An Interview with Robin Smith: Robotic and Autonomous Systems in the Australian Army

Samuel Cox (SC): Can you give readers the elevator pitch for the Australian Army's Robotic and Autonomous Systems (RAS) Strategy?
Robin Smith (RS): The RAS Strategy is trying to create a framework to assist in thinking about how these types of systems, including artificial intelligence (AI), will enable Army to gain advantage in the future.

SC: Can you speak to RAS experiments undertaken in 2019?
RS: We undertook four activities in 2019 in order to start a conversation about what *might* be. First, an unmanned ground vehicle (UGV). This was procured through Army Innovation Day 2016, contracted in 2017, and we're experimenting now. This is the Praesidium Global Mission Adaptable Platform System (MAPS) Mule. 9th Force Support Battalion (9FSB) and 2nd General Health Battalion (2GHB) fielded six of these at Talisman Sabre in the middle of the year after a series of training, techniques and procedures (TTP) development workshops. The purpose of the experiment was to understand the value of a UGV. They are operator remote-controlled with a game controller interface. Initially, people looked at them sceptically because they're not 'big'; they can only carry around 750kg. Well, to a logistician that's not a lot, but to an infanteer 750kg is a huge load. Perception is everything.

Once people got their hands on the UGVs, they could begin to see in their own context what this thing could be used for. The petroleum operators were happy to see it as a 'powered wheelbarrow' for moving pipes, pumps, sandbags, etc. If you want to move that kit with a G-Wagon, you need to have a license. If you want to move it with a UGV, you need to have been trained not to run someone over and to use a game controller; it's much quicker. That task might not sound exciting to many people, but we still need to do it. We've just found an easier/quicker way.

An artillery forward observation party who carry spare batteries, food, water and surveillance equipment could offload that weight onto a UGV. They might now be able to patrol further or have greater endurance on task. We might transport artillery ammunition with a UGV, but now that we have the flat-rack system on our Land 121 platforms that is probably less compelling than it might have been previously.

Infantry might put a fire support weapon, perhaps a twin 7.62mm or 40mm grenade launcher, on the platform; the section level might now have Company or Battlegroup level assets. Instead of 1/3 of the force element providing fire support, it can be achieved by two soldiers and four robots which means more soldiers assaulting the objective. That generates mass.

We have a lot of ideas about what UGVs might be useful for, but when we get them in the hands of end users the real innovation will occur. We continued with trials and

experimentation in November 2019 with 7th Brigade units, including the Infantry and Engineer units.

The After Action Review (AAR) points from the use of these UGVs on Talisman Sabre is that with a solely battery-powered system we need ways to charge it out field, but at the same time there is an opportunity to charge from it. We could create a hybrid system which has a generator on board to recharge the battery. But as a consequence, you now have to carry fuel, manage heat, and it now makes noise. There are compromises to be made with every system, and this helps us understand what they might be.

Secondly, with a university partner we are building two Land 121 trucks (40 M) with leader-follower and collision avoidance capabilities. What does that mean? By the end of 2019 we had two 40 M that will autonomously follow a lead-vehicle. That could be an unmanned autonomous vehicle (UAV), a person, or another vehicle of any description. It will faithfully follow the path of the lead vehicle and will avoid obstacles along the way. That's quite demanding to accomplish in urban terrain, and our university partner is developing world-leading algorithms that will use predictive behaviours to identify vulnerable road users- pedestrians, cyclists, and motorcyclists- and decide whether to stop or slow down.

This year we are hoping to have these vehicles available and therefore the ability to have a logistics convoy where people are only involved in manoeuvring the lead vehicle. We want to get that convoy approved for use on Australian roads which is a slightly different proposition to a wholly autonomous car. While our trucks will be autonomous, they won't figure out their own route which is the case for autonomous cars. On a long-haul logistics move from Adelaide to Darwin, for example, there's a potential saving in human risk as there may only be two drivers managing fatigue, rather than eighteen or twenty. Tactically, we might be able to reduce the human role in the most dangerous activities we undertake. The software is being designed in Australia and is vehicle agnostic, so it can be scaled to other platforms. This is compelling sovereign capability.

Thirdly, we contracted BAE to conduct a demonstration of autonomous M113s. This is less autonomous than we'd wish, as its leader-follower capability has limited collision avoidance and so relies upon an operator to get it where it needs to go. This is an off-the-shelf capability fitted to our M113s. We're demonstrating the concept of optionally crewed combat vehicles (OCCV).

Think about the way we currently use our M113s: we stop short, fight through the objective and receive fire support from those systems. But at the moment we only get six dismounts per section. If we could link these systems and operate them remotely, we could get two more dismounts. That's 25% more combat power on the objective. You could move them off to a flank to provide fire support or flank protection, use them as early warning, or as depth. You can also then take more risk with the platform, perhaps pushing it aggressively forward under remote control to suppress enemy depth positions.

The intent is to fire the .50 calibre machine gun remotely, but this is not an autonomous weapon system. It is a remote-controlled weapon system that is still under human control. The Australian Army understands our national position; Australia would not develop any weapons that contravene our international obligations. The OCCV was successfully demonstrated to the Chief of Army and the Chief of Army's Strategic Advisory Committee (CASAC) on 31 October 2019 at the Majura Training Area.

Fourthly, lastly, we purchased two quadruped robots from Ghost Robotics in the United States. They look like a dog without a head, and we've named them Horrie and Kuga. Army has tracked counter-IED robots and wheeled UGVs, but we wanted to experiment with legged robots. Currently, they are remote-controlled, but there is an autonomy capability. They will avoid running into something, and by the end of 2019 we had the software to enable them to climb stairs.

So what? Well, the Army is going to operate in the urban environment and this space is designed for humans. Climbing stairs is difficult for a tracked robot, but with legs it is straight forward because stairs are designed for legs [laughs].

In a rubble-strewn street, we could send the 'dog' down first and use a sensor to create a real time 3D picture of the street which informs the commander of where the rubble is and where the windows and buildings are before you patrol down the street. If you can't throw or launch a smoke grenade far enough to de-risk that move down the street, it could be on the 'dog's' back.

There are a lot of opportunities which sit in this space which we will not be able to capitalise on unless we start thinking about them differently.

Robots tend to be very good at their optimised purpose, whereas humans are very adaptable. From a physical perspective, a human can do nearly anything: run, walk, climb in-and-out of windows, crawl through tunnels, listen, see. Getting a machine that can do those things as well as a human is near impossible because being good at one thing often requires compromise on other things. A human's only power source is water, food and sleep. In addition to a power source, a machine needs maintenance and parts start to fail.

Could we give a quadruped robot to every platoon? Yes, but what do you want it to do? Would a real dog suit the task better than a robot dog?

We want to have RAS platforms widely available to Army in the next 10 years, but we want it to be informed by end user requirements. We need to figure out how it impacts our force structure and force design before we go ahead with large scale procurement.

SC: Is Army proving open to the sort of fundamental change RAS will have to the way we fight?

RS: People are open to the opportunities that come with RAS, but equally there is a cultural part of our organisation that knows failure is not an option when we deploy. Therefore, there's a tension between the value that new technology and capabilities might offer versus 'we know what works, and so we don't want to let go of what works until we prove the other thing is better'.

We're trying to help people make some of those jumps by exposing them to the potential of the technology and by allowing ourselves to talk about what *might* be, rather than what *will* be. I find that when you talk about what *might* be, people are more willing to engage because they don't feel like they're about to lose something in order to make way for something that is about to happen. This is why we undertook so much experimentation in 2019; in order to start a conversation.

From a cultural perspective, not just within the Australian Army, not just within the nation, but as humans, our tolerance of machine failure is almost zero. If you look at autonomous or driverless cars, maybe three or four people have been killed globally over the millions and millions of kilometres that have been driven. And yet, they're not widely used on the streets and they're viewed with suspicion and fear.

By comparison, around 1200 people were killed on Australian roads last year by poor decisions made by human drivers. That might have been caused by driving too fast, poor conditions, bad lighting, wildlife, drinking or drugs; and yet we just tolerate that. It's human nature. However, when a machine makes a mistake our confidence plummets. So, culturally, we have to generate trust in machines and that comes through understanding how they work and what their limitations are. There are many moral and ethical challenges.

SC: You talked about 'proving' these capabilities. How can we achieve a reassuring level of proof when we haven't tested RAS in a warfighting environment?
RS: Well, we haven't deployed our tanks in a warfighting environment and yet we have confidence that they will work. By prototyping and innovating, we're trying to prove the concepts and nudge people's ideas forward without presenting a solution. The M113 demonstration wasn't necessarily about the M113 or automation *per se*. It was about demonstrating that if the Army had this type of capability, we could do things differently, and an autonomous M113 is an example of doing things differently. It might not be a realistic undertaking in a competitive or conflict environment, but it demonstrates a potential alternative future.

Over the course of a military career we are drilled to adopt what has been proven on operations. The logic is, 'when the chips are down and people are shooting at you, this works. And so, you must do things like this and it will save your, and your mates, life'. When we deploy against an agile enemy, we want innovative thinkers, we want mavericks, we want people who can throw the foundational lessons out the window and be open minded. We are trying to open people's apertures beyond what they might be working with currently.

SC: How do we measure up in our region? Do we have a capability edge?
RS: There are areas where we are lagging, at parity or ahead of our allies. The questions everyone is asking are, '*how far can we push these machines*?', '*can they be trusted?*', and '*do they reliably work?*'. They all have vulnerability and fragility. For example, the quadruped is easily pushed over; the UGV has difficulty breaking when under load. We're all still in the 'science experiment' phase.

SC: What are the main ethical questions you grapple with in this space?
RS: If we *could* have had robotic or autonomous systems, but we don't and a soldier is killed, have we failed in our national responsibility to that individual? For example, if we were able to have a remote controlled, armoured breaching capability, and instead a soldier is killed breaching a minefield, have we failed as an organisation in our duty of care to that individual? Perhaps that's Work Health and Safety.

There is also an international movement to outlaw autonomous weapon systems, even though the definition is not agreed or clear. What is an autonomous weapon system? One definition would have you think it's 'any weapon system that can activate without further human input'. That's so broad it would include anti-tank mines and missiles.

Then there's a definition which names 'any weapon system which decides what its targets are and engages them without further input'. That's the 'terminator' model and is not something we'd approve. Would we really want a weapon which somehow understands what is going on in the war, wakes itself up, and goes out to engage its own targets of choice? Australia understands that sometimes it is preferable to withhold the application of lethal force even if we could have, so I don't see us accepting a machine making lethal decisions of its own accord. This gives us the moral high ground in the long-term.

We have a system of control for our current weapons to meet our international obligations; autonomous weapons are no different. If we can't test and prove them like we do normal systems, then we won't deploy them. I'm entirely comfortable with where the Army sits, but I recognise it is a very contested space. *Army of None: Autonomous Weapons and the Future of War* by Paul Scharre covers the spectrum of the issue, but the short Youtube 'horror' film *Slaughter Bots* also snappily demonstrates some of the concerns about robotic and autonomic systems from advocates of an outright ban. I would ask people to see beyond the hyperbole.

SC: *Army's Contribution to Defence Strategy* very clearly states that workforce and training will be the drivers of change in Army. What can RAS technology provide in that space to improve learning and training?
RS: Augmented reality, virtual reality and AI simulations afford Army a range of opportunities to improve and refine training. The RAS Strategy is deliberately focused upon the opportunities on deployment, but there are just as many business opportunities.

There has been robotic process automation (RPA) built into our Career Management System. In 2019, bots checked Performance Appraisal Reviews (PARs) for correctness and about

2,500 Posting Orders were produced by bots. And why not? Why does a person need to type that out? We can be more efficient in our back-of-house processes and free up human resources from repetitive work and into tasks that require creativity, imagination and mental agility.

SC: Which potential capability enabled by RAS do you think is the most exciting?
RS: In the near term, the opportunity to disrupt the current logistics echelon system we employ and utilise autonomous MEDEVAC is compelling. In the future, swarming small, low-cost, air and ground robots to create very complex problems for the enemy force might afford us a capability edge. Army is exploring this route and considering the benefits of swarming.

SC: How do we maintain an edge over potential adversaries when these technologies are becoming more available and affordable?
RS: One of our lines of effort is counter-RAS; if it can be detected we can engage it and kill it with our existing kinetic strike capabilities. Where that becomes difficult, is if they are small and swarming. It is also hard to detect and stop a non-physical system like an autonomous software capability which is moving at machine speed and using AI machine learning to adapt and adjust to vulnerabilities.

SC: AI will be able to sense and respond faster than humans. Is that going to improve human decision-making? Or replace it?
RS: Currently, AI is generally extremely narrow and brittle whereas humans can quickly contextualise. AI is very good at what it is trained to do, but its ability to do something else, unlike a human, is very challenged. For example, if you can drive a car, you can drive an automatic or manual, left-hand or right-hand drive. The principles are the same to you, but to a machine that would be incredibly difficult.

So, at least for a while, machines won't replace humans in decision-making. But they can fuse multiple and competing bits of information to create a rich picture of what is occurring. A Brigade Headquarters might expend 60% of its staff effort trying to understand what is going on through reports and returns and fusing them together for the commander's situational awareness. If we can automate some of those processes we'd be at a decision-making advantage. We could make our headquarters smaller. However, if we don't trust it, we won't use it, and so any opportunity it brings will be lost.

Lieutenant Colonel Robin Smith is current the SO1 Robotic and Autonomous Systems within Future Land Warfare Branch of the Australian Army HQ, where he has been in post since November 2017. He recently authored the Australian Army Robotic and Autonomous Systems Strategy. He is a logistician by background and served for over 30 years in the British Army before transferring to the Australian Army. He has commanded at all levels up to and including Regimental level and deployed a number of times. He has a background in Electronic Engineering and has fulfilled a number of roles in the Joint logistics domain at the tactical and operational levels.

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