REPLACING THE TIGER ARH CAPABILITY
– Does it make sense?

SAAB
CEO & PRESIDENT, MICAEL JOHANSSON

DETAILS EMERGE
FOR LAND 400 PHASE 3
COMPETITORS

EXOSKELETONS
FOR MILITARY OPERATIONS
Technology that lets pilots focus on the fight.

Securing vertical lift superiority in the multidomain battlespace will require even greater mission capabilities than are available today. Featuring flexible and intelligent systems, the agile, lethal and survivable RAIDER X™ provides both pilots and warfighters on the ground the reach, protection, and lethality required in the most demanding and contested environments.

Learn more at lockheedmartin.com/raiderx

Lockheed Martin. Your Mission is Ours.®
Replacing the Tiger ARH Capability
– Does it make sense?

An Australian Army ARH Tiger Armed Reconnaissance Helicopter deploys flares during a live-fire exercise while deployed with HMAS Canberra. Credit: CoA / Kieren Whiteley

Editor's Letter
Time for a new Defence White Paper

MQ-9B confirmed for AIR 7003
Operation Augury success

Japan protected by SPY-7 radar
Electric Boat contract for 9 Virginia class subs

Northrop Grumman, MBDA & Saab demonstrate missile defence solution
TIME FOR A NEW DEFENCE WHITE PAPER

KYM BERGMANN // CANBERRA

Looking back on 2019 there are few major standout moments either in procurement terms or with current operations – but nevertheless it has been another busy year for everyone. But looking at the acquisition part of the equation, it is worth asking whether this steady and largely uneventful approach is appropriate at a time when Australia's strategic circumstances are shifting irrevocably.

As we have discussed previously, there are two main regional strategic drivers – the rapid growth in the size and capability of China's military, coupled with the relative decline of the U.S., with emphasis on the word 'relative'. At the moment the U.S - combined with allies such as Japan, South Korea and Australia – remains the dominant power in the broad Asia-Pacific region. However, it would be a brave analyst who asserted their confidence that this will still be the case ten years from now, let alone further out.

These are the sorts of timescales that military planners need to think about because procurement cycles remain very long, despite the emergence of technologies such as additive manufacturing and Artificial Intelligence that in theory should speed things up. From what we can tell of the Chinese system, it is throwing a lot of money not just at conventional military hardware but also at disruptive technologies such as uninhabited systems using swarming techniques and advanced sensor arrays.

If successful, these will have effects such as to completely deny access to the entire South China Sea – which makes one wonder why Australia is spending billions of dollars on a huge ocean going conventional submarine that is designed, in part, to operate in areas where it is no longer viable to do so. There is often a lag between military thinking and changing technological circumstances. The battleships were shown to be vulnerable to air attack in 1921 – but nations continued to construct them in vast numbers until the early days of the Second World War proved that they were no longer the capital ships of the day. That title had passed to aircraft carriers, though only a few people understood that was the case.

Unfortunately, this is far from an isolated case. The machine gun made mass infantry attacks prohibitively costly; the tank changed the face of land warfare; the jet engine completely replaced propeller driven combat aircraft within a decade. In a little known historical fact, during the First World War more British shipping was tied up delivering fodder to France to feed the horses of cavalry divisions that never saw action than was used to transport ammunition.

From a policy viewpoint, these types of subjects are dealt with at a high level in Defence White Papers – and given the two year lead time in developing those, another one should be commissioned. After the somewhat surprising re-election of the Federal Government in May, there have been no appreciable policy initiatives in the national security domain and as the start of the next decade looms that needs to be addressed.

Without wishing to be alarmist, the Chinese naval buildup in particular is vast, with dozens of new surface combatants being added every year. Beijing's naval capacity has always tended to be understated in the west because to have a true appreciation of what is taking place one also needs to factor in the Coast Guard; various police forces – and even the huge fishing fleet, all of which is Government owned. This is not to say that fishing trawlers represent a direct military threat, but for data gathering they are a useful additional tool, especially when they number in the tens of thousands. Chinese efforts at increasing the size and capability of the submarine fleet is just as impressive – and worrying.

It is highly likely that China now has fixed sonar arrays on the sea floor at distances several hundred kilometres from the mainland, especially at strategic zones, such as around Hainan Island – also a major naval base. All of the Chinese-controlled islands in the South China Sea are likely to be similarly linked and protected. On the surface, increasingly capable anti-submarine warfare assets are on patrol – and not too far into the future Beijing will have available large numbers of relatively cheap uninhabited surface vessels equipped with dipping sonar and torpedoes that can work together in swarms of six or more, using AI to give them a level of autonomy not previously seen.

Without going into operational details, the main reason Australia acquired long-range Oberon submarines in the 1970s, to be replaced by the even longer range Collins in the 1990s and the planned even larger Attack class sometime in the 2030s was that they could be parked off the coast of hostile powers way, way to Australia's north. During Cold War days this meant gathering information from places like Vladivostock in Soviet Union's Far East – and in the event of hostilities being able to sink warships as they left port, well before they could reach anywhere near Australia. The logic of the Attack class size and range is similar, though of course the main ports of interest are now Chinese rather than Russian.

But given the technological changes described above, would Australia really risk the lives of men and women – and the potential loss of an extremely valuable asset – by pushing a submarine into waters that are becoming increasingly transparent? To this needs to be added the sheer size of the Attack class – 70% larger even than Collins, itself one of the world’s biggest conventional submarines – making it an easier target for detection by active sonar and also meaning that it is far less agile than smaller submarines.

It is time for the strategic justification for the programme to be re-examined – but not until after Christmas and the Festive Season, which hopefully will be one of peace and goodwill.
Australia, we’ve got your back.

Saab Australia’s developed and supported high-end technology for Australia’s defence forces for more than thirty years. We’re committed to building Australia’s sovereign capability and economy by keeping jobs in-country.

saab.com.au
GENERAL NEWS

CUTTING EDGE REMOTELY PILOTED PLATFORM CHOSEN IN BILLION DOLLAR PROJECT
– 28 November 2019 –

The Australian Government’s $1.3 billion program to deliver a cutting-edge armed remotely-piloted aircraft system is a step closer with the down-selection of the General Atomics MQ-9B ‘Sky Guardian’.

The next phase will focus on developing the MQ-9B acquisition proposal, which is scheduled for government consideration in 2021-22.

Minister for Defence, Senator the Hon Linda Reynolds CSC said this project will deliver Australia’s first armed Medium Altitude Long Endurance Remotely Piloted Aircraft System.

“Cutting-edge technology of this kind, with advanced sensors and systems, would complement advanced aircraft such as the F-35 Joint Strike Fighter and ensure that Australian Defence Force maintains state-of-the-art capability,” Minister Reynolds said.

Minister for Defence Industry, the Hon Melissa Price MP encouraged Australian industry to become involved in this billion dollar project.

“Local companies that provide a range of innovative sensor, communication, manufacturing and life-cycle support capabilities will have the opportunity to showcase their capabilities throughout this development process,” Minister Price said.

“Australian defence industries are world-class and are extremely well-placed to be involved in projects like this.”

CHIEF OF JOINT OPERATIONS HAILS SUCCESS OF OPERATION AUGURY-PHILIPPINES
– 2 December 2019 –

The Australian Defence Force has taken the next step in its enduring relationship with the Armed Forces of the Philippines.

Operation Augury-Philippines transitioned to an Enhanced Defence Cooperation Program on 1 December, recognising the maturing connection between the militaries of both nations.

Chief of Joint Operations, Lieutenant General Greg Bilton said the transition acknowledged the strong foundation built under the operational framework.

“Operation Augury-Philippines has been an extraordinarily successful operation, delivering tangible security benefits to Australia, the Philippines and the wider region,” Lieutenant General Bilton said.

“Since 2017, we have trained over 10,000 members of the Armed Forces of the Philippines in urban combat and joint operations, air coordination in the urban environment, and maritime security.

“It has become a model for how we approach partnered activities and I congratulate everyone who has contributed to its success.”

Lieutenant General Bilton said the capacity building training under the enhanced Defence Cooperation Program will commence in early 2020.

“This transition is a natural evolution of the current relationship, offering long-term mutual benefits at a level well above that prior to the siege of Marawi,” Lieutenant General Bilton said.

“Most importantly, the arrangement will continue to enhance the capacity of the Armed Forces of the Philippines to mitigate and respond to threats of terrorism.”

Minister for Defence, Linda Reynolds and Philippine Secretary of National Defense, Delfin Lorenzana announced the transition in the margins of the ADMM-Plus in Bangkok, Thailand on 17 November 2019.
THE WARFIGHTERS’ CHOICE
for Australia and its Key Allies

- Trusted, multi-role and ready
- Supported by a world-class Australian Industry team
- Backed by over 6 million Predator RPAS flight hours

Project Air 7003

©2019 GENERAL ATOMICS AERONAUTICAL SYSTEMS, INC.

ga-asi.com
The combat system for Aegis Ashore Japan will be compatible with the country’s current Aegis naval fleet for full interoperability. As the threat environment evolves, Aegis Ashore Japan will be updated from the same Common Source Library (CSL) of software updates that all Aegis assets utilize.

The Aegis Weapon System is the most deployed combat system in the world, and its flexible system architecture enables it to fulfill a variety of missions. Its unique open architecture allows the system to maintain interoperability across global domains on 118 ships, 10 ship classes and seven countries to protect warfighters.

JAPAN PROTECTED WITH SPY-7, LOCKHEED MARTIN’S LATEST GENERATION RADAR TECHNOLOGY THAT DEFENDS AGAINST BALLISTIC MISSILE THREATS
– MOORESTOWN, N.J., 20 November 2019 –

Lockheed Martin and its trading partner in Japan recently contracted with the Japanese Ministry of Defense to produce two Solid State Radar (SSR) antenna sets for Aegis Ashore Japan. Recently designated by the U.S. Government as AN/SPY-7(V)1, this technology is derived from current radar programs and significant Lockheed Martin investment. Variants of the SPY-7 radar will also be utilized through partnerships with the U.S. Government, Spain and Canada.

To date, the technology has been selected for a total of 24 systems.

Equipped with the latest digital, solid-state radar technology, Aegis Ashore Japan will integrate the SPY-7 radar with the Aegis Combat System and protect Japan with a robust system that:

• Can detect, track and engage sophisticated ballistic missile threats;
• Provides several times the detection range and sensitivity of traditional SPY-1 Aegis Ashore systems; and
• Engages multiple targets simultaneously with proven interceptors.

In defense against ballistic missile threats, Aegis Ashore and SPY-7 will provide continuous protection of Japan. As the threat landscape evolves, Aegis Ashore will protect the country and its citizens.

Lockheed Martin is leveraging programs of record for Aegis Ashore Japan and utilizing the existing supply chain that already supports multiple solid-state radar programs.

The combat system for Aegis Ashore Japan will be compatible with the country’s current Aegis naval fleet for full interoperability. As the threat environment evolves, Aegis Ashore Japan will be updated from the same Common Source Library (CSL) of software updates that all Aegis assets utilize.

The Aegis Weapon System is the most deployed combat system in the world, and its flexible system architecture enables it to fulfill a variety of missions. Its unique open architecture allows the system to maintain interoperability across global domains on 118 ships, 10 ship classes and seven countries to protect warfighters.

GENERAL NEWS

GENERAL DYNAMICS ELECTRIC BOAT AWARDED $22.2 BILLION BY U.S. NAVY FOR FIFTH BLOCK OF VIRGINIA-CLASS SUBMARINES
– GROTON, Conn., 2 December 2019 –

On December 2, the U.S. Navy awarded General Dynamics Electric Boat a contract valued at $22.2 billion for the construction of 9 new Virginia-class submarines. The contract also includes the option of a tenth ship to be constructed within the contract time frame, bringing the total potential contract value to approximately $24.1 billion. Electric Boat is a wholly owned subsidiary of General Dynamics.

The multi-year ‘Block V’ contract enables Electric Boat as prime contractor, along with its teammate, Newport News Shipbuilding, to deliver Virginia-class fast-attack submarines with advanced capabilities and expanded capacity to the Navy. Construction on Block V ships will begin this year, with deliveries scheduled from 2025 through 2029.

“Ths contract allows for our shipbuilding team, our suppliers and our employees to plan ahead so that we can continue to deliver submarines of unmatched quality, stealth and lethality,” said Kevin M. Graney, President, General Dynamics Electric Boat. “Increasing the cadence of our production from one per year to two, coupled with the start of full production of the Columbia-class ballistic missile submarine, represents a generational increase in submarine production for our nation.”

“We are prepared to meet the challenge,” said Graney.

Ships of the Virginia class exemplify the commitment by the Navy and industry to reduce costs through a multi-year procurement strategy, continuous improvements in construction practices and cost-reduction design changes.

Over the life of the Virginia program, shipbuilders have driven delivery timelines from 88 months in Block I to a current average rate of 68 months, while doubling the build rate of submarines to two ships per year and consistently increasing ship capability.

Eight of the ships produced for Block V will include the Virginia Payload Module (VPM), which Electric Boat will build at a recently-constructed facility at Quonset Point, Rhode Island. The VPM will comprise four additional large-diameter payload tubes located amidships, increasing the fixed strike capacity of the ship by more than 230 percent. VPM, which was designed by Electric Boat, will enable enhanced use of Special Operating Forces and allow the Navy to bring aboard additional weapons, sensors and other special payloads.

Electric Boat and Newport News Shipbuilding already have delivered 18 Virginia-class submarines to the Navy and all 10 Block IV submarines are currently under construction. Virginia-class submarines displace 7,800 tons, with a hull length of 377 feet and a diameter of 34 feet. With VPM, the submarines will displace 10,200 tons and have a length of 460 feet. They are capable of speeds in excess of 25 knots and can dive to a depth greater than 800 feet, while carrying Mark 48 advanced capability torpedoes, Tomahawk land-attack missiles and unmanned underwater vehicles.
Helping customers to see things differently.

Through smart technology, Leidos is creating robust and modernised environments for Defence, enabling the flexibility they require to greater support the warfighter.

Contact Us at: Leidos-Australia-Communications@leidos.com
NORTHROP GRUMMAN, MBDA AND SAAB DEMONSTRATE THE INTEGRATION OF DISPARATE MISSILE AND RADAR SYSTEMS INTO INTEGRATED AIR AND MISSILE DEFENSE BATTLE MANAGER

– HUNTSVILLE, Ala., 26 November 2019 –

Northrop Grumman Corporation, MBDA and Saab have successfully completed a joint, collaborative effort to demonstrate the ability to integrate MBDA’s Common Anti-air Modular Missile (CAMM) family and Saab’s Giraffe radar system family into Northrop Grumman’s Integrated Air and Missile Defense (IAMD) Battle Command System (IBCS). CAMM was the first non-U.S. missile system to be demonstrated with IBCS earlier this year, and Giraffe represents the first non-U.S. sensor system to be demonstrated.

The three companies demonstrated rapid and functional integration during simulated threat scenarios that included simultaneous engagements. Simulated air targets were fed to the Giraffe radar emulator, which passed the radar information to IBCS to assess and track threats. IBCS operators planned and executed optimized engagements based on that data using the CAMM missile emulators which engaged multiple threats simultaneously. IBCS then closed the loop by displaying the outgoing missiles detected and reported by the Giraffe emulators. The event successfully demonstrated both Distributed Fire Direction and Advanced Integrated Fire Control engagements.

“Building on lessons learned from the CAMM family integration, we were able to integrate the Giraffe radar onto the IBCS network even more rapidly and cost effectively, continuing to demonstrate the dynamic and flexible nature of IBCS’s open architecture in adding capabilities when and as needed,” said Bill Lamb, director, international battle management, Northrop Grumman. “Together we are creating a revolutionary IAMD enterprise that maximizes the combat potential of all sensors and weapons across all domains and fills gaps in today’s air defense capabilities.”

MBDA’s CAMM family is the next generation of air defense missiles for multi-domain applications. Designed to defeat the most challenging of modern and future threats, including saturation attacks by precision-guided munitions and maneuvering high-speed missiles attacking simultaneously from multiple directions, the CAMM family of missiles feature a solid-state active radar seeker, two way data-link, low-signature rocket motor and a 360° soft-vertical launch system.

“This represents the latest successful demonstration of the flexibility of the CAMM family, which has been designed from the ground up to operate within a modern network-centric open IAMD architecture. In this event we were able to demonstrate multiple simultaneous engagements of a full range of contemporary threats, using targeting information from networked surveillance sensors,” said Ben Newland, ground based air defence programme head, MBDA.

Saab’s Giraffe AMB radar delivers key capabilities as part of short- and medium-range surveillance and Ground Based Air Defence. It integrates powerful 3D surveillance radar and C3 functionality in one and the same system and provides forces with swift understanding of the air situation, enabling immediate and effective response to changing threats, new tactics and shifting operational conditions.

“We are delighted to see this demonstration of integration of the Giraffe radar onto the IBCS network, contributing both directly to the demonstrated “sense-assess-engage” chain and to the wider Integration Air and Missile Defense with the level of interoperability delivered by IBCS,” said Lars Tossman, vice president and head of Saab business unit Radar Solutions.

IBCS creates a paradigm shift for IAMD by replacing legacy stove-piped systems with a next-generation, net-centric approach to better address the evolving complex threat. The system integrates disparate radars and weapons to construct a far more effective IAMD enterprise. IBCS delivers a single integrated air picture with unprecedented accuracy and broadens surveillance and protection areas. With its open systems architecture, IBCS allows incorporation of current and future sensors and effectors and interoperability with joint C2 and the ballistic missile defense system.

IBCS is managed by the U.S. Army Program Executive Office for Missiles and Space, Redstone Arsenal, Alabama.

With more than 90 armed forces customers worldwide, MBDA is a world leader in missiles and missile systems. In total, the group offers a range of 45 missile systems and countermeasures products already in operational service and more than 15 others currently in development. MBDA is jointly owned by Airbus (37.5%), BAE Systems (37.5%), and Leonardo (25%).

Saab serves the global market with world-leading products, services and solutions within military defence and civil security. Saab has operations and employees on all continents around the world. Through innovative, collaborative and pragmatic thinking, Saab develops, adopts and improves new technology to meet customers’ changing needs. Learn more at www.saab.com.

Northrop Grumman is a leading global security company providing innovative systems, products and solutions in autonomous systems, cyber, C4ISR, space, strike, and logistics and modernization to customers worldwide.
Providing mission focused Defence solutions for over 40 years, Hawker Pacific is ready to deliver the Special Operations Helicopter to protect Australians at home and abroad.

Rapidly reconfigurable for the specific mission and deployed via C-17 transport within hours, operational readiness is assured using commercial off the shelf aircraft optimised for today’s battlefields and hostile urban environments.

With Bell Helicopter’s leading performance and reliability combined with Hawker Pacific’s local expertise and through life support capabilities, our world-class team provides a highly effective Special Operations Helicopter solution.

Learn more about the program hawkerpacific.com/SOH
What is going on?

Sometimes it is difficult to figure out the logic of Department of Defence processes – and the case of LAND 4503 is one of those. This is because dissatisfaction with the existing fleet of 22 Tiger Armed Reconnaissance Helicopters (ARH) because of poor availability and high cost peaked about five years ago and sources within the Army Aviation community have been saying for more than 12 months that they are satisfied with the capability. But back then the discontent fed into the 2016 Defence White Paper, which called for the replacement of the ARH fleet.

Not long after that, the performance of Tiger started to steadily improve because of a concerted effort on the part of prime contractor Airbus Helicopter, CASG and the Army aviation community. Indeed, it was only 18 months ago that the Army unofficially warned off potential competitors to Tiger, telling them that they were wasting their time and money if they continued their marketing campaigns.

But things have obviously changed – again. The Request for Information issued to industry seeks to acquire up to 29 helicopters, with 12 to be delivered by 2026 and the balance two years later. Apparently, Army are after a proven capability and that seems to limit the possibilities to a Boeing AH-64E Apache, Bell AH-1Z Viper – or upgraded Tiger, the option of which has definitely not been ruled out. A dark horse might be Leonardo with the AW249 attack helicopter under development for the Italian Army.

There are four users of Tigers: France, Germany, Spain and Australia. The first three nations are satisfied with the helicopters – and all of them plan to upgrade theirs to what is known as the Mk 3 configuration. In trying to figure out what the Australians are now up to, it is instructive speaking with another Tiger user.
FRENCH ARMY: 1ST COMBAT HELICOPTER REGIMENT (1 RHC)

Located at the Quartier La Horie Army base, near Strasbourg on the German border, Tiger helicopters of this unit have been in continuous combat operations for the past 10 years. The first mission was a deployment to Afghanistan that started in mid-2009, followed by Libya in 2011, the Central African Republic 2014 - 2016 – and since 2013 in Mali, where the helicopters have been engaged in a complex and protracted conflict that shows no sign of ending. Tragically, after the visit the news came through that on November 26 a mid-air collision between a Tiger and a troop-carrying Cougar killed 13 service personnel during a night time combat operation close to the ground – always the most dangerous of circumstances.

Hearing about the performance of a platform from a manufacturer is always interesting and worthwhile – but it is only the operators who are truly in a position to comment on its effectiveness. The verdict from all of the French Army personnel we spoke to was emphatic: an excellent machine – heavily armed, powerful, very reliable and sure to remain in service for decades to come.

There were few restrictions on our interactions on base: there was a formal detailed briefing about the Mali operation in particular and also many opportunities for informal and spontaneous conversations – including during lunch when the unit commander (security considerations unfortunately mean they cannot be thanked by name) rounded up as many English-speaking soldiers as were available and all were as open and helpful with information as they could possibly be.

FLOWN BY SOLDIERS, FOR SOLDIERS

To start with a non-technical overview: each Tiger has a commander, who operates the weapons, and a pilot. However, first and foremost they consider themselves to be regular infantry, taking to the air not in a flying suit but in full ground combat kit - including FAMAS assault rifle, with at least three additional magazines of ammunition, a side arm, a variety of grenades, body armour and a helmet. As one commander put it to us: “we are combat infantry who just happen to spend 2% of our time flying helicopters.”

This point was made repeatedly: not that the Tigers are somehow separate from the rest of the Army – on the contrary, they are an integral part of ground operations and personnel fully understand and appreciate the tactical environment in which their colleagues are operating. Asked if a particular gunner had used his rifle while on the ground in Mali, the answer was an emphatic “yes”.

In addition, a “can do” mentality was very much apparent. Gunners and commanders are regularly involved in many aspects of supporting their helicopters in the field, pitching in to refuel and re-arm them, and helping mechanics with more complex operations such as replacing blades or repairing engines.

DEPLOYMENT IN MALI

Perhaps because of this attitude, two Tigers in the most remote locations (they are always deployed in pairs as a minimum) – and we mean really remote – can be kept operational fairly much indefinitely by a team of only 5 mechanics. This must seem strange to Australian ears, which have heard a lot negative comments about the difficulty supporting our Tigers – but the evidence of how reliable they are can be gained simply by speaking directly with the French Army. Having said that, when helicopters are deployed in combat, they receive priority for spare parts and people in the field are available to work on the aircraft 24/7 and in all but the most awful of weather conditions.

Speaking of awful, that summarises the operational environment: hot; extremely dusty; enormous distances; rapidly changing weather – and the constant threat for several months a year of huge sand storms that can develop in less than one hour. No one has ever flown a helicopter into one of these monsters because they are so violent they would lead to the destruction of anything trying to pass through them. While the main French base is at Gao, in a desolate area near the borders of Niger and Burkina Faso, the Tigers are often deployed some distance away with machines in the field for several days at a time covered in tarpaulins when not flying, which often also double up as shelter for the soldiers.

AMBUSH

Many of the combat missions are also high intensity. One of the commanders described a helicopter’s worst nightmare: a planned ambush with sudden fire coming from multiple ground sources. In this case, two Tigers were sent to evaluate the aftermath of a heavy clash the previous day between ground units and an estimated 120 fundamentalist insurgents, who had taken an unknown number of casualties.

What the Tiger crews did not know was that the insurgents left behind their numerous wounded, but patched up with tourniquets and injected with painkillers, lying in wait for the helicopters they knew would come back for a closer look. They were in two groups, each armed with three or four ex-Russian PKM 7.62 millimetre heavy machineguns and rocket propelled grenades. They opened fire simultaneously and the commander describing the operation said his machine was hit 15 times and also received damage from an RPG warhead that exploded 30 metres away as it reached the end of its 600 metre trajectory.

Some precise details about tactics are classified, but both Tigers were able to return fire with their 30mm cannon and quickly suppress the enemy, killing all of the insurgents. Both helicopters returned safely and were able to be quickly repaired and returned to service. The second helicopter received a similar amount of battle damage.

While this incident is the only known attempted ambush of this scale, the Tigers are involved in combat operations around once a week. The majority of missions are during the day – unless they are working with French commandoes and other Special Forces units, who prefer the cover of darkness.

The pilots and commanders were extremely complimentary about the Tiger’s sensors, in particular the ‘Top Owl’ helmet from Thales, that has day/night all weather capability. According to them, this high technology marvel is equalled only by the F-35 helmet – and is far superior to that used on any other attack helicopter.

EXPERIENCE WITH APACHE

Turning to the topic of other helicopters, the French have had many opportunities to work with Apaches, especially in Afghanistan and during the Libya operation where Tigers worked closely with British AH-64Es. At any one time, 2 Tigers were based on board a French Mistral class amphibious support ship, with the nearby British having 5 Apaches during the same period on an equivalent vessel.

The first thing to be said is that the French were not at all critical of Apache, but noted important differences in the design and purpose of it compared with Tiger. They observed several things: the Tigers were far more reliable: of the 44 strike missions assigned to Apaches, 50% were cancelled, while the Tiger mission availability rate (which is not quite the same as overall availability) was 100%.

During combat missions – which spanned 5 months of deployment at sea – the Apaches fired a total of 4,100 rounds, destroying 107 targets, while the Tigers fired 13,500 rounds, destroying in
excess of 200 targets. This information could not be independently verified and was not ultimately from Government sources.

However, assuming that the figures are reasonably accurate, the French had an explanation for the combat statistics – namely that the Apaches were flown more like fixed wing aircraft engaging targets from a distance, whereas the Tigers were flown “very tactically” using nap of the earth high speed approaches to get as close as safely possible to targets. Also the 30mm gun of the Tiger is more accurate than that of the Apache – and this has been independently corroborated by a number of sources. The difference in accuracy becomes even greater when the gun is fired at 90 degrees to the platform – the preferred tactic of the French because it enables the Tiger to fly in a circle around the target keeping it under constant fire from different directions.

**MARITIME DEPLOYMENTS**

Regarding maritime operations, the French Army reported no particular issues with Tigers operating from Mistral class amphibious support ships, slightly smaller in size than our LHDs. They were washed down every 10 hours and required no special maintenance or equipment. Back on land they were all given minor inspections, with no corrosion reported. Even though the blades of the helicopter do not fold, they could nevertheless be housed below decks. Precise information on the time spent at sea was not available, but apparently maritime deployments are taking place almost constantly and would number in the “thousands of hours.”

The French Army provided many more details, which will be included in future articles.

**AIRBUS HELICOPTER AND THE TIGER MK 3 UPGRADE**

Asked about improvements to the availability of the Australian Army’s Tigers, the company replied that they are very proud of the performance improvements that continue to be achieved by Defence. While specific performance metrics are best provided by Defence, as a general comment it is normal that serviceability varies throughout the year depending on Operator needs. In recent months, serviceability levels have been in excess of 75% with 1 Aviation Regiment achieving 65%. This delivers the required Rate of Effort, allowing the Aviation Capability to meet their commitments to Army. During the recent live firing exercise “Griffin Guns”, serviceability was over 80%, and the Tiger Reliability and Maintainability (RAM) programme has delivered a 40% performance improvement over a 2.5-year period. The Maintenance Burden has reduced to an average of 13 hours per Command hour with Sortie Success averaging 93%. These sorts of figures for a highly complex combat helicopter set a world benchmark, and Airbus say they are proud to be part of that and are committed to continuous improvement.

In addition, Airbus say that the cost per flying hour has reduced significantly since 2015, benefiting from a fundamental change to the contract structure that means that direct maintenance costs are only paid to Airbus on a per flying hour basis (Power By the Hour – PBH model). The recent agreement of a five-year TLS extension from 2021 - 2025 has provided Defence with further efficiencies across the period. Airbus say they will continue to provide a full spectrum of TLS activities that include engineering and technical support, training, OM and DM maintenance and planning, supply chain as well as aircraft software development. This represents a much broader range of support services than are usually included within Defence’s cost per flying hour comparisons. The agreement of a 5 year support contract indicates the support meets the Commonwealth’s Value for Money expectations.

Turning to improvements and upgrades, Airbus is planning to continue enhancing ARH Tiger capability, specifically focusing on coalition force and wider ADF interoperability. These elements include connectivity by installing data and video links that better connect the aircraft to the Land, Air and Maritime domains. Leveraging from our experience and successful tests on these connectivity enhancements, the ARH Tiger will benefit from low risk upgrades that will provide a low cost force multiplier. Importantly the selection of these specific links are aligned with Defence systems, and there is no risk of creating bespoke networks.

As an example, integration of the already existing BMS TORC2H functionality (today known as ARH Tiger’s interim Tactical Data Link (iTDL) solution) will further increase situational awareness for Tiger operators and significantly simplify the usability of the system through enhanced HMI. Integrated full motion video allows Manned-Unmanned Teaming (MUMT) operations, providing ARH Tiger with a versatile operational capability to interoperate with a multitude of sensors on the battlefield. Including these capabilities, the Enhanced Tiger will not only increase its natural C2 element within Army Aviation’s Common Mission Management System (CMMS), but also be operationally capable to take on the role as an advanced C4ISR asset for the ADF.

In the near term, the modifications discussed above, plus improvements to the sighting systems and progressively keeping the electronic warfare system contemporary, will deliver a low risk, low cost Tiger that will take the fleet beyond 2040. The European upgrade plans will present additional opportunities to look at pre-tested, proven upgrades, according to Army’s needs. This is extremely positive, both from a supportability point of view, and keeping the Tiger as a leading combat capability as the Army reviews its plans for Next Generation Rotorcraft that will eventually replace the ARH.

**BOEING AH-64E APACHE**

Boeing has confirmed that it is offering the Apache Attack Reconnaissance Helicopter, model AH-64E Version 6 for the Armed Helicopter Replacement. As a proven military-off-the-shelf solution Boeing’s AH-64E Apache offers the Australian Army the greatest capability combined with the lowest risk and highest certainty of cost, schedule and upgrades.

Apaches have been in service for more than 30 years. The first version of the Apache entered production in 1982 for the US Army. The US Army accepted first delivery in 1986 and adopted a spiral development program, still underway today, which integrates new technology into the Apache to ensure it remains the world’s leading attack reconnaissance helicopter. Since the first AH-64A was delivered, more than 2400 Apaches have been produced.
The US Army Apaches have achieved more than 4.5 million flight hours and 1.2 million combat flight hours.

In 1990, the US Defense Acquisition Board approved the development of the advanced AH-64D Apache LONGBOW which was delivered seven years later. The next spiral development phase in 2010 introduced the AH-64E V1 Model, followed by the AH-64E V4 in 2013. The current US Army fleet of more than 750 Apaches has an operational availability rate of 85%.

The latest version, AH-64E Version 6, which is being offered for LAND 4503, is currently being produced and inducted into US Army fielding. The US Army’s commitment to enhancing and integrating new technologies into the Apaches has delivered the matchless combination of a mature and combat proven capability with the very latest technology for today’s battlefield.

Boeing says the Apache offers the Australian Defence Force the certainty that comes with joining the largest fleet of attack reconnaissance helicopters employed worldwide. Put simply, the Apache is the most tested, most flown and most combat-proven of currently available armed reconnaissance helicopters.

One of the reasons it is flown by 16 countries around the world is because its integrated weapons, sensors and mission systems make it an intuitive and easy to use advanced multi-role platform.

It is the only attack helicopter that features a mast-mounted, 360 degree Fire Control Radar and Radio Frequency Interferometer which provides an integrated surveillance and targeting system. This integrated system automatically detects/classifies/prioritizes multiple targets and cues weapons; all targeting information is shared digitally with teammates.

The Apache is the only platform with proven integrated manned-unmanned teaming (MUMT), which extends range sensing and target acquisition, increases situational awareness while out of contact and decreases engagement timelines. The MUMT configuration features:

• A two-way, high bandwidth link between the Apache and UAS
• Full integration into Apache’s existing display and controls for ease of use by operators
• Video and data streaming (Level of Interoperability 2).

The Apache also offers flexible weapons payloads for differing ranges of attack including:

• Up to 16 HELLFIRE missiles, up to 76 Folding Fin Aerial Rockets, up to 4 wingtip mounted air-to-air missiles and a M230 30mm Chain Gun with a 1200 round capacity
• Depending on mission requirements, the weapons payload can be replaced with additional fuel held in crashworthy external fuel tanks.

The US Army has committed to operating Apaches until at least 2060 and the production line will be operational until 2028 to fulfil existing orders.

The US Army’s Apache Modernisation Program, which will continue until the late 2040s, includes improvements to aircraft performance, interoperability, weapons, sensors and aircraft survivability. Each operator country, including Australia if the Apaches are selected, is part of Team Apache where they have the opportunity to collaborate with the US Army and other international operators to help guide future modernisation efforts.

According to the company, the AH-64E is the only platform that meets all of the currently stated ADF needs without the need for modification to add additional capability, for example it is the only platform amongst the LAND 4503 contenders that features proven Link 16 capability for integration with air battle management and to send and receive target information.

The communication subsystem provides a proven combined arms capability by using state-of-the-art radios, an Improved Data Modem (IDM), and integrated crew station and intercommunications equipment.

Additional data links include Variable Message Format (VMF) for integration with land forces battle management and joint fires systems; Air Force Application Program Development (AFAPD) to share data with wingmen, other Apaches or AFAPD-enable air assets and Blue Force Tracker 2 (BFT-2) for coalition situational awareness.

Turning to deployment on LHDs, Boeing says the AH-64E Apache is highly capable of embarked operations and has been doing so for many years. US Army Apaches in Pacific Command have operated effectively in a maritime environment and embarked on naval platforms.

The British Army’s Apache Mk1 or WAH-64 fleet, which are modified D model Apaches, serve aboard Royal Navy ships, in addition to their land-based role. The future UK AH-64E Apaches will continue to operate embarked on Royal Navy ships and further enhance this capability for UK operations.

Boeing can provide options for different levels of marinisation with production line or post-production coatings. The Apache can also be effectively managed to conduct embarked operations in accordance with the Australian Army’s amphibious concept of operations through enhanced maintenance procedures.

Regarding Australian Industry content, Boeing says that as part of the Request for Information response, they suggested using the available lead time to refine the initial scope of Foreign Military Sale and Direct Commercial Sale work share and work towards the identification of sovereign capabilities for sustainment and training prior to first aircraft arrival.

To get ready for this, Boeing say they are proactively engaging Australian industry partners to get a comprehensive understanding of their capabilities and build a solution that is responsive and seeks to keep as much service delivery in country as possible.

To that end, they have created the Boeing Rotorcraft Network – Australia (BRN-A). This network will bring together the best of Australian industry so as to maximize the amount of rotary wing through-life support that is delivered in Australia, across Boeing Defence Australia’s rotorcraft programs including the Chinook Integrated Support Services contract and the Helicopter Aircrew Training System.

In 2020, the company is planning a supplier briefing roadshow to visit a number of key locations throughout Australia. It is their intention to engage with suppliers on all of their rotorcraft programs and learn as much as possible about what can be delivered here in Australia, to help foster sovereign rotorcraft capabilities and maximize the Australian Industry Capability as part of the ARH program.

The company has launched an ICN Gateway page to ask all of industry to make their capabilities known to Boeing and assist in uncovering the hidden gems out there in industry where they may not have already engaged. BRN-A will be a select network of Australian industry partners that will evolve with the changing needs of Boeing’s customer group.

By using ICN as a single point of entry and by gripping up Boeing’s rotorcraft programs, the company hopes to simplify the outreach and reduce the burden on SMEs while increasing their visibility to opportunities across the Boeing organisation.

**BELL AH-1Z**

Bell says that they and their partner BAE Systems Australia have responded to the LAND 4503 Price and Availability and the LAND 4503 RFI, by proposing an FMS or FMS/DCS acquisition of the Bell AH-1Z Viper. First delivered to the United States Marine Corps in 2006, the AH-1Z Viper is combat proven having served with the United States Marine Corps in Afghanistan and Iraq. The company says this aircraft is the only truly marinized attack helicopter in the world with benefits that include an unequalled ability to support the Australian Army land battle and
wider ADF expeditionary and amphibious operations anywhere and at any time.

According to Bell, the AH-1Z Viper will deliver unmatched multi-mission flexibility, through all land, sea and air environments, making it the ultimate armed reconnaissance helicopter for security, reconnaissance and attack missions. The AH-1Z Viper is off the shelf, ready to deploy for expeditionary operations afloat or ashore, requires no expensive and unproven modifications, and can seamlessly integrate with all ADF Army, RAAF, RAN, and SOF assets, as well as those of the US Army, US Air Force, US Navy, and US Marine Corps.

Bell believes the AH-1Z Viper is the only platform that offers increased capability, increased safety, decreased costs, and decreased risk. The Viper is the only platform that not only meets all the requirements specified in LAND 4503, it exceeds them. It offers increased safety because it was specifically built for long distance overwater flight and for operation in an expeditionary and/or shipboard environment. The Viper offers the lowest acquisition costs and total life cycle costs, thus saving money for the taxpayer. According to the company, the current cost per flight hour for the Viper, calculated for combined afloat and ashore operations is approximately US $4,000. Apparently the nearest US competitor is running in excess of US$5,200, and this is calculated only ashore as the US does not operate it on board ships because it is not designed for shipboard operations.

The Viper’s ability to conduct simultaneous air-to-air and air-to-ground on the same sortie, means Viper can also carry ACMG pods on the wingtip stations. This will allow Army aviation to seamlessly integrate into the ADF’s collective training and test environment capability.

Bell states that because it is purpose built for expeditionary and maritime operations, it is seamlessly interoperable with all Australian Army, RAAF, and RAN operations. This includes operations of allied Armies, Air Forces, and Navies. This means the AH-1Z Viper can seamlessly transition from operations ashore to operations afloat without any degradation in capabilities. It can seamlessly move between land and sea operations without the need for costly, unproven and unequalled upgrades that can pose a safety risk when operating at sea.

In both combat and training operations with the USMC, the AH-1Z Viper has proven its capability to operate with ground units and air elements from other services of the United States military and its coalition partners. More recently, the USMC has had success integrating the AH-1Z Vipers with their F-35Bs in various training scenarios and shared targeting data for target acquisition and engagement. In addition, the USMC upgrade roadmap for the AH-1Z Viper will include Link-16 for the Australian fleet.

On maritime deployments, Bell says the AH-1Z is the world’s only advanced attack helicopter specifically designed for extended operations in a maritime environment or at sea. According to the US Navy, corrosion is one of the biggest challenges service members face daily. Corrosion reduces the size and strength of the structure with particularly deadly consequences. It is estimated that approximately 30% of aircraft maintenance costs are due to corrosion. If one looks around Asia Pacific, most countries are surrounded by sea and know the damage that operating in a maritime environment and especially salt can do an aircraft.

As the only marinized attack helicopter in the world, the Viper gives militaries an advantage when it comes to resistance to corrosion, which will enable better usage rates and lower maintenance cost over the life of the platform.

Again, marinization is more than just corrosion protection against saltwater. Another aspect is space management as space is limited on a ship. For example, the AH-1Z comes with foldable blades and its maintenance footprint is designed to be small, with no additional structures needed to do most of the sustainment work on a ship. At the recent Exercise Talisman Sabre 2019, the AH-1Z Viper was able to seamlessly integrate with the Australian LHD amphibious assault ships as demonstrated by the USMC.

In 2016, Bell chose BAE Systems Australia to support the AH-1Z Viper in Australian service. If Australia chooses the Viper, Bell will build the aircraft and work with BAE Systems in bringing them into service under the Foreign Military Sales contract, with BAE Systems providing ongoing sustainment and training. Bell, together with BAE Systems, represents a formidable consortium that can deliver and support a trusted in-service platform. BAE Systems brings more than 25 years’ experience sustaining ADF helicopters including Black Hawk, Seahawk and Chinook and has proven capability in increasing aircraft availability.

Leonardo’s credential in manufacturing marinised airframes is well known and we are proud of our maritime heritage. We are experienced in producing wet-sealed, fully-marinised airframes and so the maritime environment presents no challenge to our products.

Leonardo is assembling a “best-of-class” in Australian industry to support our product through life in Australia. We are committed to actively develop cost effective indigenous industry programmes and took a strategic decision some years ago to invest in the Australian Defence infrastructure through the provision of a Helicopter Transmission Repair and Overhaul facility in Australia. This investment, unique to the Southern hemisphere, will provide the ADF with a much needed, strategic capability. We are building on that capability though the fusion of Australian companies in support of our helicopters and our manufacturing capabilities.

(Disclaimer: the author travelled to Europe as a guest of Airbus and would particularly like to thank Laurence Petiard & Courtney Woo)
“Simply the best products and capability delivered to the Australian warfighter by a truly Australian sovereign company.”

TRUSTED. PROVEN. AUSTRALIAN.

Robert Nioa
Managing Director - NIOA

www.nioa.com.au
LYNX V REDBACK: THE COMPETITION FOR INFANTRY FIGHTING VEHICLES STARTS TO TAKE SHAPE

The shortlisting decision for Army’s future Infantry Fighting Vehicles sets up a fascinating competition between one of the western world’s best known suppliers against another that has emerged from almost complete obscurity. Or to put it another way, it will be a choice between the best of what Germany’s established military industrial powerhouse Rheinmetall can offer, compared with what South Korea’s even larger and still growing Hanwha Defense has been developing in relative secrecy.

Both solutions are the most modern available. They are at the leading edge of technology, which is why they were shortlisted to supply 383 tracked IFVs in eight different configurations, plus a further possible 67 vehicles in another three variants – taking the potential order to 450. This is big business by anyone’s measure, with the acquisition contract expected to be in the $10 billion - $15 billion range.

SOUTH KOREA & HANWHA DEFENSE

In terms of technology, the Republic of Korea (RoK) sells itself. From the country’s high speed and affordable KTX rail service, to continuous internet coverage, fingerprint operated storage lockers, high quality consumer electronics and motor vehicles, world leading shipbuilding and the appeal of K-Pop, the country has come an enormous way since the complete devastation of the Korean War, which ended in a still unresolved stalemate in 1953. To this mix can be added a vibrant research sector made up of universities and various Government and private institutes focussed on the development of innovative technologies and cutting edge products.

The Hanwha conglomerate – with a current turnover in excess of $100 billion - started life in 1952 compared with Rheinmetall, which opened its doors in 1889. The defence technology part of the company emerged as a serious player in the 1970s and as a consequence of both organic growth and various takeovers is now the major supplier of thousands of high quality armoured vehicles to the RoK Army and has enjoyed considerable export success – especially for the K-9 tracked 155mm self propelled howitzer. Hanwha Defense – excuse the U.S. spelling – is now Korea’s largest military contractor. As management emphasised several times during the author’s visit, the company has never failed to meet a vehicle delivery deadline, either for a domestic or export customer.

REDBACK UNVEILED

As APDR reported from the event – something of a world exclusive - the Korean contender for LAND 400 Phase 3 was first shown to the public in the form of the country’s Prime Minister Lee Nak-yeon and senior military figures on October 15 in Seoul. The vehicle has been designed specifically to meet the Australian requirement and in January only existed inside some computers (previously one would have written on paper) – so to have built and tested a new generation IFV in less than 8 months is a remarkable achievement by any standard. Construction of the next two vehicles needed for the Australian Risk Mitigation Activity (RMA) phase is on schedule.

The Redback has a combat weight of 42 tonnes and can carry up to eight fully equipped soldiers and is operated by a crew of three – a commander, driver and gunner. For the Australian requirement, the manned turret with a 30mm ATK cannon will be supplied by Canberra-based EOS, which is modifying an Israeli design from Elbit. Powered by an MTU eight cylinder diesel engine, it has a range of 520km and a top speed in excess of 65kmh – which gives it plenty of growth potential. The vehicle uses the same automatic transmission from Allison that is found in the Army’s M1A1 Abrams main battle tanks.

An interesting feature of the Redback is the use of rubber tracks. These have several advantages over the more usual metal variety. Firstly, weight saving: they are about 1.5 tonnes lighter per vehicle than traditional tracks. Secondly, they give a much smoother ride, with Hanwha claiming a 70% reduction in internal vibration and shock when being driven across rough surfaces – which significantly reduces fatigue for the soldiers and crew on board. The dampening effect also should logically benefit the vehicle itself, with components less likely to shake themselves loose. Thirdly, they make far less noise than metal links.
APDR had the chance to witness the performance of the first Redback roaring around Hanwha’s test track co-located with the production facility in the southern city of Changwon. Compared with other vehicles using metal tracks with their distinctive clattering sound, it was noticeably quieter – though to be fair the dominant sound was still that of the diesel engine. The company says that the rubber tracks have a lifetime of 6,000 hours – though that also depends on the terrain and the way that they are driven. Fitting and removing them is relatively straightforward with a company engineer explaining that they have a type of tongue and groove locking mechanism that also tensions them. They are quite robust – and it is worth noting that they are becoming increasingly prevalent on heavy earthmoving equipment such as bulldozers.

While details of blast protection are classified, the vehicle is obviously heavily protected, particularly in the frontal arc. This is a key requirement for Australia, with the project office confirming for the record that the priorities are:

- Protection
- Lethality
- Mobility
- Knowledge/Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR)
- Sustainability
- Suitability

The company’s local subsidiary Hanwha Defense Australia is growing rapidly. Headquartered in Melbourne, it currently has a dozen people and will triple in size to support the RMA, the vehicle testing phase of which is scheduled to begin in October 2020. The staff is made up of some familiar faces, many with military backgrounds and extensive experience in armoured vehicle programs and Defence contracting.

An intriguing prospect is that, if chosen for LAND 400 Phase 3, the Redback factory – which will be located in Geelong – could become the world production centre for these new generation IFVs. This is because Australia will almost certainly be the lead customer, with South Korea not far behind. The RoK Army will acquire more than 1,000 new IFVs and it seems highly likely that they will buy a version of the Redback with a heavier 40mm automatic cannon.

While many countries have a preference for local construction, or at least assembly, this is not necessarily the case for those purchasing small numbers of vehicles. Even the RoK, which clearly has the capacity to build them at Changwon, might be attracted to the idea of a dual supply chain because in the event of serious hostilities the Hanwha factory would be on the receiving end of a few ballistic missiles.

**RHEINMETALL AND THE KF 41 LYNX**

In response to a number of questions in writing, Rheinmetall explained that the LYNX KF41, with the Lance digital turret, is the company’s answer to operating in the denied battlefield. It is a modular and adaptable infantry fighting vehicle (IFV), with significant growth margin, that allows the platform to be rapidly reconfigured. It can be configured for differing threat environments, from a low ground pressure IFV with armour for peacekeeping operations through to an agile, high protection armour configuration designed for conventional mounted combat operations against a battlefield peer.

Rheinmetall says that the same vehicle can be reconfigured for a counter-insurgency campaign where the enemy operates predominantly below the detection threshold, employing a highly sophisticated protection design, countering threats such as improvised explosive devices and explosively formed penetrators. This flexibility enables it to meet requirements set down for a number of IFV programs now the focus of global attention, including Australia’s Land 400 Phase 3 program – amongst other international customers currently seeking to find the best vehicles for their land forces.

The only guarantee in warfighting is the continuous evolution of technologies, tactics and threats – and Rheinmetall says that the only reasonable response for armoured fighting vehicle (AFV) designers is to develop platform adaptability with reserve payload, as well as the electrical and data growth to answer the challenges of the future battlefield when they arrive.

The company says that it has designed the LYNX with the highest levels of compliance against the requirements of today’s armed forces. Growth potential is not only secured by an open electronic architecture but also by what it regards as unmatched payload flexibility and large interior volume.

The concept and design of the LYNX has been derived from analysis of the challenges that mechanised infantry increasingly face in modern conflicts. During the vehicle’s development phase, the core requirement was the survivability of crew and vehicle.

As a result, the technological advances incorporated in the LYNX deliver what the company says is the most advanced Mounted Close Combat Capability available, providing the highest survivability under all combat conditions and maximum ability to respond quickly to changing combat situations.

**TRACK RECORD**

LYNX KF41 is the latest in a long line of successful Rheinmetall IFVs. Rheinmetall is the supplier of more than 2,100 MARDER IFVs, which entered into production in 1971. Considered a workhorse of the Germany Army, the MARDER has also been fielded by several other nations including Chile, Indonesia and Jordan.

Whilst the MARDER was successfully used in combat across several deployments, the German Army sought a successor to enable a generational capability change. Rheinmetall responded by delivering the PUMA IFV. This vehicle was fielded in 2015 and is now close to its first deployment with the NATO Very High Readiness Joint Task Force. More than 200 PUMA vehicles are now in service with the Bundeswehr.

PUMA was an early contender for LAND 400 Phase 3, but the consortium that produces it – a joint venture between Rheinmetall and Krauss-Maffei Wegmann – took the view that because it is only available with an uninhabited turret it was unlikely to find favour with the Australian Army, which currently has a preference for crewed systems.

Rheinmetall took the experience, knowledge and lessons of the MARDER and PUMA IFV programs –
combined with all the data from various other wheeled and tracked vehicle programs – to develop the LYNX for customers seeking a next-generation IFV. The company says that it combines the experience and the maturity of these programs with a more challenging set of requirements and is currently undergoing intense test and evaluation trials, building system level confidence on mature and qualified subsystem products.

**FIGHTING WITH THE LYNX IFV**

Rheinmetall says that its versatility enables the LYNX KF41 and its crew to gain and maintain the initiative and bring about a result in all close combat situations. It has been designed from the outset to support mechanised infantry by:

- The combination of firepower and movement;
- Swift changes between mounted and dismounted combat;
- Close co-operation between mounted and dismounted forces;
- Mobile and highly dynamic combat; and
- Operating in step with main battle tanks.

In particular, the rapid change of combat mode is a characteristic of mechanised infantry and modern IFVs. The company says that the LYNX is not intended to be a well-armed transport vehicle but a true tactical partner of the infantry section across all combat scenarios.

The vehicle combines the competing requirements of high strategic and tactical mobility on the one hand and maximum protection, firepower and growth on the other. Through modularity the vehicle achieves this in an optimum manner in one single high-performance weapon system, with the capability to react and remain flexible at any time, in any location and at any level of intensity.

The company says that their IFV provides tactical and operational dominance on the battlefield and offers convincing and significant growth potential for the decades ahead.

**MISSION SYSTEM OVERVIEW**

The LYNX KF41 is designed as a modular vehicle platform providing standardised interfaces and a kit-based building block approach. This opens up the opportunity to easily adapt, change, upgrade or reconfigure the platform in any way. All variants are based on a common drive system using the kit-based building block system approach.

The concept and design of the vehicle is derived out of core capabilities that have been specified by Rheinmetall and based on the assessment of modern warfare scenarios and customer requirements:

- High survivability;
- High tactical mobility and range comparable to main battle tanks during enemy action;
- Mounted and dismounted fighting capability;
- Capability to negotiate barriers and obstacles;
- High sustainability;
- Highly capable for mission appropriate enforcement;
- Rapid strategic and tactical transportability;
- Basic air defence capability;
- Capability for effective self-protection;
- Ability to demonstrate force; and
- Deployment worldwide in varied climate zones including extreme climatic conditions.

**MODULARITY AND CROSS-PLATFORM COMMONALITY**

The company says that the LYNX is a complete family of vehicles that utilises a common drive module and a flexible role kit arrangement to allow any drive module to be rapidly reconfigured within 8 hours. This system provides significant total life-cycle cost savings due to drive module commonality, allowing customers to adjust force structures or develop new capabilities in an affordable and timely manner.

Enhancing the vehicle’s flexibility, the sub-systems are highly modular and adaptable. The vehicle incorporates a digital backbone with a Generic Vehicle Architecture (GVA) that allows easy integration of new mission systems, while the entire survivability system is modular and upgradable to allow the vehicle to cope with the type of highly adaptive threats faced on the battlefield.

The needs of modern armed forces include a range of different operational scenarios, which require different configurations of armoured vehicles depending on:

- Adversary threat level
- Level of training;
- Mission purpose;
- Geographic and climatic conditions or;
- Political environment

The vehicle enables a force to react to changing situations in mission preparation or even during the mission. The desired configuration can be utilised and operated by the troops with flexibility, efficiency and effectiveness in terms of time and space. Rheinmetall says that it offers a degree of modularity that equals and extends that of the Australian Army’s BOXER Combat Reconnaissance Vehicle, which it is supplying under LAND 400 Phase 2.

To achieve the level of modularity in the platform, Rheinmetall has taken the following key modularity design principles into account:

- Interchangeability;
- Adaptability;
- Commonality;
- Growth;
- Affordability; and
- Life-cycle costs.

The concept intends to minimise the number of standard base vehicles and the desired roles are achieved by adding role-specific kits. The LYNX drive modules share common drive systems, the majority of components and sub-systems.

The role kits are interchangeable and allow vehicles to be reconfigured in a reasonable period. An example of this flexibility is that it allows a customer to completely reassign role kits across their fleets to meet specific threats without changing their fleet size or altering their maintenance schedules.

Rheinmetall says that role kits are derived and aligned from the mission module equipment of BOXER to guarantee highest levels of commonality for users worldwide. Therefore, wherever possible, common components and sub-systems are used. This reduces the logistics footprint, simplifies training and helps to reduce acquisition and life-cycle costs. The vehicle capabilities can be further adjusted to threat scenarios and mission targets with customer-specific kits.

(Disclaimer: the author travelled from Seoul to Changwon as a guest of Hanwha Defense. He would particularly like to thank the friendly and professional assistance of Mr Yoowon Park.)
AUSTRALIAN GROWN INDUSTRIAL CAPABILITY

35 years Australian led research and development

100% Australian owned intellectual property and technical design authority

$134m contributed to the local supply chain including $64m to Australian SMEs in 2019

SUPPORTING THE AUSTRALIAN ECONOMY AND ITS PEOPLE
NIGHT FIGHTING EQUIPMENT: RESEARCH AND TECHNOLOGY DEVELOPMENTS FOR THE ADF

As combat and combat support personnel in all three Services of the ADF are expected to be able to operate safely and effectively 24/7 in all areas of operation and variable weather conditions, the research and acquisition of night fighting equipment (NFE) is a continuing endeavour.

NFE typically can include such items as high-performance in-line sniper sights, 1500 metre thermal weapon sights, lightweight thermal binoculars with geo location, dual beam aiming lasers and AN/PVS-21 low profile night vision goggles (NVG).

When Defence was asked by APDR about any preference between binocular and monocular devices, a spokesperson replied "LAND 53 Phase 1BR is seeking to provide a wearer of NVG with stereopsis. Stereopsis can only be achieved via binocular NVG".

Stereopsis? The visual perception of depth, or the ability to see three-dimensionally.

One of the main challenges facing NFE researchers and industry developers is that there are clear limits to the size and weight of NFE, whether for sailors, soldiers or aircrew. Technology developments that improve clarity of displayed images cannot come at the expense of increased load for personnel using either goggles or helmet-mounted devices. For example, an air force fighter pilot’s helmet typically weighs around 2 Kg, but if they perform a 9G manoeuvre this briefly increases the helmet weight to 18 Kg.

NFE typically use three different ways of capturing and presenting images. These systems are image intensifier (I2), infrared (IR) and thermal imaging (TI). I2 systems can illuminate a soldier sized target at 100 metres in starlight, or 300 metres in moonlight, while larger size objects like vehicles can be seen at up to 500m in starlight or at greater ranges in moonlight.

In soldier systems, as in the LAND 125 Integrated Soldier System project, developments in networked radios now allow two-way sharing of images to enhance situational awareness and greatly improve targeting information. Also, LAND 53 Phase 1BR of Project Ninox is replacing helmet-mounted NFE and laser aiming devices, in two tranches. This project is on course to achieve Final Operating Capability in September 2023.

Of interest is the commencement of L3Harris Technology’s rollout of Enhanced Night Vision Goggle-Binocular (ENVG-B) systems to the US Army. Ultimately more than 10,000 systems will be delivered.

In Australia, we are fortunate to have the Defence and Science Technology Group (FST Group), who pursue fundamental research, which has potential to enhance ADF operations.

PROJECT LAND 53 PHASE 1BR – PROJECT NINOX

Defence advise that:

‘This project is replacing helmet-mounted night-vision equipment and laser-aiming devices that attach to specified Australian Defence Force weapons for dismounted combatants, including regular infantry, Special Forces and selected elements of the Navy and Air Force.

‘Tranche 1 is the replacement of existing night-fighting products to enhance dismounted night-fighting capabilities with leading-edge technology, including improved ergonomic performance and reduced weight. Following an open request for tender process, acquisition and support contracts for Tranche 1 were signed on 29 September 2016 with L3 Communications Oceania (now part of L3Harris).’

Deliveries of Tranche 1 night-fighting equipment have been made around Australia, starting in 2017,
and supported by L3Harris in their south east Queensland maintenance centre.

The strategy of implementing multiple tranches enables the continuous development of night vision technologies to be accommodated. In financial year 2020-21 Defence will seek Government funding for Tranche 2 which could include night-fighting technologies that might augment, supplement or enhance already delivered equipment.

The project remains on schedule to declare Final Materiel Release in March 2023 and Final Operating Capability in September 2023.

TECHNOLOGY DEVELOPMENTS IN NIGHT FIGHTING EQUIPMENT

In order to position current ADF NFE and where new technology developments are leading it is necessary to discuss the concept of generations. As might be expected this terminology is used to discuss transitions between different technologies. Australia, Canada and the US officially recognise generations to ensure standardisation of terminology and interoperability between equipment used by the three countries.

Generation ‘0’ describes the original equipment from World War II to the 1950s where infra-red converter tubes changed infra-red images into viewable visible light. Generation ‘1’ added an infra-red illuminator.

Generation ‘2’ was developed during the Vietnam war and uses different technology to achieve better images, with little or no distortion or noise, in starlight or a small amount of moonlight. Generation ‘3’ replaces the original infra-red detectors with more sensitive gallium arsenide ones, but there are variations in performance for different models. A Figure of Merit rating is applied to these devices to help selection. ‘Generation 3 Omnibus VII’ are currently considered amongst the best devices on the market.

Is there a Generation 4? Not really, only some technology changes to parts of night vision devices.

Auto-gating constantly operates to improve the quality of the image, not only during day-night-day transitions, but also under dynamic lighting conditions, such as military operations in urban terrain which define many of today’s missions.

Image fusion is a development of great value in NFE. In these devices the infra-red image is overlaid by thermal sensor output in colour.

The Photonis XD-4™ I2 tube has broad spectral sensitivity range which results in a better picture than earlier I2 tubes. New production technology of the XD-4™ resulted in improved performance of the signal-to-noise ratio, the modulation transfer function and resolution. The XD-4™ is also available with an auto-gating power supply unit.

The XR5™ I2 tube is claimed to reveal more details of the night and offers eXtended Range capabilities. The XR5™ also offers an integrated auto-gated power supply, facilitating operation under dynamic lighting conditions.

In October 2019 L3Harris Technologies delivered the first 40 combat-ready Enhanced Night Vision Goggle-Binocular (ENVG-B) systems to the US Army and expects initial fielding of the systems to be completed by early 2020. The ENVG-B is designed to meet the needs of the US Army’s Soldier Lethality Cross-Functional team.

The new systems are designed to provide improved situational awareness, mobility and protection to soldiers. The binocular night vision goggle features white phosphor image intensification technology in a dual-tube goggle to provide an improved capability to locate and engage threats.

It also includes a separate thermal channel to enable image fusion and thermal target detection.

L3Harris has incorporated a new high-resolution display and an embedded soldier wireless personal area network in the ENVG-B system. In addition, the advanced system is equipped with target acquisition and augmented reality algorithms to interface with the US Army’s Nett Warrior integrated dismounted leader Situational Awareness system. The complete system supports interfacing with the family of weapon sights operated by the army.

AUSTRALIA’S DST GROUP RESEARCH

Australia’s DST Group is at the forefront of night vision research, not merely on the devices themselves, but also the way in which military users can gain the most benefit from them.

One recently published report ‘Augmenting Reality to make the Unseen Seen’ included a focus on understanding what information is required by soldiers, how it can best be presented to optimise performance, and to identify other research questions.

This work utilised Cognitive Task Analysis to determine what information should be presented; Virtual Reality simulation-based studies to investigate the amount and type of navigation; and blue force tracking icons that should be presented to soldiers, and subsequent navigation and target acquisition field studies to understand the “real” impact of such systems and displays.

Another informative study was on human factors implications of 24-hour vision, which is aimed at exploring the physical and cognitive impact of day/night near-to eye augmented reality (AR) displays.

DST noted to APDR that ‘Defence scientists larissa Cahill and Dr Shahd Al-Janabi are helping Defence, and particularly Army, explore operational concepts and understand the impact of augmented reality on our dismounted soldiers.

‘Cahill is approaching the topic from a research background in night vision and sensor-based systems over which augmented information is being placed. Al-Janabi is broadening that scope to include information from autonomous systems and is generally more tech-agnostic.

‘I’m looking at the general interface display and control aspects,” Al-Janabi explains. “There’s an image out there of the soldier of the future – receiving information from many different sources – that’s been created by console game developers and Marvel characters like Tony Stark in his Ironman suit. But the reality is that there’s a limit to how much information people can process at any one point in time. Our job is to use cognitive science to inform how AR displays are designed, and to test and evaluate different designs.”

“There’s no point reinventing the wheel when we’ve already got a lot of theory we can leverage for system design,” says Cahill. “Well before AR we knew that people don’t process all the visual information they receive; we pick and choose and that leads to all sorts of design considerations. We are drawing on the significant research already out there in relation...
to land vehicle and aeronautical displays in particular and understanding to what extent it is applicable to the dismounted soldier.”

“While augmented reality design for seated pilots and vehicle operators seems to work well, soldiers face a whole different ballgame including movement after dark with night vision systems that are already visually exhausting.

“We use prototype systems on soldiers out in the field to explore information needs, while also undertaking fundamental technology agnostic work,” says Cahill. “The more we can do in this space to inform Army, the better placed they’ll be to make decisions about how to design, acquire and/or operate with this technology.”

Other DST research contributing to both the augmented reality system, but more generally as well, includes tactical software displayed in helmet mounted night vision systems - effort involves investigation of several research questions linked to the application of tactical software into helmet mounted night vision systems (underway) including:

• Investigating the impact of near-to-eye map displays on soldier perceptual and cognitive load, and task performance;
• Investigate differences in display elements, understanding the impact of the different geo-referencing displays on perceptual and cognitive load and task performance;
• Lag and Latency impact on cognitive load and task performance.

Colour displays and dark adaptation research studies the emergence of full colour digital displays in night vision devices has implications for individuals who are also required to maintain dark adaptation (Tier 2 dismounted combatants). There is currently a project with the University of Western Australia that aims to investigate the impact of the emerging colour digital displays on visual search performance, under night conditions.

Digital vs Analogue Night vision Equipment Detection and Discrimination Field Evaluation was recently completed as a field assessment comparing the detection and discrimination performance of a new digital helmet mounted night vision system with the in-service analogue system.

Within Defence, there is a high level of interest in the perceptual and cognitive implications associated with AR enhanced vision systems (night, thermal or day vision systems).

A number of R&D Projects looking at metrics and physiological indices of cognitive load, within the context of combatants using AR enhanced vision systems for various task/mission profiles.

Some examples include Human Performance Research network (HPRnet) based projects:

• Perceptual and cognitive optimisation of visual augmented reality displays in simulated combat environments (Western Sydney University) – The aim of this project is to obtain fundamental information about how much AR information the human brain can process, particularly during real world scenarios. It aims to develop a realistic virtual combat scenario experimental set up with functional brain imaging, eye tracking and other physiological indices integrated to measure the cognitive and perceptual effects of AR on combatant’s performance.
• Helped, not hindered (Flinders University): Optimising the use of augmented reality by Defence Personnel – this project aims to understand the limits of human attention using AR cueing, to guide the ADF on how to train personnel to make the best use of AR and to understand a soldiers experience of the new technology assisted military environment and the use of attention within that environment.

Of note, Army combatant night vision devices encompass both helmet-mounted and weapon-mounted systems. As such DST are also investigating the implications of AR displays on weapon mounted sighting systems. Specifically, Improving Soldier Targeting Performance with HMD and Weapon Sight Information Displays - This work is part of DST’s support to Army’s Project LAND 159 (Small Arms Replacement) and aims to explore the most effective ways to present target-related information to a soldier equipped with a Digital Weapon Sight and a Head-Mounted Display.

DST’s Aerospace Division has a world-class night vision laboratory that was set up to investigate the use of night vision and other vision enhancement devices in Defence aviation. The laboratory simulates various lighting conditions, allowing comparisons of different systems being considered by Defence. The laboratory also allows the investigation of a range of human visual performance issues such as:

• Hyper-stereopsis;
• Dark adaption;
• Optical misalignment and visual fatigue and visual discomfort;
• System evaluation in task/mission representative situations, such as night landing;
• Identification and discrimination of important visual cues under various lighting conditions.

Currently DST is supporting Army Aviation with the introduction to service of Night Vision systems into the helicopter fleet under LAND 53.

Longer term, DST research is investigating the best use of colour in the next generation of helmet-based vision enhancement display systems.

**NIGHT VISION EQUIPMENT IN THE ADF**

Navy is using night vision equipment including handheld, helmet mounted devices and laser aiming illumination devices on the bridges of its ships, by crews of RHIBs conducting searches and boardings, and by the pilots of its helicopters.

A Defence spokesperson told APDR that:

“Navy ships are fitted with a range of surveillance tools and night vision equipment to enhance situational awareness. This includes the use of helmet-mounted head-up displays, hand-held devices and laser aiming equipment to support night operations.”
and target acquisition systems utilising night vision technology.

“For example, the Hobart class destroyers and ANZAC class frigates are fitted with the Vampire Infrared Search and Track System. This can provide close range infrared surveillance and tracking, as well as horizon range detection of sea skimming missiles.

“Further night vision surveillance, target acquisition and tracking capability is provided by the Toplight electro-optical directors, which control small calibre guns on the platforms. The ANZAC class frigates are also fitted with a SAAB 9LV Fire Control director, which has an electro-optical sensor capable of controlling the 5” gun.

“Navy’s minor war vessels such as the Armidale Class Patrol Boats and Huon Class Mine Hunters, are also fitted with electro-optical directors to provide night vision capable close-range surveillance and fire control direction for their small calibre weapons.

“Ships’ crews also use thermal imaging equipment to assist in maintenance tasks and damage control. For example, locating fire or hot spots in smoke filled compartments.”

Night fighting equipment is a key enabler to ensure the Army is able to conduct operations and training 24 hours a day. Soldiers and commanders are always seeking ways to enhance Army’s effectiveness through leveraging technologies. Night vision capabilities are utilised widely across Army, whenever an enhanced night vision is required.

When asked for specifics, the Defence spokesperson noted:

“The Army employs multiple devices including night weapon sights that attach directly to rifles and machine guns, night vision goggles which are worn on the head and hand held night vision systems. Many Army vehicle platforms (land and air) also have a night viewing capability as part of the on-board sensor suite. Night fighting capability includes both image intensifying (low light) and thermal systems to provide different capabilities.”

Air Force personnel are trained in the use of night vision equipment as required for training activities, exercises and operational deployments.

**IN CONCLUSION**

One of the more cost-effective ways to update NFE is by interchange of components, where this is possible. For example, older night vision goggles can be upgraded by replacing the existing tubes with modern image intensifier tubes, giving clearer images and also extended life.

Navy has always had the advantage of night vision binoculars being available on the bridge and only needing to be taken up when required. However, where RHIB crews are despatched at night they need similar helmet-mounted night vision systems as required by land-based personnel.

As technology advances Army combat troops are being outfitted with ruggedized touch screens, radios, GPS, smartphones, night vision equipment, specialised sights to increase fire accuracy out to ranges of over a kilometre, helmets and pouches loaded with devices all using different batteries. Add to this body armour, ammunition, grenades, medical packs, personal items, water and other necessities that mean we have reached a point where already-laden soldiers cannot take any extra weight accompanying new technologies.

Therefore, the aim now is to integrate the various systems used by combat and combat support personnel so that their load is reduced in bulk and weight, so movement becomes less tiring for the soldier.

In many ways, aircrews have the greatest need for lightweight, highly effective night vision equipment. This applies particularly for night helicopter operations, where close proximity to the ground leaves little margin for error. The sensor fusion in modern fighter and larger aircraft greatly helps situational awareness in the air, but the challenge of taking off and landing at night on forward operating bases remains.
Kym Bergmann: Can you please provide an overview of how Saab sees the Asia-Pacific region?

Micael Johansson: This is a region that is really important for us. This is especially the case for Australia, which for decades is a country where we have grown our operations.

Generally speaking, we have to move from being a successful Swedish company to being even more multi-domestic in our approach. This means that we need to be fully embedded in the defence fabric of the countries in which we operate. Australia is definitely one of those countries where we are doing that. It also happens to be an important country in its own right in the Asia Pacific region.

Today we have an important part of our portfolio in Australia – of course we have been building local combat system capabilities for quite a long time. In doing so we have created an indigenous combat system house. As successful as that has been, we certainly wish to expand our portfolio of interests, if possible.

Kym: Looking more generally at the region, are their particular programs or contracts of interest? I know you are very strong in Thailand and also have hopes for the Indian market.

Micael: You have mentioned two of the countries that are indeed of interest. We are following the procurement processes in both countries – and we are hopeful that in Thailand they will increase the size of their Gripen fleet. There are also possibilities that they will upgrade the aircraft and systems that they already have. On top of that, there are a number of other opportunities that we are aware of.

India is also clearly of interest and we are awaiting the release of the expression of interest for the Multi-Role Medium Combat Aircraft, where we believe Gripen will be a strong contender. We see this as part of being a strategic partner with India and we are examining what that process looks like. Saab understands that we have to build capability in India if we are going to be successful. At the moment the details of what the Government of India requires are not known, so we are waiting for more information. However, this is a process that we are absolutely fully involved in.

Kym: The “Make In India” policy puts companies under a lot of pressure to move work to that country. How will this effect Saab? Do you plan to develop a local footprint or engage with Indian partner companies?
Micael: Saab already has considerable engineering capability in India, such as in Hyderabad for example. As well as that, we have relationships with numerous Indian companies. Also there are a number of activities where we are already working at a subsystem level. However, for a big program such as the new combat aircraft, we would need a number of partnerships with local industry to be successful in that undertaking. At the moment we don’t have a big operation in India, but the foundations are definitely there.

Kym: To switch technology questions from aircraft to submarines – how is the Swedish A26 program coming along?
Micael: We are through the design phase and are approaching the production of various parts and components and have started assembly of the different sections of the submarines. This program is going really well. This is a completely new way of building submarines – it’s all a digital process, with lots of automation in the shipyard production part of the equation. We are actually taking a lot of the knowledge that we have acquired from the fighter aircraft side of the business and applied these digital technologies to designing and producing a submarine.

Kym: So if I were to visit Karlskrona today I would see lots of people with angle grinders and sparks flying everywhere?
Micael: Absolutely.

Kym: How is the schedule looking?
Micael: The contractually committed dates for the submarines is the first to be delivered in 2023 and the second in 2024.

Kym: I have heard suggestions that the launch date of the first submarine might coincide with the 500th anniversary of the Royal Swedish Navy.
Micael: Yes, I have heard some discussions along those lines – but there is nothing formal in place.

Kym: Looking at the submarine export market, I am aware that you have a campaign in the Netherlands. Do you foresee other possibilities, such as Poland?
Micael: In Poland the way forward is still being discussed. It looks like the acquisition of a new submarine might have been deferred and that a gap-filler or intermediate capability will be considered. We shall see – and we could play a role whichever path is chosen. For the moment this is more in the realm of Government-to-Government discussions.

Kym: For the Netherlands requirement are you offering something that looks like a New Generation Collins class?
Micael: It is a conventional submarine based on existing design capabilities, such as for the A26 and
also the sorts of blue water features such as size that are found in the Collins class, so in a way your categorisation is correct.

Kym: How about the A26 itself – is that exportable, or is it only for Sweden?
Micael: No, other countries are likely to be interested in acquiring the A26. But the submarine market is not like the fighter aircraft market, with fewer countries interested in this sort of capability. Some new entrants might pop up – Canada for example – but the market is well defined. As I mentioned before A26 technologies feature in our Netherlands bid – and the submarine itself could be a solution for Poland.

We will pursue opportunities wherever they emerge.

Kym: Now a business question: looking at defence industry in the western world, there is a trend towards more mergers. For example in the U.S., L3 and Harris have merged, along with Raytheon and United Technologies. How does Saab view these sorts of developments and will they flow on to Europe? Will you remain independent?
Micael: At the moment I see no reason to believe anything else. We are a strong company not only in the European context but also globally. Of course we are continuing to watch closely what is happening in Europe from a defence spending perspective and the consequences of that. If the reality is that leads to some form of consolidation in Europe we will take that into account – but at the moment I have no knowledge or specific information relating to those sorts of possible developments.

Kym: So, you don’t feel the need to double the size of the company overnight or anything like that?
Micael: Of course we want to double the size of the company over time – but the way we plan to do that is not something I am going to reveal.

Kym: The security situation in northern Europe looks a little tense at the moment – particularly given Russian activities. How is that impacting on Sweden?
Micael: What this means for Swedish security policy is that we are returning to a condition of strong national defence, I think. This is manifesting itself on a lot of things – such as building capability in Sweden. Our parliamentary defence committee recently produced a report saying that we had to do a number of things in different domains to further increase national capacity – and that applies particularly to the ground and naval domains. So, Sweden is spending more money on defence – but politically decisions have not been made on that particular report. What has been committed to by all parties is the necessity of substantially increasing the budget.

This is in the broad national security interests
MICAELE JOHANSSON is President and CEO of the Swedish defence and security company Saab. He is a member of Saab Group Management
Mr Johansson took up his position October 23 2019

Mr. Johansson brings around 40 years of experience within engineering, sensor systems and defence. He is an experienced leader, and has served within many different areas and at many different levels of Saab AB through the years. Most recently, he served as Senior Executive Vice President and Deputy CEO for Saab AB. Before that, he served as Senior Vice President and head of business area Surveillance, comprising Saab’s operations within Radar, Electronic Warfare, Command and Control and Traffic Management systems.

Mr. Johansson started his career as a systems engineer in 1985. After that, he held various management positions at Saab Avionics (then known as Ericsson Saab Avionics). In 2008, he was appointed President of Saab Avitronics and in January 2010 Senior Vice President and Head of Saab’s business area Surveillance. He is active on a global level within Saab through various positions and boards within Saab, giving him a unique platform for involvement in the business in countries such as USA, United Arab Emirates, Saudi Arabia and Brazil. Mr Johansson holds a BSc+ in Mathematics and Computer Science at University of Uppsala, Sweden and various management training, e.g. at IFL Executive Education and Investor Forum Novare.

He resides in Uppsala, north of Stockholm, Sweden; he enjoys golf and downhill skiing.

Born
6 October 1960 in Västerlänga Sweden

Education
• BSc+ in Mathematics and Computer Science at University of Uppsala (1985)
• Military service at The Armed Forces HQ

Previous positions and assignments
• 1982-1985: Computer technician Adedata in Uppsala
• 1985-1995: Various Engineering and Managerial positions at Ericsson Radar Electronics
• 1996-2005: Division Manager Display & Recce Saab Avionics/SaabTech
• 2001-2003: Executive Vice President Ericsson Saab Avionics/Saab Avionics
• 2005-2008: Executive Vice President Operations, Saab Avitronics
• 2008-2009: President Saab Avitronics
• 2010-2016: Senior Vice President and Head of Business

Area Surveillance Saab AB
• A broad international experience through positions and boards within Saab, including in USA, United Arab Emirates, Saudi Arabia, Brazil, Australia and South Africa
• South Africa (2008-2017)

Languages
• Fluent in Swedish and English

Leisure activities
• Golf, training, downhill skiing

Kym: Swedish politics looks complex with a number of parties involved. Are all of them on board?
Micael: There is certainly broad support for what I have described – certainly amongst the major parties to go in that direction. There is a big political majority in favour of increasing defence spending. This is both in terms of cash and as a proportion of GDP going forward. We see that happening – and it has to be long term.

Kym: Let’s finish with Australia – how do you see growth here? Do you have any figures in mind?
Micael: As you know, we have been selected by Government in 2017 to create commonality on naval combat systems across the entire surface fleet. That is of course a big opportunity for us to grow our Australian operations even further for many years to come.

We also have a strong interest in what happens with the Life Of Type Extension of the Collins class submarines. If we can be of help for this project – having a considerable design capability in Saab and working with ASC – that’s a prospect for us. We will have to wait and see what happens.

Saab is bidding on the joint health care capability project JP 2060. We are hopeful of being selected and will approach this as a further extension of our indigenous capability in Australia – and this is a big opportunity for us.

Basically, we are looking for any activities that match our broad capabilities. I am not closing my mind to any opportunities here – we definitely see ourselves as part of the local defence industry environment.
When APDR asked Lieutenant Colonel Robin Smith, Army’s SO1 Robotic and Autonomous Strategy, for his views on the importance of these systems, he responded: “Robotic and Autonomous Systems will provide us a more efficient supply chain, medical chain and maintenance, provide us with more force protection, removing ourselves from the dull, dirty and dangerous tasks. It will allow us to grow our mass and presence on the battlefield, potentially making us more lethal. And lastly I think it can improve our decision making.”

At the end of October this year two modified optionally crewed/autonomous Australian Army M113 AS4 armoured vehicles conducted fire and manoeuvre demonstrations alongside crewed vehicles, unmanned aerial systems and Ghost Robotics four-legged unmanned ground vehicles to the Chief of Army and Department of Defence senior leadership at the Majura Training Area, ACT. The demonstration showcased the potential for robotic and autonomous systems to enhance Army’s capabilities on operations.

ARMY’S ROBOTICS & AUTONOMOUS SYSTEMS STRATEGY

The Chief of Army released the Robotic and Autonomous Systems (RAS) Strategy in 2019 that articulates a framework under which the Army will exploit technology to provide the Australian Army a marked advantage in the future operating environment.

Army’s RAS Strategy articulates how Army aspires to ethically leverage emerging technology such as Artificial Intelligence (AI), autonomy and robotics as they mature to gain asymmetric advantage.

The RAS Strategy identifies five fields including:

- efficiency;
- improved decision making at all levels;
- improving soldier performance through lightening cognitive and physical load;
- force protection; and,
- generating mass and scalable effects.

This very comprehensive document considers in detail the way emerging and disruptive technologies like robotics and artificial intelligence can safely and effectively conduct tasks initially, with the future possibility of these extending to full missions, although always with a human in the loop.

UNMANNED GROUND VEHICLES BEING TESTED BY THE AUSTRALIAN ARMY

Army is currently undertaking experimentation and prototyping with different platforms including Unmanned Ground Vehicles (UGVs).

A defence spokesperson wrote to APDR...
explaining that current experimentation and development activities coordinated by Army include:
• a research agreement with an Australian university partner to develop advanced leader follower and obstacle detection and avoidance;
• experimentation with two Ghost Robotic quadruped robots;
• demonstration of two M113 AS4 Optionally Crewed Combat Vehicles (OCCVs); and,
• experimentation with Praesidium Global’s Mission Adaptable Platform System (MAPS) Mule UGVs.

The spokesperson informed us that ‘Two Ghost Robotic quadruped robots have been procured for experimentation with soldiers to provide feedback for concepts of employment. The robots are expected to be highly applicable to urban environments, in humanitarian assistance and disaster relief scenarios and may offer opportunities to remove soldiers from highly dangerous tasks. The quadruped platforms have a small payload capability, and can be operated using line of sight or via a video feed.

‘Aimed at efficiency, generating mass and scalable effects and reducing the physical load on the soldier, Praesidium Global UGVs were a successful pitch to Army Innovation Day 2016 which was selected for further funding and trials. Army purchased six Praesidium Global UGVs and have been undertaking experimentation with combat and combat service support units to evaluate their application across different roles and functions.

‘Deployment to Exercise Talisman Sabre in July 2019 saw the UGVs used by 17th Sustainment Brigade units in the field. The UGVs are currently conducting combat brigade trials with 7th Brigade. Functional roles include logistics, intelligence surveillance and reconnaissance collection platforms, human machine teaming, casualty extraction and crew served weapon support.

‘Army has partnered with BAE Australia to convert two M113 AS4 armoured vehicles to be autonomous, remote controlled, including leader follower waypoint navigation technology. A demonstration of the two M113AS4 OCCVs, the Ghost Robotic quadruped robots, a Nerva robot, and multiple Unmanned Aerial Systems was displayed on 31 October 2019. ‘

‘All prototypes and experimentation aim to inform Army’s requirements and applications for wheeled, tracked, legged autonomous systems, in different functional roles including combat, combat support and combat service support. Outcomes and data captured from these experiments and prototyping will augment information available for programs for lessons learned and observations for future capability requirements.

‘As well as Army trials, DST Group is undertaking research in the areas of Human Autonomy Teaming and Multi-Uninhabited Ground Vehicle control, as well as looking at the vulnerabilities and reliability of Uninhabited Ground Vehicles and robotic technologies.’

**BAE SYSTEMS AND ARMY SHOWCASE AUTONOMOUS VEHICLES**

As noted above, two fully autonomous armoured vehicles were the centrepiece of a landmark demonstration for the Australian Army on 31 October this year, providing crucial insights into the capabilities of integrated autonomous technologies on future battlefields.

In a six-month project, engineers and technicians installed hardware and software in the vehicles enabling them to operate autonomously. The innovative autonomous technologies being explored could remove soldiers from future battlefields and enable a range of other applications including intelligence gathering and logistics support. The on-board systems have been designed to comply with the rules of engagement, which always require a human in the decision-making loop.

At the demonstration BAE Systems Australia CEO Gabby Costigan said:

“This project highlights our commitment to leading the development of new technologies and collaborating across industry and academia to advance autonomous capabilities.

“BAE Systems Australia’s autonomous systems capability leverages more than three decades of collaboration between BAE Systems Australia and the Commonwealth Government through Programs such as Nulka and Evolved Sea Sparrow Missile (ESSM).

“Autonomous technologies will support soldier responsiveness in an accelerating warfare environment - increasing their ability to outpace, out-maneouvre and out-think conventional and unconventional threats.

The BAE Systems autonomous technologies used for this project have already supported Australian and UK Autonomy programs such as Tarantis, Mantis, Kingfisher UAS demonstrators as well as the multi-all-terrain vehicle (MATV) and Digger unmanned ground vehicle (UGV) demonstrators.

The vehicles will also be used as test vehicles for technology developed by the Commonwealth’s recently announced Trusted Autonomous Systems Defence Cooperative Research Centre.

**ARMY INNOVATION DAY 2019 (AID19)**

AID19, a joint venture with the Defence Innovation Hub, was an opportunity for Defence industry to present a range of unique, innovative ideas and future technologies not currently operational or still in development.

The theme for AID19 was ‘network assurance’. Ways to increase computer network resilience and redundancy or reduce an adversary’s ability to deny, disrupt or exploit Army information - part of Army’s Accelerated Warfare concept.

AID19 attendees included Defence personnel and contractors, senior officers from the Australian Federal Police, the Australian Border Force and Home Affairs, representatives from media outlets and any other guests invited by Defence.

Army continuously explores new ideas, and builds relationships with Defence industry, academia, and international partners on the latest developments in technology and war-fighting capabilities.

In its sixth consecutive year, the event attracted 75 submissions from Australian companies, with 10 being selected to present their cutting-edge technologies to Army at the Australian Defence Force Academy on September 25.

The Chief of Army, Lieutenant General Rick Burr, said AID19 was an opportunity for industry to pitch innovations that could shape Army’s approach to meeting the challenges of a changing operating environment.

“Army continues to innovate, to modernise, and get after the future, and it’s a tangible demonstration of an Army in Motion,” Lieutenant General Burr said.

“I see lots of opportunities for bespoke innovation that will give Army the edge, as we continue to deepen our partnerships across Defence industry.”

**UK AND US ARMIES ARE TESTING UNMANNED GROUND VEHICLES**

While the growing chorus of ‘take the man out of the machine’ has led to an explosion in aerial drone use over recent years and kept many pilots safely out of harm’s way, there have been far fewer moves to do the same for military drivers and land vehicles.

As the first event of a three-year collaborative project between the UK Dstl and organisations from the US Army’s Research, Development and Engineering Command, with defence industry partners, commercial-off-the-shelf suppliers and tech start-ups, November 2017’s joint US-UK Coalition Assured Autonomous Resupply demonstration in Michigan, as a week-long exercise, featured cutting-edge autonomous ground-supply technologies. The event marked the first time ever that a combined
fleets of British and American driverless trucks have travelled in this kind of convoy format.

The ground-breaking line-haul convoy, consisting of a British Army MAN SV 6-tonne truck ‘lead’ vehicle with two US Light Medium Tactical Vehicles ‘follower’ trucks, travelled at up to 25mph, using integrated on-board robotics to make autonomous decisions regarding their speed and steering.

Like drones before them, remotely driven vehicles offer a bridge technology allowing all the benefits of cost-cutting and life-saving of driverless ‘Last Mile’ supply to be achieved, with the human still kept in the loop, but at a safe distance away. The effectiveness of this approach was demonstrated in Michigan, using a remotely operated Polaris MRZR 4×4 all-terrain vehicle. Equipped with Light Detection and Range (LiDAR) technology, an advanced sensor system, cameras and GPS, the joint UK-US trials team were able to tele-drive it around the trial ground and successfully complete its simulated mission tasks using an adapted Xbox controller.

In a separate exercise later, the US Army Tank Automotive Research, Development and Engineering Center in Warren, Michigan, demonstrated advanced behaviours in an autonomous leader-follower convoy at the American Center for Mobility in October 2018. The demonstration saw a mixed convoy of two commercial line-haul trucks and two army counterpart M915 tractor-trailers loop around a two-mile course performing a series of driverless technology manoeuvres.

In addition to the standard leader-follower, or platooning, capability-enabling throttle and brake control, engineers showed off lateral steering control through the convoy. An additional vehicle was also merged into the convoy with the trucks reacting automatically to the incursion. With a merging vehicle, the convoy trucks will either speed up or slow down, depending on the best way to avoid a collision.

Meanwhile in the UK, Milrem Robotics’ UGV was selected as one of the winners in the Autonomous Last Mile Resupply competition as part of a team lead by QinetiQ. The aim of the program is to develop autonomous systems that distribute humanitarian relief to disaster areas and deliver combat supplies from the forward-most location (such as a physical base or a logistics/infantry vehicle) to personnel engaged in combat operations.

“Being selected to two separate UK Army programs demonstrates once again that Milrem’s THeMIS unique modular design is much appreciated and provides many advantages to the end user. The THeMIS is the most mature UGV in its size class on the European market and an excellent product for different upcoming programs,” said Kuldar Väärsi, CEO of Milrem Robotics.

The UGV participating at the Last Mile Resupply is the TITAN, which is a joint product developed together with QinetiQ. It features the THeMIS UGV and a control system developed by QinetiQ.

“QinetiQ is delighted that the TITAN robot – collaboratively developed with Milrem Robotics – is part of our offer for Phase 2 of Autonomous Last Mile Resupply. The proven mobility and payload of the TITAN vehicle make it the ideal recipient vehicle for advanced autonomous driving software that will enable our system to conduct resupply in the most challenging environments,” said Keith Mallon, autonomy campaign manager at QinetiQ.

The aim of the Army Warfighting Experiment (AWE) is to identify how the Army can exploit developments in robotics and autonomous systems technology through focused analysis, capability integration and experimentation.

Two Milrem Robotics’ UGVs participated at the AWE as part of QinetiQ’s offerings. One of the UGVs was equipped with a remote weapon system and used for assault while the other was equipped with a surveillance mast with land radar and thermal and night vision cameras.

The THeMIS Transport is intended to support dismounted troops by carrying everything a soldier would normally carry, thus letting the fighter concentrate on the mission at hand. It can be outfitted with various types of tie downs and restraints to prevent load shift.

IN CONCLUSION

The trials conducted so far with unmanned ground vehicles confirm their usefulness for tasks which are ‘dangerous, dirty, dull’ jobs during military operations. This is especially true for ‘Autonomous Last Mile Resupply’ to, or medevac from, those forward positions.

Whether remotely driven, or autonomously controlled from within the vehicle itself, the ability to manoeuvre over ground is also dependent on their method of propulsion. Although the first examples were wheeled or tracked, coming through now are quadraped robots whose four legs are capable of handling rougher or steeper ground. These latter robots also have the ability to right themselves and carry on, should they fall over.

Being trialled now, and likely to become more important over the next few years, are unmanned ground vehicles (UGV) which also carry and control their own unmanned aerial vehicles (UAV). These UAVs can be used for communications relays or to scan the ground ahead. One challenge awaiting reliable solution is how to recover the UAV back onto the UGV. Frankly, the answer will involve larger UGVs than quadraped robots!
ADVANCING INTO A NEW ERA OF DEFENCE
The Australian Army's current MBT is the U.S.-made M1A1 Abrams originally designed by Chrysler Defense (now General Dynamics Land Systems). In 2006, Australia acquired 59 M1A1s in the Abrams Integrated Management (AIM) configuration, replacing the venerable Leopard AS1 in 2007. These 59 tanks were a hybrid of former U.S. Army and U.S. Marine Corps vehicles but without depleted uranium layers in their armour. Under the AIM program, the tanks were completely disassembled and overhauled to a like-new, zero-mile condition. General Dynamics said at the time they would incur lower operational and support costs and report higher operational readiness rates.

The decision to upgrade the tanks was cemented in the 2016 Defence White Paper and its accompanying Integrated Investment Plan with then-Chief of Army Lieutenant-General Angus Campbell stating that the Australian army was looking to upgrade the M1A1 fleet to the M1A2C standard under LAND 907 Phase 2.

According to Defence, LAND 907 Phase 2 will upgrade the M1A1 Main Battle Tank and the tank supporting systems. The objective of the upgrade is to "maintain a credible, deployable and sustainable Main Battle Tank capability with a Life of Type to 2035 and maintain its effectiveness against evolving threats". It confirms the upgrade will bring the tanks to “a new generation M1A2 Main Battle Tank variant” and “includes enhancements to survivability, lethality, mobility, communications and training/simulation systems.”

Defence also said that it will “seek to include
equipment such as radios and battle management systems that are common to, or compatible with, existing Australian Defence Force equipment including those delivered in the LAND 200 project* into the Abrams as part of the upgrade. This is where the improvements to the communications part of the upgrade come in, and will almost certainly see the integration of the Abrams’ communication suite into the overall Army Battlefield Management System (BMS) and Integrated - Battlefield Telecommunications Network (I-BTN) being delivered under Project Currawong.

So, what else will come with an upgrade to the M1A2 (or M1A2C) standard? The baseline M1A2 is fitted with an independent thermal sight that gives the tank commander the ability to engage two targets in rapid succession without the need to acquire each one in sequence.

This variant came into service in 1992, and since then has been ongoing upgrades, some driven by American requirements and others by export customers. These come under various System Enhancement Packages (SEP) that are further subdivided into different variants, with the M1A2C also being known as the M1A2 SEPv3.

Prototype M1A2C vehicles began testing in 2015, and the first were delivered in October 2017 with the U.S. military expected to begin fielding them in 2020. Improvements include increased power generation and distribution, better communications and networking, new Vehicle Health Management System (VHMS) and Line Replaceable Modules (LRMs) for improved maintenance, an Ammunition DataLink (ADL) to use airburst rounds, improved counter-IED armor package, improved FLIR using long- and mid-wave infrared, Next Generation Armor Package (NGAP), and an Auxiliary Power Unit (APU) under armour to run electronics while stationary instead of the engine (this is visually distinguishable by the addition a small exhaust at the left rear of the vehicle).

Other features include more passive ballistic protection added to the turret faces, along with new Explosive Reactive Armor mountings (Abrams Reactive Armor Tile or ARAT). It is not clear if all of these features will be sought by Defence for the Army’s tanks, and GDLs Australia referred APDR to Defence for comment as the project is “currently in the Commonwealth’s process for review and approvals”.

However, an upgraded Australian Abrams may (or may not) differ from the U.S. military’s in some ways. The U.S. tanks are fitted with the Kongsberg Protech Systems M151 Common Remotely Operated Weapon Station II (CROWS II) remotely operated weapon system since the M1A2 SEPv2 in place of the pintle mounted machine gun to allow for closed hatch operation, an important requirement for crew survivability in combat.

The U.S. Army has also selected the Rafael Trophy Active Protection System (APS) for its Europe-based tanks as an urgent requirement, and will almost certainly follow up with the similar system for the M1A2C upgrade.

However, in January this year, Army Director General for Armoured Fighting Vehicles Brigadier Greg McGlone was quoted at the International Armoured Vehicles 2019 event in London that Rheinmetall has been asked by Army to evaluate the integration of Israel Military Industries’ Iron Fist to the Boxer CRVs being acquired under LAND 400 Phase 2, and if successful, the APS will be adopted for the 8x8 wheeled armoured vehicles.

If that is the case, there it would therefore make sense that for commonality purposes, Iron Fist will likely be a logical solution for the Abrams upgrade. Meanwhile, should a Remote Weapon Station (RWS) be part of Defence’s thinking for LAND 907 Phase 2, a seemingly logical choice would be Australia’s own EOS, who has found success at home and abroad with its line of RWS products.

The company’s R400 Mk2s being acquired by the ADF have been integrated with the Australian Generic Vehicle Architecture, and the Australian BMSC2 battlefield management system, and like the Iron Fist will go on the Boxer CRVs, adding to the list of ADF vehicles already operating RWS made by EOS. The R400, then under the banner of Recon Optical before it was bought by EOS in 2009, had been fitted on American tanks operating in Iraq as the M101 CROWS from 2004 onwards, so integration on the Abrams is hardly uncharted territory.

**SUPPORT VEHICLES**

LAND 907 Phase 2 will also look at the supporting systems for the Abrams fleet. Defence has confirmed to APDR that it will not follow the U.S. Army in upgrading its current Armoured Recovery Vehicles to the M88A3 standards, and will instead acquire an unspecified number of additional M88A2 HERCULES (Heavy Equipment Recovery Combat Utility Lifting Extraction System) ARVs to add to the 13 Australia has already acquired in two separate batches of seven and six vehicles in 2010 and 2016 respectively.

The second batch of vehicles was acquired for a reported cost of $64.7 million in today’s dollars, and in 2018 the seven earlier vehicles started a “technical refresh” that involved deep maintenance as well as ensuring there is a common configuration across the whole M88 fleet. The refresh was performed at the Army’s Joint Logistics Unit – North (JLU-N) in Darwin by an integrated project team that includes JLU-N, BAE and Broadspectrum.

In addition, LAND 8160 Phase 1, which was previously a standalone program, has now been rolled under the LAND 907 Phase 2 umbrella and managed as a combined program. This project will acquire an armoured engineering capability for the ADF that addresses four capability roles: assault breaching, armoured bridge launching, armoured engineering and armoured recovery.

Defence says that the decision to manage LAND 907 Phase 2 and LAND 8160 Phase 1 as a combined program was driven by the fact that all vehicle platforms are based on the M1 Abrams chassis, adding that “the combined approach will increase efficiencies in the delivery of the project” while “common spare parts, facilities, simulation and attrition stock will also achieve greater economies of scale”.

It also confirmed that “the acquisition of vehicles will be done through the United States Foreign Military Sales Program. Defence will be requesting scalable costed options from the United States Government for all platforms being acquired to ensure the final quantity of vehicles acquired represents the best value for money.

It had been reported before that the army has been without organic capability in its armoured forces to lay bridges or breach obstacles such as walls, fortifications and minefields, and that Australia is planning to acquire just the base vehicle chassis and outfit them in accordance with the Army’s own requirements, supported by local industry.

The U.S. military already has its own M1150 Assault Breacher Vehicle for the Marine Corps and Leonardo DRS Technologies has been awarded a contract by the U.S. Army to produce the M1074 Joint Assault Bridge System (JABS) that will replace the too-expensive M104 Wolverine Heavy Assault Bridge and the older M60-based bridging system, however developing our own vehicles would not only ensure Australian Industry Content, but also that any Australian-specific requirements can be met while doing away with features that have no relevance in our context.

The combined total budget for both programmes is reported to be about $1.75 - $2.5 billion, and Defence says that LAND 907 Phase 2 project is currently finalising its acquisition and sustainment strategies with IOC is expected in 2023-2024 and FOC planned for 2026-2027.
STRENGTHS AND WEAKNESSES

The Indian approach seems to carry much embedded risk. Typically, the prime contractor takes responsibility for everything, be it design maturity, delivery times, manufacturing quality, serial production delivering advertised performance etc. Ultimately, this is what the customer pays for. All of the local companies have no experience with submarines except for Mazagon Dock. How will they manage in case something goes wrong?

Another weak point is the fact that the current Indian plan does not set priorities. What is more important: to provide the navy with its required quantity of modern boats within a reasonable timeframe or to create an ecosystem? The greatest risk is to solve both tasks simultaneously.

For a foreign collaborator committing itself to participation in long-term, risky and technologically challenging programs like SEA1000 or Project 75i, it is important to understand who will bear responsibility for quality and compliance of the final product. Changes to the original specification have been a regular occurrence on a number of recent defense programs worldwide. If extra work on design alterations and implementing them in metal should be necessary, who will pay for it?

Another point of concern is to do with vendor items. One of the requirements for boats to be built under the Project 75i is that manufacture of vital components shall be done in India. This is good news for local industry, but not for foreign collaborators. Technical performance of onboard equipment affects the whole ship. There are dozens of vendors involved in the build of a small submarine and hundreds for a larger, longer-range boat. A Russian negotiator who often goes to India told us the following story:

The first meeting, and a simple question: can you make a pump?

“Yes, we can! We have been working on some strategic programs and have manufactured lots of pumps already.”

Here are specifications of the pump for our submarine. Can you make it?

“Oh, these requirements are very demanding, can you lower them a bit?”

No, we cannot. The pump must be compact, yet very reliable in operation, and feature low vibration and power consumption.

“I cannot make such a pump right away. I need some time to develop or buy modern technologies”.

If we provide you with the technologies necessary, how much time will it take to master them at your factory?

“Well, I need to get some skilled workers first”.

This simplified yet real-life example of a conversation between a procurement manager and potential supplier shows that local companies
may have some capabilities, but these are often not up to modern requirements. Even if advanced manufacturing techniques are available through a Transfer of Technology (ToT) agreement (which is now a must for all new big contracts to global OEMs) with a foreign collaborator, there is no assurance these can be mastered by local partners in a short time. This adds a lot of complexity to the process of sourcing highly specialised equipment locally.

**AMUR 1650**
The Indian navy requests a submarine with Air Independent Propulsion. Russia answers with a stretched version of the baseline Amur 1650 with an additional (sixth) section housing either Russian (Rubin's) or Indian auxiliary power unit (DRDO's Naval Materials Research Laboratory) - both employing fuel cells. In theory, the original hull can be made even longer to seven sections should the customer choose to have vertical launchers for the three-tonne supersonic cruise missiles of the BrahMos PJ-10 type.

Speaking to Indian journalists in July, Vladimir Drozhzhov, deputy head of Russia’s Federal Service for Military-Technical Cooperation (local acronym FSVTS), thus formulated the gist of the Russian proposal:

“The Amur 1650 serves as a baseline platform for customized versions, such as one equipped with an air-independent propulsion (AIP). It is our belief this is a very promising project for Indo-Russian cooperation. We have already put the proposal on the table. During a series of presentations in India, we explained that our offer is far more competitive than those of other bidders in the tender for Project 75i. This is not about license production but joint development and co-production of a prototype. After, that the Indian side would have all the necessary knowledge to build a series of such boats locally, no matter how large production run is. We will share all the technologies and intellectual property rights. Also, such a boat may come with jointly developed BrahMos missiles. So, from the viewpoint of technology, and also that of weaponry, our proposal is far better that those from the competition”.

On the additional missile section, Rubin managers explained: “That was our proposal, but we have no confirmation from the Indian navy that they would go for that”. According to the Indian admirals, they seem more inclined to have the BrahMos-NG, a new weapon fitting into standard 533-mm torpedo tubes. It has been in development for several years already.

**PROJECT 677 LADA**
The Amur 1650 is an export version of the Project 677 Lada developed to Russian navy requirements. The first hull was launched on water fifteen years ago and raised the naval ensign in 2010. Since then Sankt Peterburg has undergone numerous testing during her operational trials with the Northern Fleet. The second hull – Kronstadt - was started in 2005 and now undergoes sea trials with a view to commissioning in 2020. Due to numerous stops and restarts, her construction and testing cycle stretched for fifteen years. Velikiye Luki was laid down in 2015 using metal parts manufactured back in 2005. She will be launched on water in November 2020 and become operational the following year.

Last fall, the Russian navy commander said that series production of the Lada class, no less than twelve units, is planned. At the Army'2019 international military technical forum held in June, the defense ministry placed a follow-on contract for two boats, thus bringing the total order to five. They are planned to be laid-down in 2022 and commissioned in 2025-2027. These dates are more distant than expected. This may be explained by fact that the navy wants new boats to have an AIP. Rubin has completed ground tests on prototypes of a Lithium-

---

**In theory, the original hull can be made even longer to seven sections should the customer choose to have vertical launchers for the three-tonne supersonic cruise missiles of the BrahMos PJ-10 type.**

---

Indian Navy ships Sahyadri, Sindhukirti (foreground) and Royal Australian Navy frigate HMAS Parramatta sail in formation during AUSINDEX 2019. Credit: CoA Kylie Gibson
NEED FOR A NEW DESIGN SUBMARINE

Russian shipwrights are convinced that to meet the customer requirements put forward in the course of Project 75i, the future submarine needs to be developed anew rather than be a derivative of something. “Project 75i calls for a national submarine that meets the Indian Navy’s specific requirements. These are vastly different from those of the Russian navy. This implies the resulting boat will be very different to the Lada and its exportable version, the Amur 1650”. This further implies that the development, testing and construction cycle will take a long time.

“Russia is a long-standing partner of India. So, we consider it our responsibility to warn our partners of the dangers and advise them against making risky steps”, they explained. As part of that effort, the ten-year-long discussions on the future of the Indian underwater force (since the first RFP for Project 75i) has led to some changes in the original plan making it now somewhat more realistic. Also, because of that interaction, the requirements for the future boat are technically up-to-date, despite them taking a number of different routes in the past decade.

Meantime, the ongoing lifetime extension (to 35 years) and mid-life refit efforts on the Indian navy’s Project 877EKM fleet appears to be helpful for Indian scientists, engineers and naval officers working on national submarine programs. The Zvezdochka repair center in Severodvinsk is now working on INS Sindhuraj. She will receive a similar package to that already fitted to INS Sindhukesari in 2016-2018. It includes fifteen items of Indian equipment. These replaced the original systems for the purpose of improved performance and specimen testing ahead of installation on Indian designs. Among other things, this boat now features the USHUS sonar (in place of the RBK400 Rubikon) developed by the Naval Physical and Oceanographic Laboratory (NPOL).

Upon returning to India, INS Sindhukesari was damaged during installation of a new periscope from L3 Communications. This work had not been authorized by the OEM. We asked FSVTS to explain the Russian view on these and other cases and received the following reply. "Any work attempted intrusion".

Concluding, one wants to stress that the current Australian and Indian submarine programs look very ambitious, and therefore will generate a lot of interest around the world. Other nations willing to develop bluewater forces and cultivate their shipbuilding industries will make decisions basing on experience of Australia and India. If successful, SEA1000 and Project 75i, will set good examples for others to follow.

Japan moves to lithium-ion propulsion  
Mike Yeo // TOKYO

Japan has gone all in with lithium-ion battery technology on its latest submarines, with its newest conventionally powered attack submarines being powered entirely by these batteries for improved submerged performance.

Speaking to APDR at the inaugural DSEI exhibition in Chiba, Japan, a spokesman from Kawasaki Heavy Industries confirmed that the Tonyu, the 12th Soryu-class submarine for the Japan Maritime Self-Defense Force (JMSDF) has its traditional lead-acid batteries and even Stirling Air-Independent Propulsion systems fitted on board replaced entirely by a bank of lithium-ion batteries.

The Tonyu, which was launched by KHI on 6th of November, follows the Oryu, which is also powered by lithium-ion batteries, into the water. The latter boat was launched by Mitsubishi Heavy Industries on 4 October 2018 and makes Japan the first country to put lithium battery-powered submarines into the water.

Lithium-ion batteries provide better power-density compared to traditional lead-acid batteries, the most significant being that they are lighter than older battery designs, and can provide large output on demand, in theory enabling submarines to achieve higher submerged speeds compared to AIP.

Other advantages of the new-generation batteries are the ability to provide more consistent power output even when their charge runs low, as well as significantly faster recharge speeds compared to lead-acid batteries.

The removal of the AIP also frees up valuable space inside the submarines, which can be taken up by batteries or other mission-specific payloads.

Japan is confident it has sufficiently de-risked the potential for fires caused by runaway lithium-ion battery fires, which have occurred on other platforms utilizing lithium-ion batteries in the past, most notably on the Boeing 787 Dreamliner.

The resultant fires burn at extremely high temperatures as well as giving off toxic fumes and generate conductive dust, which would naturally be a very bad thing to happen on board a submerged submarine potentially operating in enemy waters, but Japan has done extensive testing on its lithium-ion battery technology, which included saltwater intrusion, drop, impact, and short circuit tests.

The batteries, which are built by Japanese company GS Yuasa, feature improved chemistry and will also be enclosed in larger battery matrices with reinforced compartments to reduce the potential for such catastrophic events.

Japan is building a new, 3000-tonne class of conventionally powered submarines as a follow-on to the Soryu-class, which will also run on lithium-ion batteries. Neighbouring South Korea is building the Jangbogo III-class of submarines, which will also be powered by lithium-ion batteries.
Network and connect with Army, the ADF, industry and government at the premier land forces exposition for Australia and the Indo-Asia-Pacific region.

**LAND FORCES 2020** will highlight defence capability and strategy and showcase platforms, equipment, support and technologies.

- Key Australian Army, ADF, government and industry conferences and briefings
- International defence, government, industry and academic delegations
- Comprehensive industry exhibition Don’t miss this opportunity to network and connect with key thought leaders through the fourth issue of this established, world-class biennial exposition.

### 2018 HIGHLIGHTS

<table>
<thead>
<tr>
<th>Total attendances</th>
<th>Companies from 26 countries</th>
<th>Australian small businesses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>15,331</strong></td>
<td><strong>624</strong></td>
<td><strong>328</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>International Service Chiefs</th>
<th>Delegations from 36 countries</th>
<th>Conferences and symposia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>31</strong></td>
<td><strong>74</strong></td>
<td><strong>21</strong></td>
</tr>
</tbody>
</table>

Platforms - Equipment - Support - Technologies

www.landforces.com.au

BRISBANE CONVENTION & EXHIBITION CENTRE, AUSTRALIA

For further information contact the **LAND FORCES 2020** Sales Team:

PO Box 4095 Geelong, Victoria 3220 Australia

T: + 61 (0) 3 5282 0500  E: expo@amda.com.au
EXOSKELETONS

MIKE YEO // MELBOURNE

TRYING TO IMPROVE THE PHYSICAL PERFORMANCE THROUGH THE USE OF EXOSKELETONS

The idea of using an external powered exoskeleton to enhance the performance of human soldiers, thus creating what is essentially a “super soldier”, is not a new one and has been something imagined in concepts of future soldier systems for years, if not decades. Put simply, a powered exoskeleton is a wearable mobile machine that is powered by a system of electric motors, pneumatics, levers, hydraulics, or a combination of technologies that allow for limb movement with increased strength and endurance.

The design of such an exoskeleton would be to provide back support, sense the user’s motion, and send a corresponding signal to motors which manage the gears, and in effect supports the shoulder, waist and thigh, and assists movement for lifting and holding heavy items.

In addition, wearing an exoskeleton can conceivably improve the current physical capabilities of a human, allowing them to run faster, lift heavier objects and relieve strain on the body during physical activity, and as anyone who has served in the military will tell you, soldiers encounter an inordinate amount of all abovementioned activities out in the field and any assistance they can get will be appreciated.

However, until now, the limiting factor in the development of such soldier augmentation systems has been technology. An exoskeleton for military use is quite unlike that being used in healthcare or civilian industries, and requires a reliable source of power that is able to work for extended periods in rugged conditions in the field and might not have access to tethered outlets for recharging purposes.

A good example of a concept falling foul to power limitations was the TALOS suit by the United States Special Operations Command. The suit weight somewhere between 272.7 and 318.2kg (600-700 lbs), and was designed to increase wearer strength and mobility while carrying heavy payloads in dynamic environments.

Other objectives were to increase survivability through anti-ballistic full-body armour and visual augmentation, and offer a high level of situational awareness via multiple sensors by giving the user access to next-gen displays, and communicative functions, however the project was dogged by issues powering the entire system and the design was abandoned.

Another issue is that of materials used in its construction. Early exoskeletons tended to use inexpensive, easily-sourced and moulded materials such as steel and aluminium. However, the weight of steel meant that power is needed by the exoskeleton to overcome its own weight, thus reducing efficiency.

On the flip side, aluminium alloys are lightweight, but do not have the strength of steel and have shorter lifespans.

The joint actuators of exoskeletons also face the challenge of needing to be as lightweight as possible, yet powerful to work as intended. Technologies used include pneumatic activators, hydraulic cylinders, and electronic servomotors. Elastic actuators are being investigated to simulate control of stiffness in human limbs and provide touch perception, and other developments are ongoing to enable them to provide tactile feedback.
The human condition is also another limiting factor. Since no two individuals are exactly alike, fully mimicking the degrees of freedom of a joint is not possible. Instead, the exoskeleton joint is commonly modelled as a series of hinges with one degree of freedom for each of the dominant rotations.

Many of the joints in the human body such as the hips and shoulders are ball and socket joints, with the center of rotation inside the body. Spinal flexibility is another challenge since the spine is effectively a stack of limited-motion ball joints, and no simple combination of external single-axis hinges that can easily match the full range of motion of the human spine.

The way to get around this is to have devices often including the ability to compensate for misalignment with additional degrees of freedom. Modern soft exoskeletons have since been developed to bend with the body and address some of these issues brought about by the adapted human body, with the utility traditional of “hard” robots being limited.

U.S. TRIALS ONGOING

In the United States, the US Army Natick Soldier Research, Development and Engineering Center (NSRDEC/Soldier Center) has kicked off a $10.15 million, 48-month long program together with industry to develop several high-tech exoskeleton systems to conduct a comprehensive operational evaluation to see how exoskeletons could be used for military purposes.

“As we explore the more mature exoskeleton options available to us and engage users, the more we learn about where the possible value of these systems is to army operations,” said David Audet, chief of the mission equipment and systems branch in the soldier performance optimisation directorate at the Soldier Center.

“Before the army can consider investing in any development above what industry has done on their own, we need to make sure that users are on board with human augmentation concepts and that the systems are worth investing in.”

Of the Soldier Center’s $6.9m budget, around 10% has been set aside for Lockheed Martin’s Onyx, which had performed well in initial testing, but needs to be put through more rigorous operational testing environment. The Onyx system combines mechanical knee actuators with multiple sensors and artificial intelligence software to improve strength and endurance.

Another system being tested is Dephy’s ExoBoot. The company says that its design approach is focused on the lower leg below the knee, aligning the joint areas on the human musculoskeletal system with a mechanical structure rigid enough to transfer significant force to the ground, yet light, comfortable, and compliant enough to not compromise natural motion.

It adds that on-board artificial intelligence adapts to each user, and is capable of applying over 200W of mechanical power through a robust, power-dense electromechanical drive system. This is in the form of a pair of powered wearable boots, each weighing 1.6 kg with batteries that can last 9.6 km on a single charge while reducing the user’s load carriage effort by 23 kg.

AN AUSTRALIAN SOLUTION

In 2015, Australia’s DSTO (now DST Group) has developed a proof-of-concept demonstrator of a non-rigid exoskeleton which it called the Operational Exoskeleton or OX. This is a passive, unpowered exoskeleton that provides what DST Group calls a simple but pragmatic solution. Weighing 3-4 kg, it is low cost, easy to remove and pack away as well as designed to conform and integrate with the user and standard kit; making it less restrictive than current exoskeletons.

Instead of seeking to augment the soldier’s power and turning them into super soldiers, OX instead focuses on reducing the problems of injury and fatigue by transferring the load to the ground instead of it being borne by the soldier.

Noting that soldiers can carry up to around 80 kg worth of equipment on their bodies or around 2/3 of their body weight when out in the field, most of it on their backs. DST Group’s Tom Chapman says that this results in a compressive load on the soldier’s muscular-skeletal (including vertebrae, knees and shoulders) system between the load and the ground. This causes fatigue, and over the medium to long term can lead to increased risk of injuries.

OX is designed to reduce the load by using a series of high-tensile wire cables (Bowden cables). During their experiments, Chapman said they found that cables with a total diameter of 0.14mm can hold up to 5 kg of compressive load, and from there they started designing a wearable exoskeleton that can hold the loads with minimal impact on the wearer’s movement and ability to carry out normal activities.

Fast forward to today, Defence says OX is “undergoing human systems integration and biomechanical testing alongside other emerging unpowered assistive technologies under a research partnership between DST, Victoria University and the University of Melbourne”. It adds that “the team has been able to quantify the transfer of load from the wearer’s musculoskeletal system by the OX’s novel Bowden cable solution, and is now exploring use cases for which the load distribution benefit sufficiently offsets the costs of integration, acquisition and sustainment”.

CONCLUSION

A 2018 report by the Center for New American Security (CNAS) noted that while there have been advances in technology, “development is needed before full-body exoskeletons will be feasible for infantry combat away from a reliable power source. Still, these advances represent a major step forward in the necessary technology for dismounted soldier exoskeletons”. As such, we will likely not be seeing full Iron Man-type suits on soldiers on the battlefield for the foreseeable future. Instead, what is more likely is simpler soldier augmentation systems “with more modest goals, such as lower-body exoskeletons that
SUBSCRIBE NOW!
PRINT SUBSCRIPTION ALSO INCLUDES DIGITAL MAGAZINE

- Yes!

please enter my subscription to Asia Pacific Defence Reporter:

<table>
<thead>
<tr>
<th>Country</th>
<th>1 year</th>
<th>2 year A$</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>A$198</td>
<td>A$375 (Inc postage &amp; GST)</td>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
<td>A$224</td>
<td>A$398 (Inc airmail postage)</td>
<td></td>
</tr>
<tr>
<td>Asia-Pacific</td>
<td>US$170</td>
<td>US$298 (Inc airmail postage)</td>
<td></td>
</tr>
<tr>
<td>Rest of World</td>
<td>US$236</td>
<td>US$430 (Inc airmail postage)</td>
<td></td>
</tr>
<tr>
<td>India/Pakistan &amp; Bangladesh</td>
<td>US$300</td>
<td>US$577 (Inc registered post)</td>
<td></td>
</tr>
</tbody>
</table>

- Please charge my: Visa Mastercard

Expiration date
Signature

- (Or) My Cheque Payable to Ventura Media Asia Group Pty Ltd is enclosed for $

Rank/Title
Initials
Job Title
Address
City
Postcode
Country

Phone, Fax or Email Subscription to: Ventura Media Asia Pacific Pty Ltd.
PO Box 88 Miranda, NSW 1490 Australia
Phone +61 2 9526 7188 // Fax +61 2 9526 1779
Email subscriptions@venturamedia.net // ABN 76 095 476 065
Set your sights on the future of flight

SINGAPORE AIRSHOW 2020
Asia’s largest aerospace and defence event

Zoom in on the latest innovations by aviation and aerospace giants and engage with top leaders from the government, defence and commercial sectors. Aviation’s finest comes together at Singapore Airshow 2020 to tap into the fastest growing region. Register your attendance now and be amongst the wise ones to get ahead of the future.

REGISTER FOR A TRADE PASS TODAY!
Enjoy the Early Bird Rates and stand to win in our Pre-Registration Lucky Draw when you register as a trade visitor by 29 November 2019!
Terms & Conditions apply.

LEARN MORE ABOUT THE SHOW AT WWW.SINGAPOREAIRSHOW.COM
With a pedigree of protected vehicles, Rheinmetall’s next generation LYNX KF41 is ready to be manufactured in Australia and supported by a national network of industry suppliers.

LYNX KF41 offers the Australian Army state of the art sensor and armament systems integrated into a connected and lethal package that will enable our soldiers to fight, survive and win in combat.

Only LYNX KF41 delivers an unmatched capability and a long term future for Australia’s sovereign military vehicle industry.

www.lynxifv.com.au

@lynxifv