs. Prior to Echo Voyager, Boeing developed Echo Seeker and Echo Ranger, autonomous and large UUVs as test beds for its current XLUUV.

IN CONCLUSION

Extensive and continual operation of uncrewed systems in the field will truly test their operational benefits and limitations.

In 2007, the then Rapid Prototyping, Development and Evaluation group within Navy/Defence conducted trials at Jervis Bay of uncrewed systems. 14 years later, it is sobering to consider whether or not Navy could field uncrewed systems for an extended operation in a remote area during a time of heightened tension.

The procurement practices for uncrewed systems must be overhauled to make them a better fit for the rapid development of the field, with the aim of getting technology into the war fighter’s hands faster.

Australia doesn’t need to waste money developing new uncrewed vehicles. There is a plethora of vehicles readily available on the market, operated by allies and priced for global sales, not sovereign budget.

Australia can easily access appropriate platforms with the dynamic characteristics needed for whatever task the ADF defines. There is no need to pay a premium to develop a new platform as the chances of a return on investment are slim. It would be much wiser to acquire a low-cost platform and invest in the local capability to maintain, adapt and operate the platform locally.

This will yield a return on investment through the savings made by avoiding returning the platforms of the overseas OEM for repair and maintenance over its service life.

The Remus experience is a good example. There are multiple Remus UUVs for a multitude of missions and BZG is developing many skills to maintain sovereign support for the various models chosen by the ADF and projected for future investment.
The most advanced Infantry Fighting Vehicle and Australia’s own Combat Support Vehicle, manufactured with Australian materials.

The Lynx Combat Support Vehicle (CSV) is the most sophisticated and capable armoured vehicle ever to be designed and built in Australia, and based on a version of the Lynx Infantry Fighting Vehicle (IFV).

The Lynx CSV offers significant flexibility and is a game-changer for armies to complete a range of missions while fully protected.

Soldiers can perform recovery, repair, maneuver support and support logistics using a vehicle with similarities to the existing Lynx IFV.

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

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Readers of Asia-Pacific Defence Reporter don’t need to be told that Australia now has a first-rate navy that – while numerically smaller than the navies of some of its larger neighbors – wields increasingly positive influence in the Indo-Asia-Pacific region and beyond. These readers are also well aware of the commitment the ADF and RAN have made to acquiring uninhabited systems to complement its manned ships and other platforms.

What is less clear is whether the Australian Defence Forces have yet evolved a CONOPS – a concept of operations – for how these uninhabited systems will integrate with the human teammates who seek to use them to do the dull, dirty and dangerous work that puts people in harm’s way. Beyond that, one has to wonder how unmanned maritime systems the ADF and RAN intend to employ will get to the fight.

The easy answer, of course, is to just put them aboard a RAN ship. But these vessels, even the large and highly capable amphibious ships–HMAS Canberra and HMAS Adelaide–are already loaded with the “kit” that must be taken to the fight. Space is at a premium and taking aboard “just one more thing” is rarely an option. Another way must be found if uninhabited systems are to become useful partners.

Australia’s alliance partner, the United States—specifically the U.S. Navy—is dealing with this challenge and has evolved a CONOPS to get its uninhabited maritime systems to the fight. This still-emerging CONOPS involves an approach that has evolved to be called “Nested Dolls” (or Russian Dolls if that visual is more appealing).

What this means is that a large uninhabited maritime systems (LUSV) is loaded with medium uninhabited maritime systems (MUSV), which, in turn, carry various sizes of smaller USVs, as well as uninhabited underwater systems (UUVs) and uninhabited air systems (UAVs). The LUSV thus becomes the “truck” that carries its smaller cousins to the fight.

While this CONOPS might sound complicated, it is anything but, and it is one that is gaining increasing support within U.S. Navy circles. Attaching a LUSV carrying MUSVs and smaller uninhabited systems to a strike group offers great potential to provide a step-function increase in capabilities of these fighting units. The ADF and RAN would be well-served to watch this evolving process as it seeks to fully leverage the enormous potential of its capital ships and its emerging uninhabited systems.
Specialist 2nd Class Natalie M. Byers


THE U.S. NAVY’S UNINHABITED SYSTEMS JOURNEY

The U.S. Navy is committed to integrating unmanned systems into its Fleet. This is seen in the Navy’s official Force Structure Assessment, as well as in a series of “Future Fleet Architecture Studies.” In each of these studies, the proposed future Navy Fleet architecture has large numbers of air, surface, and subsurface unmanned systems working alongside the Navy’s manned platforms.

Because they influence all domains, the U.S. Navy is committed to fielding substantial numbers of unmanned surface vehicles. A naval affairs specialist at the Congressional Research Service put it this way: “The Navy’s next force structure assessment likely will add significant numbers of large and medium-sized unmanned surface vessels to meet the challenges of a new era of Great Power competition. The emphasis on unmanned for the new shift in fleet composition would show the urgency with which the Navy is attacking the situation, even without a concept of operations as to how these vessels would be used.”

While this may seem to be a relatively benign comment, it reveals why this Nested Dolls approach has gained such currency in the U.S. Navy. Simply put, while the USN has ambitious plans to rapidly integrate unmanned surface vehicles into the Fleet, absent a CONOPS for how to actually use them, the U.S. Congress has been reluctant to go “all in” on the Navy’s ambitious plans. Here is how one analyst put it:

Unmanned surface vessels are all the rage in the office of the Secretary of Defense, and the U.S. Navy has lined up behind the effort. But Congress remains skeptical until it sees the Navy make progress on the basics. In short, this would mean the Navy could not spend procurement dollars on unmanned surface vessels until it has a working model and not try to develop those technologies on the fly. The Navy has pitched a range of missions for its unmanned surface and undersea vessels, ranging from gathering intelligence to laying mines to launching missiles but few concrete concepts of operations have been released.

These Congressional criticisms that the U.S. Navy has not yet presented a basic concept of operations for how it intends to use the large number of large, medium and small USVs it seeks to procure are now being addressed at professional symposia. As the U.S. Navy grapples with this challenge and evolves CONOPS such as the Nested Dolls, the ADF and RAN can leverage this experience to develop their own CONOPS to integrate uninhabited maritime systems into the force structure.

A CONCEPT OF OPERATIONS FOR UNMANNED SURFACE VESSEL EMPLOYMENT

The concept of operations presented here may well lead to a more rapid integration of unmanned systems by marrying various size unmanned surface, subsurface and aerial unmanned vehicles. Simply put, the LUSV serves as a truck to move smaller unmanned surface vessels, UUVs and UAVs into the battle space in the increasingly contested littoral and expeditionary environment.

The technical challenge is to make these different sized craft work together as an integrated team that not only operates together but can be launched and recovered from each other in a larger UxV-UxV operational, mission-focused, environment. This is the “Nested Dolls” taxonomy mentioned earlier where the LUSV is sized to operate as part of a strike group. The LUSV will carry the MUSVs, and they, in turn, are configured to carry the small USV, along with UAVs and UUVs.

While there are a plethora of important naval missions this Nested Dolls combination of unmanned platforms can accomplish, this we will focus on three: intelligence surveillance and reconnaissance, expeditionary logistics, and mine countermeasures. There are many large, medium, small and ultra-small unmanned systems that can be adopted for these missions.

Thus, rather than speaking in hypotheticals as to how unmanned vehicles might be employed for these three missions, we will offer concrete examples describing how commercial-off-the-shelf unmanned systems have been evaluated during a number of U.S. Navy and Marine Corps exercises, experiments and demonstrations.

While there are many large, medium and small USVs that can be married together in a Nested Dolls CONOPS, we will focus on those that I have seen utilised in a number of recent Navy and Marine Corps events, as well as those that appear to have traction with Navy officials. For the small and medium category, I will focus on the MANTAS and Devil Ray USVs, and for the LUSV I will focus the Navy’s mid- and long-range plans to develop LUSVs, as well as a recent Navy initiative to modify the expeditionary fast transport USNS Apalachicola (EPF 13) (built by Austal USA) to establish the ship as an autonomous prototype.

SMALL AND MEDIUM USV PERFORMANCE IN INTELLIGENCE SURVEILLANCE AND RECONNAISSANCE, EXPEDITIONARY LOGISTICS, AND MINE COUNTERMEASURES MISSIONS

As noted above, the U.S. Navy has cast a wide net and evaluated any number of USVs that can potentially fulfill these important missions. My focus is to explain how commercial-off-the-shelf small and medium USVs have already been put in the hands of Sailors and Marines. Therefore, I will use these as building blocks for the Nested Dolls CONOPS.

Intelligence Surveillance and Reconnaissance Mission

For centuries, commanders have struggled to collect enough information to give them the edge in combat. As the Duke of Wellington famously said, “All the business of war is to endeavour to find out what you don’t know by what you do; that’s what I call guessing what’s on the other side of the hill.”

The Ship-to-Shore Maneuver Exploration and Experimentation (S2ME2) Advanced Naval Technology Exercise (ANTX) (S2ME2 ANTX) provided
an opportunity to demonstrate innovative technology that could be used to address gaps in capabilities for naval expeditionary strike groups. S2ME2 ANTX had a focus on unmanned surface systems that could provide real-time ISR and intelligence of the battlefield (IPB) of the battlespace.

During the assault phase of S2ME2 ANTX, the expeditionary commander used a USV to thwart enemy defenses. The amphibious forces operated an eight-foot MANTAS USV which swarmed into the enemy harbor (the Del Mar Boat Basin on the Southern California coast) undetected, and relayed information to the amphibious force commander. Once this ISR mission was complete, the MANTAS USV was driven into the surf zone to provide IPB on obstacle location, beach gradient, water conditions and other information crucial to planners.

**Expeditionary Logistics Mission**

While ISR and IPB are vital in an amphibious assault, once the assault is underway and Marines are on the beach, a critical factor in ensuring their success is rapid resupply. Using manned naval craft to do this mission puts operators and vessels at unnecessary risk. A major U.S. Navy-Marine Corps amphibious exercise, Valiant Shield, evaluated the ability of unmanned surface vehicles to conduct this resupply mission.

During Valiant Shield, USVs were used to resupply the landing force. The exercise coordinator used a catamaran hull, 12-foot MANTAS USV to provide rapid ship-to-shore logistics sustainment. While this small, autonomously operated, USV carried only one hundred and twenty pounds of cargo between an offshore MSC supply ship and the beach, the proof-of-concept worked and demonstrated that unmanned surface vehicles could effectively resupply troops ashore.

**Mine Countermeasures Mission**

The use of mines, as well as countermeasures to mines, has figured significantly in every major armed conflict and nearly every regional conflict for decades. Mine warfare is an essential capability integral to the ability of naval forces to open and maintain sea lines of communication and to dominate the littoral battlespace. During Trident Warrior 2020 a MANTAS 38-foot USV—since renamed the T38 Devil Ray—served as the truck and worked in concert with a Thayer Mahan Sea Scout Subsea Imaging System and a Pluto Gigas Mine Neutralisation System ROV to detect and neutralise simulated mines. The Devil Ray is virtually identical in size to an eleven-meter RHIB carried by many naval ships and can operate in up to sea state five.

**BUILDING NESTED DOLLS INTO AN INTEGRATED UXV-UXV SOLUTION**

As noted above, the building blocks for a CONOPS using USVs to accomplish important missions are available in small and medium USVs that have been evaluated over five years of Navy and Marine Corps exercises. The question then becomes: how do these smaller vessels actually get to a location where they can perform these missions?

That requires a LUSV. The USN is moving quickly to acquire these craft. This is how an October 2020 Congressional Research Service report describes this vessel:

The Navy envisions LUSVs as being 200 feet to 300 feet in length and having full load displacements of 1,000 tons to 2,000 tons. The Navy wants LUSVs to be low-cost, high-endurance, reconfigurable ships based on commercial ship designs, with ample capacity for carrying various modular payloads—particularly anti-surface warfare (ASuW) and strike payloads, meaning principally anti-ship and land-attack missiles.

A March 2021 Congressional Research Service report, Navy Large Unmanned Surface and Undersea Vehicles: Background and Issues for Congress, provided details on the Navy’s plans for LUSVs and XLUSVs. And as one indication of the Navy’s efforts to accelerate the development and fielding of LUSVs, in June 2021, as noted above, the Navy awarded a contract to modify the expeditionary fast transport USNS Apalachicola (EPF 13) to establish the ship as an autonomous prototype and ultimately a LUSV. Importantly, this craft has the speed to keep up with a strike group.

While there are many ways to describe this CONOPS, we want to focus on a scenario that is built around an expeditionary strike group that is underway in the Western Pacific. This strike group includes three LUSVs under supervisory control from a large amphibious ship. Each LUSV is then further configured with onboard multiple smaller USVs, UUVs and UAVs to perform the ISR, IPB, logistics and MCM missions. Each of the three LUSVs is carrying three or more T38 DEVIL RAY craft configured with small USVs, UAVs, and UUVs for specific missions.

The Expeditionary Strike Group is on routine patrol about five hundred nautical miles from the nearest landfall. An incident occurs in their operating area and the strike group is requested to (1) obtain reconnaissance of a near-shore littoral area and (2) determine if the entrance to a specific bay has been mined to prevent ingress. This area must be reconnoitered within twenty-four hours without the
use of air assets.

Command staff decides to dispatch the three LUSVs for the mission. Two LUSVs are configured with four T38-ISR craft and the third LUSV is configured with four T38-MCM vessels. The single supervisory control station for the three LUSVs remains manned in the mother-ship for the initial transit to the MUSV departure point.

The three LUSV depart the strike group steaming together in a preset autonomous pattern for two hundred and fifty nautical miles to a waypoint that is central to the two hundred nautical mile ISR scan area. At this waypoint, the LUSV will stop and dispatch the smaller T38 craft and then wait at this location for their return. At the dispatch waypoint, command is given as follows:

- Two T38-ISR craft to be launched from each of the two LUSVs. The autonomous mission previously downloaded specifies a waypoint location along the coast for each of the four craft.
- Two T38-MCM craft to be launched from the third LUSV. The autonomous mission previously downloaded has them transit independently along different routes to two independent waypoints just offshore of the suspected mine presence area where they will commence mine-like object detection operations.

- In this manner, each of the six craft will be transiting independently and autonomously to their next waypoint which will be the mission execution start point.
- Transit from the LUSV launch point, depending on route, will be about two hundred and fifty to three hundred nautical miles to their near-shore waypoints. Transit will be at seventy to eighty knots to their mission start waypoint near the coast.
- The plan is for each of the T38-ISR craft to complete their ISR scan in four to five hours each and for the two T38-MCM craft to jointly scan the bottom and the water column for the presence of mine-like objects in four to five hours at a scan speed of six to eight knots.

I have not included the expeditionary logistics mission in this scenario, simply to keep the length of this article in bounds, and because the U.S. Navy intends to showcase this mission in upcoming exercises such as Valiant Shield 2022.

BUILDING ON THIS CONOPS FOR ADDITIONAL USV MISSIONS

I am virtually certain that readers of Asia-Pacific Defence Reporter could easily think of many more CONOPS for ways that USVs can perform missions that are important—and vital—for the ADF and RAN. I offer this one as just a starting point for further dialogue in for those with stewardship for acquiring and deploying these assets.

Having a CONOPS for the uninhabited systems it intends to procure is essential if Australia’s defence forces want to gain the support of Parliament to provide the funds to procure these systems. This will require a substantial change in mindset within the ADF and RAN. The emphasis should on no longer thinking of each uninhabited maritime system as a “one-off,” but rather, to package these together as multiple-sized and function vehicles designed for specific missions.

To be clear, this is not a platform-specific solution, but rather a concept. When operators see a capability with different size uninhabited COTS platforms in the water working together and successfully performing the missions presented in this article, they will likely press industry to produce even more capable platforms to perform these missions. While evolutionary in nature, this disruptive capability delivered using emerging technologies can provide the ADF and RAN with near-term solutions to vexing operational challenges.
Noteworthy was the role of the Tidbinbilla Tracking Station, ACT. Australian technicians played a key part in monitoring the Apollo 11 mission and relaying the critical data back to the U.S. That included the first pictures of the momentous event which were beamed right around the world.

The developments of Australia’s defence industry in their space domain capabilities have taken a surprisingly long time to emerge, with some honorable exceptions.

There are now at least three companies offering launch sites on the Australian mainland, two or which offer near equatorial launches that take advantage of the Earth’s rotational speed. Another one in South Australia can launch satellites into polar orbit and provide whole Earth’s surface coverage every 24 hours.

Australia is running behind New Zealand where Rocket Lab’s launch complex 1 on the North Island’s Mahia Peninsula, in 22 launches has already put 107 satellites into low Earth Orbit since 2018 - including many for Australian firms and United States agencies.

A common view within the Australian defence industry is that partnerships with global leaders in the space business will be crucial to local industry delivering sovereign capabilities. Their willingness to transfer unique, proven and low-risk mission solutions leveraging their expanding Australian footprint will be vital to the Commonwealth launching sovereign programs that are well integrated with coalition operations.

APDR asked three industry leaders for their opinion on Australian industry’s current and future space capabilities.

Alan Clements, Managing Director L3Harris Australia responded:

“We recognise the unique role L3Harris Australia must play in the advancement of space control, space domain awareness and other sensitive technologies. These are not stand-alone systems – they enable joint and allied missions, and that is an important point that is well understood by our team.

“I am excited to see L3Harris take on the important work of expanding our partnerships and development of advanced mission functionality to keep our men and women in uniform safe and effective.”

Matt Buckle, Boeing Defence Australia director of Emerging Markets, told APDR that:

“Boeing Australia is continuing to make strategic research and development investments and partnering with strong Australian businesses who offer best-in-class capability in order to support the Commonwealth in their efforts to expand sovereign space-based and space-enabled capabilities.

“Drawing on more than six decades of space experience across The Boeing Company, Boeing Australia has the experience, established Australian presence and understanding of key issues to help build our nation’s space industry”

David Ball, Regional Director for Space at Lockheed Martin Australia said:

“As a sovereign Australian space company, Lockheed Martin Australia has a deep stake in the development of Australia’s space industry. We are committed to working with all stakeholders, including government, local industry—big or small— the university and research sector, as well as international partners to deliver the best space capabilities, whether its space domain awareness, satellite communications, space-based navigation systems, or sovereign intelligence, surveillance and reconnaissance.”

Typical of the entrepreneurial drive by Australians, Fleet Space Technologies is a start-up, co-founded by Flavia Tata Nardini and Matt Pearson, which has created the most advanced smallsat payload yet delivered to orbit. These devices, roughly the size of a shoebox, generate 10 times more throughput per kilo than larger spacecraft and will support radical new efficiencies for hundreds of industries using IoT. This will transform the ability of companies and institutions to manage and control their remote assets across the world and in real-time, 24 hours a day.

Fleet Space Technologies provides this function through a smallsat satellite-based network made up of six nanosatellites, which were launched to orbit via SpaceX, an Indian Space Research Organisation rocket and two Rocket Lab launches in New Zealand.
AUSTRALIAN SPACE AGENCY (ASA)

ASA is an independent central entity for aerospace and related activities in Australia. They provide a comprehensive communication hub for professionals, amateurs, and the wider community.

ASA undertakes its own projects, including infrastructure, R&D, and education. Clients and associates benefit from their comprehensive suite of services. These include engineering, design, local industry, and promote investment in space capabilities and high-tech jobs of the future for Australians.

Some emerging areas of collaboration between Boeing and ASA under the Statement of Strategic Intent includes capability roadmaps and industry assessments; advanced antimicrobial technology for space missions that aims to ensure the health of crews and protect spacecraft systems from bacteria and biofouling – and ultimately may help prevent interplanetary contamination from Earth-borne or another planet’s microbes.

AUSTRALIAN SPACE LAUNCH SITES

Equatorial Launch Australia (ELA) has a mission to launch and recover objects flown to and from space by providing a flexible and responsive launch site and associated services. Site efficiencies are real. NASA has signed a contract that will see their rockets and payloads being launched with ELA in 2022.

Their Arnhem Space Centre site is in Australia’s Northern Territory, outside of the East Arnhem township of Nhulunbuy, approximately 12 degrees south of the Equator.

Gilmour Space Technologies is a venture capital-backed rocket company in Queensland that is developing new launch vehicles powered by low-cost hybrid propulsion technologies. Based on the Gold Coast it is working through the approvals phase for its plan for a rocket launch site at Abbot Point, just north of Bowen. This site is at 20 degrees south latitude, so still offers an orbital speed boost of 437 m/sec compared with Earth’s rotational speed of 465 m/sec at the Equator.

They recognise that launch is a bottleneck, and that launch costs and availability are two of the biggest hurdles for smallsat customers who are developing, testing and deploying New Space technologies. Gilmour’s own Eris orbital rocket will offer affordable, reliable and dedicated launches into Low Earth Orbits.

The company’s chief executive Adam Gilmour says if everything remains on track the first rocket could be launched from the proposed facility in the middle of 2022.

Southern Launch is a launch service provider, headquartered in Adelaide, South Australia. Their offering includes the Whalers Way Orbital Launch Complex, and the Koonibba Test Range, a suborbital testing facility.

Their team of leading engineers, project managers, specialists, and regulation experts have developed a full-service continuum catering to the key needs of rocket manufacturers and their payload customers.

SPACE TECHNOLOGY COMPANY GROUPINGS

Small to medium enterprises which have developed specialist skills and products for the space industry have better chances of commercial success if they join in larger groupings of companies. This can include being part of a team, led by a major defence contractor, which is bidding for a specific piece of defence business.

Michael Ward, managing director of Raytheon Australia, told APDR that in early 2021 Raytheon Australia launched its SME engagement program, Capability Plus. This exclusive program was designed to be tailored to the needs of each SME, helping them to strengthen and grow their organisation while improving their capability and competitiveness in the local defence industry and on the global stage. It now has a total of 12 Australian companies currently participating in the program.

The most recent addition was HEO Robotics, a Sydney-based company which was the first in

A common view within the Australian defence industry is that partnerships with global leaders in the space business will be crucial to local industry delivering sovereign capabilities.
the world to inspect satellites in orbit and provide insights on satellite health to empower the operator to make data-driven decisions.

Mr Ward explained that his organisation has been delivering a proven global space surveillance capability at the Harold E. Holt Naval Communications Station in Exmouth, Western Australia and previously were the operations and maintenance contractor at the Canberra Deep Space Communication Complex (CDSCC) for seven years.

Raytheon Australia’s CDSCC team provided Australian communications and launch support for missions such as the Mars Exploration Rovers, the Cassini/Huygens mission to Saturn and Titan, and the New Horizons mission to Pluto.

Northrop Grumman Australia says it will partner with Inmarsat to develop an agile, resilient and sovereign satellite communications capability to support the future joint force and protect Australia’s strategic interests in response to the JP9102 Australian Defence Satellite Communication System project.

Another typical example is also Lockheed Martin Australia’s (LMA’s) bid for JP9102. This project aims to deliver a system which will enable the joint command and control of deployed forces through resilient and responsive communications beyond the range and capacity of other communication systems.

LMA’s industry team for JP9102 includes Av-Comm, Clearbox Systems, Ronson Gears, Shoal Group, STEM Punks, Calytrix, and EM Solutions, a subsidiary of Electro Optic Systems.

LMA told APDR that they currently have 19 Space-related export R&D contracts across near space technologies, propulsion, radhard circuits, robotic path planning, new materials development, EW and sensing, composite tank technology.

One of these is a collaborative partnership between LMA, Australian manufacturer Omni Tanker and UNSW Sydney to develop and commercialise world-first composite tank technologies. The co-funded project, worth a total $1.4 million, will utilise two revolutionary home-grown technologies to solve the challenges of using composites for the transportation and storage of liquid hydrogen with applications on ground, in the air, underwater and in space.

The Boeing Company has 60 years’ global space experience. It says it is the industry leader for next-generation satellite technology and manufacturing practices, and designs and builds advanced space and communications systems for military, commercial and scientific uses.

Boeing Australia is well positioned to accelerate Australia’s sovereign space capability. They are bringing US experience to Australia with the intent to create in-country capability and establish sovereign control. The company says it is committed to transferring knowledge and expertise to local industry, creating local jobs, and establishing export opportunities for Australian small businesses.

An example of this is Boeing and its Australian supply chain working together to build a sovereign Advanced Ground Architecture that supports multiple space missions and aligns to the needs of the Australian Defence Force for JP9102. Their team includes Leidos Australia, Viasat, the Indigenous Defence and Infrastructure Consortium, Clearbox and Saber, amongst others.

L3Harris says it leads in many areas of the defence, commercial and dual-use space technologies of highest importance to the Commonwealth’s current and future missions. Specifically for the space sector they deliver multi-band, high-bandwidth satellite communication solutions networking all operational domains and unfurlable mesh reflectors and antenna subsystems for smallsat architectures.

BAE Systems Australia has an Australian leading capability to deliver complex integrated technology solutions with local teams specialising in the development and servicing of advanced radio frequency, electronics and optical products and systems.

Through its work with the Department of Defence it also has significant experience in the support of satellite ground stations, and as a global company has delivered key components for over 200 satellites.

IN CONCLUSION

The Review of Australia’s Space Industry Capability 2018 is an excellent reference on this subject. It can be found on the internet by Googling ‘Review of Australia’s Space Industry’.

The Space Discovery Centre in Adelaide aims to inspire the next generation of the space workforce with stories of innovation, curiosity and technology.

Their goal is to triple the size of the sector and create up to 20,000 new Australian jobs by 2030. They are actively seeking to enthuse young people to carry out tertiary study and equip themselves to have a choice of careers.
Kym: Let’s start with the basics and a description of how 3D printing – or additive manufacturing - works.

Herbert: It depends on the technology that is applied. If I speak specifically about Titomic, you need to think of it as using a kind of rocket engine – a small one – that has a nitrogen gas feed mixed with a metal powder. Within that rocket engine you accelerate the powder to literally supersonic speeds. When you push it out through a very thin nozzle that can be made from different materials you have a stream of metal particles travelling at around Mach 2 or Mach 3.

This is seriously fast. As soon as these particles encounter some resistance in the form of a scaffold or a structure they start to deform and bond with each other. This creates something that is harder than the original material and allows you to spread a single layer on the surface. If you repeat that process you can start building three dimensional structures.

Another analogy is a painting machine where you spray layers of colour on a wall. This is a great way of doing things because you get consistent coverage, it’s fast and it’s easy to handle. This means that using this process you can cover any type of part with a thin layer of something – and in our case that thin something is a metal.

This could be titanium, steel, copper – anything you can think of, as long as the metal can come in the form of a powder. You can spray a surface or something in the form of a tube that with repeated applications gives you a 3D structure.

Q: Are there limits to the types of structures that you can produce?

Herbert: At the moment with the level of precision that can be achieved it is what we call near-shape technology. For example, if you are attempting to produce a tool for the aerospace industry that will manufacture carbon fibre components, what we can make from metal is close to the final shape. It is thicker than the final part, which means that it needs some machining and heat treatment for completion.

However, from a production standpoint this is a much, much better and more sustainable process than traditional methods. We can produce something that is only 20% larger than the final part, greatly reducing the amount of material that you have to machine from it. This is so much better than having a billet where 80% of the material has to be removed and basically thrown away, compared with an average wastage rate of 10%-12% for the way we do it.

Secondly, we can also save time. It’s easy to understand that carving off 80% of material with a CNC cutter from a blank takes much longer than the same machine trimming off 10%.

Q: Turning specifically to defence and aerospace applications, how do you see the future, particularly regarding titanium components which are becoming more prevalent?

Herbert: The properties of titanium are well known in industry. Many people want to use titanium components but cannot afford them because the metal is so expensive to start with. This is particularly so in defence industries, where steel is still the dominant material in use because of the favourable ratio between cost and function. There could be many other materials better suited – titanium for example – but there is still the commercial decision of whether it is really worth the extra expense.

Are there any parts that are specifically great for titanium? The answer is: technically not at all. However, the founder of this company, Geoff Lang – who is the Chief Technology Officer – focussed on titanium and hence our name. This is
a combination of titanium and atomic level, though it is something of a coincidence because we are producing parts from a lot of different materials.

For example, we are using invar – a nickel iron alloy - in the tooling space because it is very temperature resistant. We use copper and also increasingly tantalum, which has a number of interesting properties. We are carrying out a project right now with ANSTO (Australian Nuclear Science & Technology Organisation) and Swinburn University involving tantalum. It has a great ability to shield against radiation encountered in space.

Ask yourself: what other technologies are available right now to put on a part in the same way that we can apply a layer of tantalum? Alternatives are very cumbersome and expensive processes compared with our ability to spray on a coating of half to one millimetre. Tantalum is becoming famous – and that will only increase – because I can tell you it has many anti-radiation uses.

You need radiation shielding whenever you go into space. That’s the basic starting point – it’s a problem of nature that cannot be avoided.

Whenever you are more than 100 kilometres above the surface of the earth you encounter very strong radiation that you cannot avoid, you can only shield against it. The way that you do that is to identify the parts you need to protect, which might be the electronics, computers and motherboards – or even the crew in a spaceship.

This also applies to systems such as missiles and supersonic aircraft, which at higher altitudes also start to be exposed to significant amounts of radiation. Tantalum not only protects against external radiation but can also be used to shield an emitter to stop anything leaking out. That’s the same application that you have in nuclear plants because you want to shield that radiation from the outside world, or in a nuclear powered submarine to protect the crew and equipment.

Just a few weeks ago we received a $2.3 million grant to work on space applications of tantalum for shielding, where it is phenomenally good. Another property that comes with it – that so far has not been particularly useful – is that it is twice as heavy as lead and that is the opposite of what you want for aerospace applications. But on the other hand, consider that it absorbs any kind of radiation – including from radars. Any platform covered in it would basically be electronically invisible.

This might be especially useful for platforms such as ships, where extra weight is not that much of a challenge. We are working with ANSTO and some others at the moment to work out in the near future the specific types of anti-radiation shields that we can produce. There are different types of radiation and depending on the frequencies you wish to shield from you need a specific design.

You might need to cover the shield with different materials that might include a layer of tantalum with copper and titanium to achieve a particular result. This is a focus for us now and the results could be very exciting.

Q: That sounds like you have a lot going on.

Herbert: Yes – and we are looking at other applications of our material spray process. For example, if you have a kind of pipe and rotate it while our spray gun goes back and forth across the surface you can build up a layered scaffold. This is a type of barrel – and is a new way of producing a very strong hollow tube.

Producing gun barrels for military use is a science – and we are working with a partner, Repkon. They have just become a strategic investor in Titomic with a $2.5 million commitment. We are investigating the possibility of forming a joint venture with them specifically for barrel production.

Making a steel barrel is a complex process with greater heat resistance needed the closer you are to the breech than at the muzzle. What you can do with our technology as you are spraying it on you can have a gradient of material which is moving from one metal to another one as you move along the barrel in a continuous manner. This means you can optimise temperature distribution along its entire length.

Q: I know that for a Main Battle Tank gun there are many steps, including drilling out a huge blank made from specialist steel and then coating the inside of it with chrome and numerous other stages. How would you do it with your system?

Herbert: That’s kind of a trade secret and we are in the middle of working that out right now with our partners. At the end of the day what you want to achieve are barrels with longer life, that are corrosion resistant – they are exposed to enormous environmental challenges – because they need to be available for use in every imaginable
circumstance.

For the moment that’s all I can share, other than to say all that you need to start with using our process is a thin pipe that you can then cover with layers of material. We reduce the number of steps required to make a barrel, so we can also do it faster. This is going to happen via a joint venture with our partners where Titomic provides the fusion process and they provide the specific know how about barrel production.

The next thing to mention on my list of defence applications is the production of ballistic protection panels. We have started to produce some and we are in contact with companies such as Rheinmetall and Diehl in Germany about the possibilities, which include making panels out of titanium rather than steel.

There is a big weight advantage in using titanium – to achieve the same level of ballistic protection as steel the panel can be much thinner. That has to be offset against the greater price. However, the cost of using titanium can be reduced by the use of non-spherical powder in our fusion process.

Q: You will need to explain that.
Herbert: There are two technologies available for 3D metal printing. One is called the Laser Beam Powder Bed Fusion process. It is the dominant process in industry today. The companies that use this system take a metal powder, place it on a printing table and with a high energy laser they basically melt all of the particles at the spots where they are building the part. To work, there are specific quality requirements for the powder – in particular the particles have to be almost all the same shape and size.

Ideally, they are spheres. When the powder is on the table it needs to behave like a liquid. That powder is available, but because the production process is quite intensive it drives up the cost. A kilo of titanium spherical powder is $200-$250. On top of that, the main suppliers are Russia and China. This is a problem with defence technology, especially if you want to sell to the US.

However, the Titomic fusion process can use non-spherical powder because when you accelerate it to supersonic speeds it doesn’t make any difference when it impacts. Non-spherical powder is available for around one third of the cost per kilo at $80-$100 for titanium.

Now, get this: which country sits on top of the world’s largest reserves of titanium sand? Australia. Part of our strategy is to team up with a mining company here and we produce non-spherical powder for our own use. No one in the US or Europe has a problem with titanium components made in Australia.

This is going to take money and we will probably be looking at another capital raising exercise next year so that we can develop a joint venture for titanium mining.

Q: With ballistic panels, are there any size limitations?
Herbert: They could be almost any size – certainly much larger than is possible with the other 3D printing process. Laser-based fusion technologies seem to have a limit of about 500mm – which is fine if you are talking about things such as spinal implants. But if you are talking about defence and aerospace it can be a problem. With our system we can go up to a couple of metres.

There are a lot of certification requirements involved and we have been undertaking testing at the BMT (Ballistics and Mechanical Testing)
institute in Port Melbourne and we were fine for Level 2 but missed out on Level 3 by 10%. We have received a report back and we will make adjustments and re-test so that we will get the necessary certificate so that we can go back to Rheinmetall and Diehl with the information that they need.

Ballistic panels are usually very thick, very heavy flat panels that are welded together. Wherever there is a weld there is a potential weak point. The beauty of our process is that we can have three dimensional structures that are basically a side wall and a floor without the need for any welds.

This process can also be applied to body armour, where weight is a big issue – and that is something we will look at in the future.

Q: How do you compete against well known and relatively lightweight solutions such as Kevlar and carbon fibre.

Herbert: With our spray gun process you can start with one metal and then switch to another or even have a mixture. We will be able to create alloys that the world has not yet seen. You can even go further than this and think about metal particles being combined with polymers and ceramics.

This means that we might be able to develop alloys involving both metallic and non-metallic elements.

Q: This sounds like a huge science project.

Herbert: Science is very important but I have been called in to help commercialise the technology. As a company we need to find the right balance. On one side to monetise the solutions that we have already developed and at the same time work on materials and technologies going forward.

Titomic has a very strong R&D base but after a while investors start to get impatient and would like to see some returns – and that’s what I am trying to do right now.

I say that the beauty of 3D printing is that everything is possible. But the bad thing is also that everything is possible. This means that it is easy to take on more opportunities that you can handle and you end up being a mile wide and an inch deep. To be successful we can’t do everything but instead have to concentrate on concrete opportunities. That can sometimes hurt because people have been working on things but sometimes we have to put them to one side and we can return to them later.

Q: Is there anything else you would like to add regarding defence applications.

Herbert: Yes – repairs and coatings. Steel components on big machinery wears out over time because of loads and corrosion. We can offer onsite repair services where a part can be returned to its original geometry by spraying metal onto it and then if necessary machining it. That’s going to be a really big game changer. For that you are going to need a mobile unit – which to date we have not had.

Some other companies have this sort of on-site repair capability. It’s a natural fit where you go out with a specific metal powder and restore very large metal parts like gearboxes to their original shape. This saves not only money but also a lot of time – so it’s a good deal for everyone involved in the supply chain because you don’t need to bring the part all the way back to a major logistic centre.

There are also a lot of commercial applications for countering corrosion on things such as bridges and wind powered turbines.

Kym: Thank you for your time.
Israel is already a space power. Launchers, satellites and ground stations are developed and manufactured mostly for Israeli needs, but now this advanced technology is offered to other nations that see the importance of space for their security. Some of the Israeli systems are highly classified but others are enough to demonstrate the efforts and the achievements of the country’s space industry.

The most recent addition to the versatile list of products developed in Israel is a new concept for communications by introducing the MCS – a Mini Communication Satellite. According to IAI, the country’s main space company, the MCS is an advanced communication satellite weighing roughly 700 kg upon its launch and includes a complete digital communication payload weighing up to 200 kg. This is in comparison with a full size communication satellite with an average weight of 5,000 kg.

IAI says that due to its light weight, the satellite can be launched in a rideshare arrangement with other satellites, greatly lowering launch costs. In addition, it has a life expectancy of no less than 14 years and is specifically designed to provide multi-zone communication services to customers or countries with diverse communication needs.

The MCS uses an electrical propulsion system, developed specifically for this low weight satellite. It has been developed based on 30 years of IAI’s experience with various satellites and on the capabilities developed initially for Dror 1, Israel’s next generation space communications platform.

As Dror 1 is aimed to serve Israeli defence requirements, most of its capabilities were developed in-house by IAI, including an advanced digital communication payload and "space smartphone" feature that provide the operators with flexibility throughout the satellite’s mission life. In addition, the command program and development architecture allows for applications loaded from a ground station during the satellite’s entire life to adjust and modify assignments in accordance with changing communication needs.

IAI says that the MCS is fully digital with a flexible communication payload & applications; has high performance; has multi band capabilities, with up to four steerable antennas; and is cyber protected. It enables scalability, modularity, redundancy, and short-term responses to traffic demand.

These qualities are - according to Israeli defence sources - essential for the planned use of this national satellite.

According to Shlomi Sudri, general manager of IAI’s space division, the mini satellite offers a new concept to the communications market, serving as a complementary or a focused regional system:

“The MCS allows IAI to offer full satellite capabilities at a competitive price and expand into new satellite markets. IAI is in touch with a number of customers globally”

Every satellite is connected to a ground station that turns the raw data into actionable information. After very focused development efforts, IAI has unveiled the Blue Sphere, a cloud-based ground station for satellites. While it sounds like a contradiction, the company says that it significantly increases information received from the satellite and allows it to communicate with Earth at any given moment.

The setup of this virtual ground station in the cloud enhances the availability of the satellite output, reducing the dependence on it needing to be above a specific ground station. Instead, the satellite is able to broadcast the information collected to any available ground station worldwide. From there, the information is transferred immediately to the cloud, allowing the data to be extracted on demand, leaving it for the ground station to transfer or withdraw the information immediately without dependency on reception towers.

At the start of 2020, the Israeli government commissioned IAI to develop and build Dror 1 in order to fulfill the country’s national communication satellite needs. The specifics of this very advanced...
satellite are highly classified but sources say that it will "stream all types of communications" as if they are carried on a digital super highway.

In recent months Israel’s need for space assets has brought other local companies to offer their technologies, first to the Israeli Ministry of Defence but also with an eye on the international market.

It is well known that Israel launches and operates a number of very advanced spy satellites. But these low orbit spy satellites from the Offeq series, visit “areas of interest” at large intervals. Their optical or radar payloads cannot keep constant watch over points of interest because they are orbiting at high speed - and when it comes to the ballistic missiles threat, this is a major problem.

The Israeli MoD has contracted the company Rafael to develop nano spy satellites that will operate in swarms to allow the country to get real-time warnings on evolving threats. This will work like other constellations where at any time at least one satellite will be over the area of interest.

Israeli space initiatives are growing in number and technology. IAI has recently teamed with a startup company to make special satellites that can service other satellites in space, signing an agreement for technological and financial cooperation with local startup Effective Space.

Effective Space plans to order from IAI a fleet of maintenance satellites, each weighing not more than 400kg. The average life of a communication satellite is 15 years. It goes out of service when the hydrazine gas runs out and cannot keep nudging it back into its correct high orbit.

Israeli companies also develop maintenance tools for space systems. Astroscale Holdings Inc. says it is the market leader in satellite servicing and long-term orbital sustainability. The company recently revealed a universal docking device it hopes will become standard on all future Low Earth Orbit (LEO) satellites.

There are an unprecedented number of satellites due to launch over the next decade, the majority into LEO, which is defined as being 250km to 2000km above earth. The U.S. Federal Communications Commission has approved 16,447 satellites to date and has applications pending for an additional 64,816 platforms. The potential for high-velocity, high-impact collisions is likely to increase unless disposal of satellites becomes part of everyday space operations.

Astroscale’s Docking Plate can be compared to a car tow hook – a standardised interface that enables future servicing. Docking plates are designed to be discrete during satellite operations but robust and reliable if required. They can be customised for different satellite designs and will enable both robotic or magnetic capture mechanisms to securely attach a servicing device to a satellite.

“The Astroscale Docking Plate is designed to be lightweight and easy to fit onto LEO satellites,” said John Auburn, Managing Director of Astroscale Ltd. “As a low-cost solution it enables satellites to be captured and removed from space, keeping our orbital highways clear. We all value satellite communications supporting our global connectivity and economic prosperity.”

Astroscale U.S. Inc. earlier this year announced that it decided to acquire intellectual property and other assets of Israeli company Effective Space Solutions R&D Ltd. (ESS). This is the first acquisition of an Israeli space technology company by a foreign entity.

Another Israeli company is developing a gel-based propellant that will change the way rockets and satellites are being operated. According to NewRocket, conventional rocket engine technology in either solid or liquid form has many risks, including high toxicity, transportation challenges and produces rockets that are difficult to control or extinguish.

NewRocket is developing proprietary gel technology enabling a stable and non-toxic engine propellant, without sacrificing performance and control. According to the company, the "green propulsion" technology, combines all the advantages of both liquid and solid propellants.

The new propellant is also safe to use and transport. The company also said that the propellant will improve rocket performance, offering a powerful thrust that can be controlled and extinguished when needed. "NewRocket’s gel propulsion technology is designed to meet the strictest industry regulations," a company source said.

The company has successfully completed a proof of concept for the proprietary technology and identified key applications for the aviation, space and power generation markets. It says that existing satellite propulsion systems are currently too expensive or toxic, and often limit the performance of nano satellites. These restrictions lead to a dramatic reduction in satellite lifespan and make operating large constellations prohibitively difficult, especially in Very Low Earth Orbits (VLEO).

As mentioned, some of the most advanced Israeli space systems are highly classified. At least it can be said that the threats Israel is facing has brought local industry to stretch existing technological boundaries and come up with breakthrough systems.
A defence arrangement was quickly drawn up to protect the Malaysian peninsular and Singapore. This was built on the foundations of the Anglo-Malaysian Defence Agreement involving Malaysia, the U.K, Australia and New Zealand. With Singapore as a newly formed nation, the Five Powers Defence Arrangement (FPDA) was established in November 1971, and has evolved into a consultative-based pact, rather than a NATO-style military alliance.

From the early days, officials from the five militaries gather at the FPDA Integrated Air Defence (IAD) HQ in Butterworth, Penang, for air defence exercises. This has evolved into joint exercises to cover land and sea elements, becoming the Bersama-series exercises we know today. The Integrated Air Defence HQ has been renamed Integrated Area Defence to reflect the joint nature of the drill.

Bersama exercises continued in an era of relative peace in the 80s and 90s. However, as the world entered the millennium it was presented with a new threat of terrorism post-9/11 and saw unprecedented military-led humanitarian and disaster relief (HADR) operations after the 2004 Boxing Day tsunami.

FPDA continued to keep up with the times and included operations other than war (OOTW) series in its annual exercises, such as counter-terrorism and HADR cooperation.

FPDA TODAY

50 years on, it is as if the FPDA has come a full circle. The region is now faced with unpredictable security threats on multiple fronts. Regional states and the West are increasingly uneasy of China's growing influence, wealth and military activities on the seas and in the air. Chinese vessels are making...
an appearance around Malaysia’s EEZs, mostly for fishing. At the end of May, China flew 16 aircraft over Malaysia’s Exclusive Economic Zone off the island of Borneo, prompting the scramble of jets in response. However, it is important to note that the FPDA does not cover East Malaysia.

The FPDA exercise areas are arguably among the most realistic in the world. Unlike other wargames that use marked training ranges away from civilisation, FPDA exercises present a “what-if” scenario over the entire peninsular. Commercial country’s commitment to the FPDA despite the smaller contribution of assets.

The sudden pull out of US-led forces in Afghanistan and the resurgence of Taliban power has also prompted worries that the war-torn country will become a hotbed for Islamic extremism, spreading extremist ideologies into Southeast Asia.

While the FPDA was established to help Malaysia and Singapore defend themselves as the British vanished, five decades later U.K. forces are returning on a larger scale than before. The Carrier Strike Group 21 led by the HMS Queen Elizabeth aircraft carrier is making its rounds and two Royal Navy offshore patrol vessels are on their way for a five-year deployment to the region. However, the aircraft carrier did not participate in the war games and the Royal Navy was represented by Type-45 destroyer HMS Diamond.

Kara Owen, British High Commissioner to Singapore said the UK has plans to “make a bigger and more consistent contribution” to the FPDA, in line with its Defence Command paper and commitment to pursuing deeper engagement in the Indo-Pacific region.

“The UK is also looking to increase its capacity building and training across the Indo-Pacific, delivered through longer and more consistent military deployments and by better leveraging our existing regional facilities,” she said. She added that interoperability is one of the key goals of FPDA, which will come in the form of common A400Ms with Malaysia, F-35s with Singapore and Australia and its future P-8 Poseidon with both Australia and New Zealand.

Even within FPDA, the member states have varying appetites on security policies and international relations, especially with China. Singapore has stood its ground on its neutral stance, while Australia, New Zealand and the UK are taking a stronger position in line with the U.S, a non-FPDA member. Similarly, the Australia-US-UK (AUKUS) trilateral military pact has mixed reactions within the agreement. New Zealand and Singapore are largely indifferent with the game-changing alliance AUKUS will bring, but Malaysia says it will seek Chinese views on the matter.

The FPDA has also fostered high-level and person-to-person defence ties through the years, the latter being a key component to establishing mutual trust and cooperation. The exercises survived a number of highs and downs, including the 1997 Asian financial crisis, the global 2008 financial crisis, the rescission of Malaysia airspace for transit by Singapore military aircraft and more recently, Covid-19.

In an increasingly diverging world, the role and function of FPDA has been underrated. It represents a half a century long-term commitment by the FPDA governments to the stability and security of the region. In the future we should continue to look forward to the regular interaction of men and women from the five militaries, diffusing mistrust, honing interoperability and fostering long term goodwill.

Indeed, Singapore’s defence minister Ng Eng Hen said at the FPDA 50 celebrations that the the greatest threat to the region is not any particular country, but in fact “misunderstanding and miscalculations” and that the grouping’s posture is “adequate for the peninsula’s security challenges” today.

“It does not mean that we would not have surprises, but I think what we are doing is exactly the right thing – to continue to exercise during peace time, to build understanding so that you can be more responsible,” he said.

“50 years on, the world and our region have vastly changed. Yet the FPDA retains its relevance and value. It is an established and accepted way of conducting exercises and wargames, the hallmark of the FPDA,” he said.

The New Zealand High Commissioner to Singapore, Jo Tyndall, told the media that New Zealand’s defence focus has always been in the South Pacific and usually in humanitarian operations. However, she said that does not discount the
Typically, the ARMY GAMES stretch for two weeks. Service personnel representing their national armed forces try to outdo others in skills in a given warfare discipline, military equipment operation, field repair and managing an emulated tactical situation. This year’s event attracted over 5,000 participants in 277 national teams. These are just those taking part in the sports, not counting many more of their colleagues in 42 countries arranging and running the competitions and supporting their teams as fans and viewers.

The launch of a large-scale military sports competition was the brainchild of the Russian defence minister Sergei Shoigu. He does not hide his satisfaction at the substantial growth in all figures and parameters in what is sometimes called the “War Olympics”. Back in 2015 it was almost a national event with only a small amount of foreign participation, but the following year 19 independent states collectively sent 3,500 servicemen to compete in 23 events. In 2017 China obliged with hosting six more and helped bring the number of participating armies to 28. The next year co-organiser countries amounted to 7, and, later, 10-12.

The figure could have been bigger if not for the COVID19 pandemic which made some countries cancel competitions they had sought to run. For instance, Mongolia called off invitations to the “Equestrian Marathon” for mounted units to test their skills in navigating in a desert, controlling horses and firing when in the saddle.

In pandemic times, the number of co-organisers and participating countries decreased, but Moscow kept running the games as planned. Early this year, Russia and China declared the vaccination campaign in their armed forces complete, thereby encouraging other countries to send their teams again without fear of infection.

For the first time in 2021, ARMY GAMES opened on August 23 simultaneously with the ARMY international military and technical forum. President Putin attended the ceremony to make a speech to thousands of people who flocked to Kubinka for that reason (including the King of Jordan awaiting him on site for negotiations). By combining the two events, the organisers set new records. The thousands of weapons and items of military equipment involved in running the games were in 300 static exhibits as well as 230 combat vehicles taking part in the dynamic display at the forum.

The second largest weapons exporter in

RUSSIAN ARMY GAMES 2021 – HUGELY POPULAR WITH ASIAN NATIONS

Launched seven years ago as an annual military sports event in Russia, the International Army Games has found staunch supporters among several Asian nations, who eagerly open their firing ranges and training grounds to foreign servicemen competing for trophies. The number of competitions has risen to 34, of which China runs three, Vietnam two, Iran three, Armenia, Qatar, Kazakhstan and Uzbekistan one each. Even though Russia still hosts the majority (16), it now provides only 11 firing ranges and training grounds out of 23 in total.
the world (after the U.S.), Russia is interested in expanding its client base across the globe. Here, the “War Olympics” serve many purposes, including demonstrations of Russian weaponry and the Russian army’s expertise in handling them. Having become a co-organiser country, China pursues similar goals. According to the terms of participation, the host party provides all teams with equipment and all types of support (repair, maintenance, refuelling), as well as the necessary amount of ammunition for training and the completion of stages. It also takes care of accommodation, food and medical support for personnel taking into account the implementation of all sanitary and anti-epidemic measures to counteract coronavirus infection.

Pursuant to the provisions of the ARMY GAMES, crews are able to operate vehicles which are in service with their national armed forces. In some contests, a number of teams can use their own vehicles and ammunition. To ensure this, the host side helps organise transportation of that hardware by rail, road or air.

Most teams are happy with equipment offered by the host country. China is different. It always brings Type 96 MBTs to run in the Tank Biathlon in Kubinka/Alabino while all other 19 teams (with Vietnam, Qatar, Laos, Myanmar, Mongolia, Syria, Tajikistan, Uzbekistan among them) are ok with T-72B3Ms from Russian army stocks (refurbished with 1130-hp turbocharged diesels for higher manoeuvrability). Going to other competitions on Russian soil, PLA servicemen took their own IFVs, trucks and support vehicles with them.

For Aviadarts and Aviamix competitions for flight crews held in Ryazan, the PLAAF flies in J-10, JH-7, Y-20, amongst others. This increases the number of participating aircraft to fifty. Colonel Anatoly Ulianov, a senior referee at Aviadarts 2021, said that, by sending their best aircraft, Belarus (it made use of freshly delivered Su-30SM fighters) and China added much heat to the competition, while their hand-picked pilots and technicians proved tough competitors, able to challenge the Russian hosts in every field. China hosted Aviadarts once and seeks to repeat the experience.

Over 800 PLA officers and soldiers took part in the ARMY GAMES 2021. They fought in 21 contests, which is less than Russia (34), Belarus (27) and Uzbekistan (24). Addressing journalists in Kubinka, Chief Colonel Hu Zunpin (serving as a referee) stated that the event serves as an excellent platform for service personnel to show their skills, better train on the equipment and share experience with other armies. Since PLA officers are not entitled to address the media except under explicit orders to do so, it is believed the speech had been approved by senior PLA leadership. He said:

“The games give a good chance for our team to excel in the competitions, as well as to demonstrate the performance of the homemade equipment. We take part in 12 contests in Russia and 6 in other countries, and host three in Khorla: Suvorov Onslaught (IFV crews), Clear Skies (portable SAM operators) and Safe Environment (nuclear, chemical and biological protection specialists). Competing for cups, our servicemen foster the military morale, improve their skills and learn new ones. National crews have been improving their team work and spirit, and achieving higher scores. Our crews will continue to compete justly and with dignity, to uphold the PLA image on the world stage. We express the desire to take part in more competitions in the future, and to broaden interaction with other armed forces during the army games”.

The chief colonel thanked the Russian MoD for organising the event and expressed the hope that “under Russian leadership” the games will expand in scope and number of competitions.

Speaking on behalf of the Vietnamese army, Colonel Nguyen Din Nam (a referee) also thanked Russia, for the assistance rendered during the games and “in the historic past”, including during the War of Liberation. Vietnam took part in the games for the fourth consecutive time, in 15 contests including four new ones. One of those is held for seamen on a ship in Vladivostok, involving mooring, rescue, firing at shore, sea-going and aerial targets.

The country hosts two: the Sniper Frontier and Emergency Area. He said:

“This is a high scale event attracting many nation states, whose number has been growing. Hence, it is very important for Vietnam to make use of this platform and build good relations with various countries. In future, the Socialist Republic will continue to stay an active participant, and take opportunities to compete in more contests found suitable to us. We will do so chiefly for the purpose of supporting the Russian initiative and also for strengthening relationships between our nations. We will always fight to the end so as to show ourselves in the best way”.

Brigade General Muhammed Reza Zavar Habib from Iran complained that the two-year COVID19 pandemic put his country – along with many others in the developing world – into “unequal conditions”. Iran has been taking part in the games since their inception in 2015. This time, it intended to compete in 14 contests, but strict medical terms in China prevented the Persians from taking part in the IFV crew competition out there. He commented:

“We are grateful to Russia for organising and running the ARMY GAMES, and keen to continue our participation in the years ahead. It is our belief that these will facilitate military and military-technical cooperation between our countries”.

Iran sent three teams to Russia: infantrymen for Tactical Shooter in Ryazan, surveyors for the Meridian in Moscow and marines for the Seaborne Assault at the Clerk training ground on the Sea of Japan coastline. The Persians also came to Belarus (special
forces), Kazakhstan (120-mm mortars and UAVs operators), Serbia (military policemen) and Qatar (military traffic police) for a total of six competitions there. He said:

“The command of the Iranian armed forces finds that the International army games produce a significant impact on strengthening the national defence capability and help our servicemen obtain more tactical experience in a comfortable atmosphere among friends”.

Iran itself hosts three competitions: Depth (divers in the Arabian Sea), Sea Cup (warship manoeuvering and firing in the Caspian) and Gunsmith (field repair on howitzers, rapid-fire cannon and rocket launchers) with teams representing Russia, Venezuela, Syria, India, Vietnam, Uzbekistan, Azerbaijan and Kazakhstan. This gives a rare chance for the Islamic Republic to improve its image as an open and hospitable country, and also to compare its equipment, training tools and technologies with those of other nations.

Egypt wants to make participation in the ARMY GAMES a regular practice, General Muhammed Ahmed Saadelddeen Abuelnasr said:

“Over the past few years, we have been taking part in more contests, now with over a hundred servicemen. Let me express gratitude to Russia, China and other co-organisers for their contribution in promoting these games. This gives us ample chances to get acquainted with weapons and equipment that are not in our service. Examples of those are provided to visiting teams by the host nations for use in the competitions”.

Lt. Colonel Mohammed Ikerban with the Algerian Popular Army said his country was taking part in the games for the fourth consecutive time. This year, Algeria attempts the role of a co-organiser by running a K9 competition, the True Friend, unofficially referred to as “dog-biathlon”. In addition, it sent 40 paratroopers for the Airborne Platoon contest at the Dubrovichi training ground in Ryazan to compete with 18 nations, including first-timers Brazil, Pakistan, Myanmar, Mali. He added:

“We thank the Russian MoD for making available to us all the necessary means and facilities to live, work and exercise. Also, I would like to express special thanks to the chief referee General Gorbatenko for his high dedication and professionalism”.

Referees’ work turned more difficult through adding unarmed (hand-to-hand) combat to the paratrooper competition. Here, Algeria managed to get into the unarmed (hand-to-hand) combat to the paratrooper competition. Here, Algeria managed to get into the top-list along with Russia, Belarus, Kazakhstan, China, Uzbekistan and Venezuela. The latter has participated in all the games since 2016 except last year, on medical considerations. In 2021, it tried its luck in 11 contests on the territory of five countries.

Addressing Russian media, the head of combat training with the Venezuelan armed forces, Brigade General Jose G. Perez conveyed fraternal greetings from the Bolivarian Republic’s President Nicolas Maduro. He also quoted part of President Putin’s, opening ceremony address stating that the games and the ARMY forum will help strengthen relations between participating countries, develop friendly ties among them and increase the level of their military preparedness. To that, Perez added:

“The international army games have become a major event globally, calling in representatives of the many armed forces to flock together and compete in various warfare disciplines. Everyone wants to demonstrate a high level of combat training, military morale, psychological development, and strives to strengthen friendly relationships with colleagues from other participating nations. Beyond doubt, this facilitates the process of sharing experience and developing military-technical cooperation. We brought teams that are keen to demonstrate their top skills and eager to win”.

According to the chief referee General Alexander Gorbatenko, this year marked the first participation of mixed crews, made up of servicemen from various national armies:

“Sometimes it happens that the visiting team does not have enough technicians trained in the vehicles of the host country. For instance, Brazil has a shortage of those who are good at Russian equipment, so we obliged them with our own. Also, local representatives joined the Israeli team to operate Russian-made KAMAZ and URAL army trucks in the Military Rally contest.”

In a move to attest interoperability between servicemen, two mixed crews were formed - one comprising servicemen from Russia, Belarus and China, and the second from Vietnam, Laos and Iran - to take part in the Meridian contest for topographic and geodetic specialists. They were given maps and measuring devices to determine cannon/mortar bearing angle with a task to hit an assigned target.

“Despite the language barrier, the mixed crews demonstrated good results, scoring close to the national teams. This means that the servicemen of our countries are ready to work hand-in-hand, to fulfil combat missions together”, Gorbatenko said.

While keeping the role of the main organiser for itself, Moscow seeks to hand over rights to hold certain contests to anyone willing. So far, attempts to involve Europeans have found a positive response only from Serbia. Europeans are also narrowly represented, with only Greece and Cyprus sending their teams to Russia. Turkey also sent a team, but not to the games, just to the “drone biathlon” (a contest for lightweight UAV control skills) held as part of the ARMY forum.

This compares to twenty Asian nations, half of them from the Asia-Pacific region. Seven have become co-organisers, compared to one in Africa and one in Europe. In the foreseeable future, the number of participants is likely to grow with small nations from the developing world participating, while those who are already in, will gradually try their luck in more competitions. The army games are not only about sport; the organiser and certain co-organisers look far further than that.
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T: +603 2702 7700
E: enquiry@dsaexhibition.com

Malaysia & Asia Sales
Ezwain Effendy
T: +6010 828 9690
E: ezwan@dsaexhibition.com

Hazri Hasril
T: +6019 220 9690
E: hazri@dsaexhibition.com

Sponsorship / Branding
Peter McKenna
Sponsorship Producer
E: info@official-events.net
Nurizan Manap
E: nurizan@dsaexhibition.com

www.dsaexhibition.com
Very few details emerged from the meeting, but its relevance could be seen in the fact that the US delegation included representatives from the Office of the Secretary of Defense and the Joint Chiefs of Staff, while the Chinese delegation featured members of the Central Military Commission’s Office for International Military Cooperation (OIMC).

The key issue on the agenda was the Pentagon’s latest assessment that China is expanding its nuclear weapon capabilities at a much faster rate than US officials had predicted a year ago. More precisely, the authors of the 2021 ‘China Military Power Report’ warned that the “accelerating pace” of the People’s Liberation Army’s (PLA’s) nuclear expansion “may enable the PRC [People’s Republic of China] to have up to 700 deliverable nuclear warheads by 2027”, adding that Beijing “likely intends to have at least 1,000 warheads by 2030, exceeding the pace and size the [US] DoD projected in 2020”.

Beijing itself does not release any data on its nuclear weapons arsenal, but in the 2020 edition of the same Pentagon report, US officials had estimated that the number of China’s nuclear warheads was “in the low-200s”. This was projected “to at least double in size” over the next decade as part of the PLA’s efforts to “modernise, diversify, and expand its nuclear forces”.

To accelerate the expansion, Beijing is investing in a number of land-, sea-, and air-based nuclear delivery platforms and constructing the necessary infrastructure to support them, noted the Pentagon in its 3 November report. It also pointed out that China is increasing its capacity to produce and separate plutonium for warheads by constructing fast breeder reactors and reprocessing facilities.

“The PRC probably intends to develop new nuclear warheads and delivery platforms that at least equal the effectiveness, reliability, and/or survivability of some of the warheads and delivery platforms currently under development by the United States and/or Russia,” wrote the authors of the report, pointing out that the move is part of China’s nuclear deterrence strategy as well as plans to deter and counter third-party intervention in regional conflicts.

**AIRBORNE CAPABILITY – NEW ALBM**

In this context the US DoD said that China has “possibly already established a nascent nuclear triad” with the development of a nuclear-capable, air-launched ballistic missile (ALBM) and the improvement of its ground and sea-based nuclear capabilities.
According to the report, China already signalled the return of the airborne leg of its nuclear triad on 1 October 2019 – during the country’s National Day Parade – when the PLA Air Force (PLAAF) publicly revealed the H-6N as its first nuclear-capable, air-to-air refuelable bomber.

Derived from the H-6K long-range bomber, the H-6N features recessed fuselage modifications that allow for external carriage of an ALBM. In fact, about a year after the aircraft’s first public appearance over the skies of Beijing, images emerged on Chinese social media forums showing an H-6N carrying a large weapon under its fuselage that appeared to be an ALBM fitted with a hypersonic glide vehicle (HGV). Against this background the Pentagon noted that new H-6N-equipped units will “very likely” be developing “tactics and procedures to conduct the PLAAF nuclear mission”.

That said, the H-6N will probably not be China’s only nuclear-capable bomber for long. The Pentagon stated that the country is also developing a new stealthy strategic bomber as the PLAAF seeks to extend its power projection capabilities. In this context it pointed to official Chinese media reports stating that the future bomber will have “a nuclear mission” in addition to filling conventional roles. While this programme was publicly announced by the PLAAF in 2016, Washington noted that “it may take more than a decade to develop this type of advanced bomber”.

LONGER-RANGE SLBM UNDER DEVELOPMENT

Regarding China’s sea-based nuclear capabilities, the Pentagon report confirmed that the PLA Navy (PLAN) currently operates six Type 094 nuclear-powered ballistic missile submarines (SSBNs), each of which can carry up to 12 JL-2 submarine-launched ballistic missiles (SLBMs).

However, the country is already working on the new JL-3 SBLMs that will equip the service’s next-generation Type 096 SSBNs. The reason behind this is that the current range limitations of the JL-2 would require the Type 094 boats to operate in areas “north and east of Hawaii should China seeks to target the east coast of the United States”, noted the authors of the Pentagon report.

That said, newer, more capable, and longer-range SLBMs – such as the JL-3 – would give the service the “ability to target the continental United States from littoral waters”. As a result, the PLAN may consider “bastion operations” to enhance the survivability of its sea-based deterrent, with the South China Sea and Bohai Gulf probably being China’s preferred options for employing this concept, according to the Pentagon.

DIVERSIFYING THE PLARF’S ARSENAL

The diversification of China’s nuclear arsenal can also be seen in the growing capabilities of the PLA Rocket Force (PLARF), with the Pentagon pointing out that the service continues to expand its inventory of road-mobile DF-26 intermediate-range ballistic missiles (IRBMs), which can be used to carry out conventional and nuclear precision strikes against ground targets as well as conventional strikes against naval targets. The weapon is also viewed by the Pentagon as the most likely system in the PLARF inventory to field a lower-yield nuclear warhead in the near-term.

Moreover, the service began fielding its first operational hypersonic weapon system – the HGV-capable DF-17 medium-range ballistic missile – in 2020, and a new DF-27 ballistic missile – with a possible range between 5,000 km and 8,000 km – is reportedly in development.

That said, China appears to have tested yet another hypersonic missile system in August, with US Army General Mark Milley, the chairman of the US Joint Chiefs of Staff (JCS), describing that test launch as a “very concerning” and “very significant” development.

Gen Milley’s remarks marked the Pentagon’s first official acknowledgement of that hypersonic test, which was first reported by the Financial Times newspaper on 16 October. According to the paper, China tested in August a nuclear-capable, hypersonic missile. More specifically, the PLA reportedly launched a rocket carrying an HGV that glided along the upper layers of the atmosphere before flying down towards its target.

In its 3 November report the Pentagon also said that China is believed to be working on new intercontinental ballistic missiles (ICBMs), such as the DF-5C and the DF-31B, while at the same time expanding its ICBM arsenal, which currently consists of approximately 100 ICBMs, including fixed and mobile launchers capable of launching unitary and multiple re-entry vehicles.

In fact, the Pentagon warned that China is “on the cusp of a large silo-based ICBM force expansion comparable to those undertaken by other major powers”, as it has commenced building “at least three solid-fuelled ICBM silo fields, which will cumulatively contain hundreds of new ICBM silos”.

This, said Washington, will not only significantly improve the PLARF’s nuclear-capable missile forces but also “require increased nuclear warhead production”, partially due to the incorporation of
multiple independently targetable reentry vehicle (MIRV) capabilities.

In this context the Pentagon indicated that China appears to also be considering additional launch options for the road-mobile, MIRV-capable DF-41 ICBM, including rail and silo basing, and that Beijing may be building new silos for its DF-5-series ICBMs.

LAUNCH-ON-WARNING POSTURE
The Pentagon is of the view that China’s expanded silo-based force, along with its ongoing strategic early warning progression, indicate that Beijing intends to increase the peacetime readiness of its nuclear forces and move to a launch-on-warning (LOW) posture.

Referring to this approach, which allows commanders to launch a retaliatory strike against an opponent as soon as space- and ground-based sensors detect an incoming enemy missile, the Pentagon said it believes China will probably seek to keep at least a portion of its nuclear force at this status.

To underscore this view, the Pentagon said the PLARF has been conducting exercises since 2017 involving the early warning of a nuclear strike followed by LOW responses. It also stated that China has made advances in early warning capabilities, noting that the PLA already fields several ground-based large phase array radars – similar in appearance to US PAVE PAWS radars – that could support a missile early warning role.

There have also been reports claiming that China has been aiming to field geo-stationary satellites capable of detecting ballistic missile launches. Satellites, equipped with infrared (IR) sensors that can detect the launch of a missile from the heat plume of its exhaust and provide continuous surveillance, are an essential warning system component.

However, it is not known whether China has developed suitable IR sensors. In October 2019 Russian President Vladimir Putin said that his country was assisting China in the development of a missile warning system. The Russian leader said at the time it is intended to enhance China’s defensive capabilities, pointing out that “currently only the United States and Russia have such systems”. No further details were provided.

China has described several of the satellites placed in orbit in recent years as having, at least in part, a “technology experimental function”, which might include IR missile-launch sensors, or may be an intended area of co-operation with Russia.

An effective warning system would need to integrate inputs from multiple ground-based radars and satellite-based sensors, and this could be an area in which Russian assistance could shorten development timescales.

FUTURE TALKS?
Beijing did not issue a statement on the 30 November meeting between US DoD and Chinese OIMC officials, so it is unclear how it reacted to the talks. That said, the fact that the two sides discussed these issues can generally be seen as a positive sign. The US has repeatedly called on China to join talks on nuclear arms control similar to the ‘Strategic Stability Dialogue’ it has with Russia.

However, Beijing has rejected engaging in such talks, with the Ministry of Foreign Affairs (MoFA) arguing that China’s national defence strategy is “defensive in its nature” and that “it is only reasonable and legitimate [for China] to increase input into the national defence sector proportionally as our economy keeps expanding”.

The MoFA also sharply criticised the Pentagon report shortly after its release, saying that it “disregards facts and is filled with bias”, while adding that Washington has used the report to “hype up the ‘China nuclear threat’ theory”.

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DRIVING SIMULATION TECHNOLOGY

Cutting-edge technology is being trialled by the Army to help improve driver safety, save money and be more sustainable.

The NOVA is an untethered full motion simulator giving 360 degrees of motion created by a Lower Hutt company.

The Emerging Technology Group has been working with Eight360 alongside 5 Mov Coy and 10 Tpt Coy to investigate its utility in driving simulation. Emerging Technology Director, Mark Baddiley says “when coupled with a virtual reality headset the NOVA gives a fully immersive experience of a driving scenario. The NOVA platform allows the NZDF to use technology to enable more flexibility in the way personnel can become familiar with various military vehicles and driving scenarios.”

This means Army personnel can practise driving some of the larger and most expensive equipment with no risk to either themselves or the vehicles.

This is especially useful when it is hard to replicate a complex environment such as an amphibious landing. The initial exploration involved the “wet gap transition” in an amphibious landing operation. This comprised of testing vehicles moving from HMNZS Canterbury onto a landing craft and then onto a beach. The simulation of the ramp angles involved, the associated movement of the vessels and the incorporation of a guide with associated communication via hand gestures created an environment providing a realistic experience of the transition.

The CAT938K vehicle is especially difficult to handle in this scenario as the driver is required to reverse the vehicle without visibility, relying on guides to help them navigate the wet gap. The Canterbury stern ramp can be up to 15 degrees, and the LCM ramp can be up to 28 degrees. Both actions can take a bit of getting used to for the drivers as the centre of gravity of the vehicles change, especially with the added complexity of changing sea state.

The Officer Commanding 5 Mov Coy at the time, Major Pete Van der Vlerk’s prime motivation was to reduce risk by giving the drivers an experience that replicates the most dangerous aspects of the exercise. The use of simulation will not necessarily reduce the need to train with the real vehicles in the real scenarios but supplement the training programme and help increase confidence and experience.

The opportunity to train in this scenario is limited and can be cancelled or postponed for numerous reasons as it requires the coordinated availability of personnel, vehicles, ships, landing craft, weather conditions and the beach itself.

The NOVA platform can also simulate the scenario in different sea states whilst in a safe environment, which benefits the operator before they encounter a potentially hazardous real situation.

“A simulator also means different driving situations can be replicated and practised regularly without the added burden on the physical vehicles – improving sustainability as well as real costs in terms of wear and tear on the vehicles and fuel savings,” said Mr Baddiley.

A small six-week window of opportunity existed last year to create the scenario and get the necessary operating permit to enable safe trialling prior to Exercise Joint Waka 2020. The content to create the simulation was split into two parts – the creation of a virtual vehicle and the virtual environment that the vehicle is required to navigate. Creating the virtual vehicle involved taking approximately 1,500 images of the CAT938K to make a digital model, building customisable controllers that match the physical controls, such as steering wheel and pedals, and using sensors to capture the feeling of driving the vehicle in real life along with configuring the virtual vehicle with the nuances of the CAT938K.

NZ TOPS GLOBAL TRANSPARENCY RATING FOR DEFENCE AND SECURITY SECTOR

Overall, New Zealand achieved a score of 85, putting it at the top of international rankings. The report found that agencies have very robust institutional resilience to corruption.

The five-yearly GDI measures political integrity, finance, personnel, operations-controls in the field and procurement across 86 different countries. This is the second time that New Zealand has received the highest rating.

The results showed the integrity and transparency that exists within the New Zealand defence and security sector, and the strong systems and processes that are in place to address the risk of corruption, said Chief of Defence Force, Air Marshal Kevin Short.

Transparency International suggests improvements could be made to the level of regulation around political lobbying, corruption monitoring in operations and anti-collusion controls in contracting.

“It is important that defence and security institutions have a strong reputation as being ethical and professional. We are pleased to be at the top of the international rankings and will look for opportunities to improve for future assessments,” said Secretary of Defence Andrew Bridgman.
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