Land Forces 2024

"Defence Robotics: Opportunities for Australia"

Friday 13 September, 2024

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Australia has huge opportunities and a role to play in the world of defence robotics

Today I'll talk about how we need to think about robotics and Defence. I will outline several imperatives for Australia and our allies – opportunities, challenges or problems, depending your psychology. And I'll provide two key considerations in the approach we must take as we build our future together.

When we talk about robotics we need to keep three big things in mind

#1. It's not just robots.

It's complex RAS[1] and C4ISR[2] integrations. *Robotics* is a group of different technologies integrated to deliver benefits. The technologies includes mechatronics, sensors and effectors, AI algorithms, mobility systems, communications, human machine interfaces and user experience, observation and monitoring, simultaneous localisation and mapping, navigation in GPS denied environments, edge computing, software, and cybersecurity. It's everything from the bare metal silicon to the grease used on bearings and every line of code in an algorithm, and more. These technologies are Critical Technologies in the National Interest and underpin AUKUS Pillar II asymmetric capabilities.

[1] Robotics & Autonomous Systems
[2] Command, Control, Communications, Computers, Intelligence, Surveillance, Reconnaissance

#2. It's about productivity.

Productivity with robotics is about *accelerating outcomes*, *augmenting humans*, and *automating processes* to outperform competition, solve problems and creating competitive advantage faster and more efficiently than we can today. This is about accelerating the OODA Loop[3] and delivering effects. It includes productivity enhancements in things such as logistics, surveillance, medical diagnosis, augmented human physical capabilities, automated signals analysis, automated defence, decision support and more. Offensively, it includes what we see in Ukraine daily, providing precision and targeted effects to minimise harm to non-combatants and the environment.

#3. Adopting robotics is an imperative.

It's game changing and disruptive. Not having access to and effectively utilising robotic capabilities at scale is a strategic weakness for Australia.

Why? Because robotics can provide asymmetric capabilities and preserve our human personnel. Any economy or defence organisation that can adopt and implement and harness the benefit of robotics capabilities economically, efficiently and effectively will have a strategic competitive advantage over adversaries. It's wise for us to be on the front foot.

Bill Gates wrote in 1996: "We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten. Don't let yourself be lulled into inaction."

It's important to look at our adversaries and our environment, and then consider what capabilities are required to deliver the future we want.

Six Transformative Opportunities Australia can address

Each can enhance our national security, develop our economic complexity and support transformation of the economy to deliver higher-value outputs.

1. Reimagining the Defence Environment with Robotic Ubiquity

This goes beyond piecemeal employment of robotic platforms to envision a fully integrated ecosystem of autonomous systems working in concert with human operators.

[3] Observe, Orient, Decide, Act. COL John Boyd, USAF (ret).

Robots everywhere, in many forms, doing lots of different jobs.

Ubiquity requires low-cost, *high-enough* performance, and ability to rapidly deliver capability cheaply and at scale.

This includes concepts such as:

- AI-enabled command and control systems to process vast amounts of data in real-time, providing human commanders with enhanced situational awareness and decision-making superiority
- Forward deployed, distributed, persistent networked autonomous sensors and software for monitoring and early warning across all domains - land, sea, air, cyber and space
- Human-machine teaming in combat situations, including robotic platforms, augmented reality, and robotic exoskeletons
- Swarm robotics, equipped with sensors and effectors for electronic warfare and collectively forming phased arrays of quiet forward-deployed defences
- Disposable, biodegradable and attritable-by-design communication relay nodes that can be scattered across battlefields
- Small ground robots equipped with chemical and biological sensors for CBRN threat detection
- Australian-based validation & verification for testing and assurance
- Low-and-no-maintenance technologies, with through-life-support in and by Australians

A driving question:

What's the simplest thing that could possibly work?

Or: what's the least complex, without cutting corners?

Robotics is already revolutionising warfare, but it will not remove the need for human troops on the ground. Instead, RAS+C4ISR integrations will accelerate and automate activities, augmenting human operations, reducing risk to personnel, and enabling a strategy of denial and deterrence.

DARPA's research on swarm robotics, such as the OFFensive Swarm-Enabled Tactics (OFFSET) program, demonstrates the potential of this approach. These swarms can adapt to dynamic environments, work collaboratively to achieve objectives, and overwhelm enemy defences through sheer numbers and unpredictability.

2. Mass Production of Small and Simple Robotics & Technologies

While there's often a focus on large, complex robotic platforms, there's immense potential in developing simpler, smaller, and more affordable robotic systems.

The key advantage here is scalability and expendability. Such systems can be produced in large numbers, allowing for saturation of the battlespace and redundancy in case of losses. This approach aligns well with the concept of mosaic warfare, where a multitude of low-cost, adaptable systems can work together to create a resilient and overwhelming force.

However, a challenge – and opportunity – for robotic ubiquity and mass production is that every novel technical capability requires – by definition – novel manufacturing capability.

3. Robotic Manufacturing of Components and Assembly of Platforms

While sometimes requiring large capital investment, robotic manufacturing can significantly reduce operating costs, increase precision, and accelerate production timelines. COVID and conflict in Ukraine and Middle East are recent examples of the challenge to industry to produce materiel, components and complex systems rapidly to meet threats and to replenish stocks. While some lag is to be expected, any lag is a competitive disadvantage. Investment in manufacturing capability and capacity is required.

Rapid production and deployment of capability before it's needed.

Most robotic manufacturing systems are currently built in Europe or China and exported to Australia. Long lead times and scale of production are challenges, and our Australian approach has generally been to build for what we need now in Australia, rather than what might be necessary in future. That seems like a fiscally prudent approach, and it's focused on *return of capital* rather than *return on capital*, and often because we're focused on Australia rather than supply to the rest of the world.

Organisations must live within their means and do what they think makes sense, but using AI and robotics in manufacturing can deliver benefits including reduced design timeframes, assistance with identification of design flaws, optimised cost of ownership through predictive maintenance, rapid prototyping and testing, streamlined quality assurance and production at scale.

This opportunity not only enhances our ability to produce defence equipment domestically but also positions Australia as a leader in advanced manufacturing

techniques, with spillover effects into other industries to boost Australia's overall manufacturing capabilities.

4. AUKUS Partnership for Global Market Access

AUKUS. Australia is a world leader in innovation and development of high-technology, high quality products. It's an excellent size to produce and incubate novel capabilities but is military is small and onshore dual-use opportunities are too small to get the return the investment demands. The new Defence Export Controls regime with the United States and the great work of Austrade present opportunities for Australian robotics and technology component suppliers to access a global supply chain. This can help move beyond Australian-based primes, their AIC [4] programs focused on meeting CASG[5] requirements, and expedite delivery of the best of Australian expertise into the global market.

The combined defence budgets of the AUKUS nations exceed $800 billion annually.

The capital markets in the US and UK also dwarf Australia's, and I know of numerous companies in Aerospace and Defence who are raising funds in the US, bringing foreign direct investment to Australia and building teams, businesses and IP here in collaboration with Australian universities and SMEs[6].

Access to larger markets also allows for shared development costs and risk mitigation. And by working more closely with our AUKUS partners, we can ensure that our robotic systems and technologies are interchangeable and interoperable with allied forces, enhancing our collective defence capabilities.

5. Development of Specialised AI and Cyber-Resilient Systems

Specialised AI and cyber-resilient software is a requirement for High Assurance Cyber Military Systems (HACMS). As adversaries become more technologically advanced, the need for secure, intelligent, and resilient robotic systems becomes paramount. The dual-use opportunities are massive as the cyber domain includes defence and civil organisations. Critical infrastructure, businesses and communities are all at risk and potential first-strike targets to impede defence responses to attacks.

[4] Australian Industry Content
[5] Capability And Sustainment Group
[6] Small to Medium Enterprises.

Australia is already a leader in these technologies, with the development of the open source seL4 microkernel and Cyber Assured Systems Engineering tools by CSIRO, the University of New South Wales and University of Melbourne together with Defence Science & Technology Group, DARPA and Collins Aerospace. Australia also leads with enterprise grade post quantum cryptography for hardware with companies like Quintessence Labs and secure laser communications pioneered by The Australian National University.

A bigger challenge, but one that is essential and must be grown, is AI-enabled cyber defence – adversarial AI which *detects* threats, *attributes*, *responds*, and *recovers* at machine speed.

Operate and have impact at machine-speed.

This opportunity is particularly crucial as it addresses one of the main concerns about increased autonomy in military systems: trustworthiness, security and reliability. By developing robust, cyber-resilient software, we can ensure that our robotic systems remain under our control and cannot be turned against us by adversaries.

6. Space Robotics – Extreme Environment Robotics

Space has always been a defence domain, with Sputnik's October 1957 launch triggering the creation of DARPA four months later in February 1958. The space race was an industry transformation that funded massive development of Silicon Valley and the Boston technology corridor around Route 128. This all kicked off before NASA was even founded in July 1958.

Robotic systems will increasingly play a crucial role in everything from satellite maintenance to lunar exploration.

Extreme environment robotics: if it works on the moon, there's a lot that will work here on Earth.

The Australian space sector is growing, driven by the Australian Space Agency, and supply chain opportunities into the global markets are a focal point. Space requires robotics, autonomy and remote operations in environments hostile to humans – much like terrestrial defence environments. The ELO_2 lunar rover designed with funding form the Australian Space Agency under the Moon to Mars Trailblazer Program is remotely operated with autonomous capabilities of the lunar south pole – an unstructured, high-

radiation and thermally extreme environment, in vacuum, at a distance of 384,000kms. A true extreme environment.

Applications include satellite maintenance, earth observation, space domain awareness, and real time threat detection. And over the next decade, increasingly, Cislunar and lunar operations.

Defence Export Controls changes and the Technology Safeguards Agreement signed between Australia and the United States support closer US cooperation, knowledge sharing and participation of Australian technology in US supply chains.

An Australian Approach

There are two big considerations in our approach that can accelerate delivery of desirable outcomes for Australia.

I emphasise the outcomes must be *accelerated*, because of our environment, but they must also be *desirable* and delivered with integrity and support of society.

The first consideration is Collaboration.

Collaboration between industry and research institutions is a cornerstone of accelerated innovation and value delivery. And in 2023 Australia ranked last among OECD nations for industry-research collaboration. Effective collaboration is the key to driving innovation and economic growth. By strengthening these partnerships, we can unlock tremendous potential for technological advancement and competitive advantage in the global marketplace. And when Government/Defence joins industry and research organisations, it's the holy trinity if effectively managed by a translator who speaks the different languages of each sector.

Great exemplars are iLaunch Trailblazer and the Defence Trailblazer. DARPA, and DIU also do a brilliant job. The Australian Strategic Capabilities Accelerator is starting, only in its second year, and should be an exemplar in future.

"If you want to go fast, go alone.
If you want to go far, go together."
African proverb.

The second consideration is Ethics.

The development and deployment of robotics and autonomous systems in defence must be guided by strong ethical principles and strict adherence to the laws of armed conflict. As we advance these technologies, it is crucial to engage in ongoing dialogue with ethicists, legal experts, and policymakers to ensure that our robotic systems operate within established international norms and treaties.

Equally important is the need to educate and inform the public about the realities of defence robotics, dispelling misconceptions about "armies of terminators" and highlighting how these technologies can reduce civilian casualties and protect our personnel. We must emphasise that the goal is not to remove human judgment from warfare, but to augment and support human decision-making with advanced capabilities to protect Australians.

If you have the power to prevent something bad and don't do so, is it unethical?

Regardless of what adversaries may be doing, it is essential to maintain our integrity and the support of society acting within the values and obligations that Australia and allies hold dear.

It's critical to recognize that standing still is not an option in this rapidly evolving field. Adversaries are investing billions into the development and testing of complex RAS and C4ISR capabilities to achieve their own strategic aims. The global security environment is not static, and failure to advance our own capabilities is folly.

Australians are generally risk averse when it comes to investment, but we need to look longer term with a more expansive horizon and an eye on the risks of not acting quickly. Both risks and opportunities are accelerating, and Australian industry and research organisations have a big part to play.

Let's lean in.

About EPE

EPE provides Force Protection, CBRN defence (CBRND) and Counter IED solutions and support to Defence Forces, Law Enforcement, and other government agencies throughout Australia, New Zealand and the Indo-Pacific region. EPE is the Grantee and co-lead of the ELO2 Consortium designing space robotics for lunar and terrestrial missions.

Veteran and 100% Australian owned, EPE has been supporting Defence and other customers for over 25 years. We are former Counter IED specialists with real world operational experience. We understand how the specialist equipment is used and more importantly, the demands placed on equipment and operators in the current 'high-threat' environments in which they may be deployed.

Robotics and Autonomous Systems (RAS), Artificial Intelligence (AI) and Machine Learning (ML), as well as other technologies that optimise human performance are all core parts of our roadmap.

About Ben Sorensen

Ben works with EPE Oceania and am Consortium director for ELO_2 - a 22-member Australian industry-research collaboration to design a lunar rover to go to the moon funded by the Australian Space Agency and NASA. EPE has over 300 robots and thousands of sensors in service with the ADF, national security agencies and emergency services.

Ben provides leadership and strategy working with engineers and scientists to deliver game changing technologies for Australia. He has been a Board Director of the Cybersecurity Cooperative Research Centre, led Enterprise, Defence and National Security relationships for CSIRO's Data61, led the CSIRO-DARPA relationship focusing on High Assurance Cyber Military Systems and Robotics, and served on the Steering Committee for CSIRO and DSTG, Australia's two largest publicly funded research agencies.
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