Industry Report

Unmanned Vehicles (Land & Air)

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VEDP | Virginia
Economic
Development
Partnership

Contents

Executive Summary

As the Australian Global Network Consultant to the Virginia Economic Development Partnership (VEDP), Foley & Associates was commissioned to prepare an in-depth industry report covering the **Unmanned Vehicles (Land & Air)** sector in Australia.

This report is intended to provide Virginian companies with an **overview of the Unmanned Vehicles sector in Australia**, as well as offer specific **insights into industry opportunities within three (3) key sub-sectors:**

1. **Unmanned Vehicles – Air**;
2. **Unmanned Vehicles – Land**; and
3. **Autonomous Vehicles – Road**.

We have structured this report into the following sections:

- ✓ **Current Trends Summary:**
  - o **Overview of the Australian Sector**; and
  - o **Current Status & Recent Developments**.
- ✓ **Industry Opportunities:**
  - o **Unmanned Vehicles – Air**;
  - o **Unmanned Vehicles – Land**; and
  - o **Autonomous Vehicles – Road**.
- ✓ **Key Players:**
  - o **Industry Bodies**;
  - o **Government Agencies**; and
  - o the **Competitive Landscape.**

The final section of the report provides information and general recommendations regarding:

- ✓ **Local Legislation & Regulators**; and
- ✓ **Market Entry Options**.

We encourage any Virginian companies with questions or enquiries to contact VEDP for further information.

We look forward to continuing to assist VEDP and Virginian exporters in the Australian market.

Foley & Associates

Sydney, 28 June 2019

Introduction

Economic Overview

As one of the richest nations in the world, Australia is currently in a strong economic position. Over the last quarter century, Australia's **medium-sized AU$1.7 trillion economy (ranked 14th in the world)**, has proven exceptionally resilient, recording **27 years of uninterrupted economic growth**. This growth was catalysed in part by microeconomic reform and a productivity boost in the 1990s, and then fuelled by a terms-of-trade boom after 2000, as a global rise in resource prices increased the value of Australia's commodity exports.

Since their peak in 2011, however, Australia's terms of trade have fallen by over 30%. According to the Australian Treasury, in order to achieve a long-run trend rate of 2% growth in GDP – which is required to maintain current standards of living – **Australia requires an annual productivity growth of 2.5% a year**. Based on current figures, **this cannot be achieved by increases in labour productivity alone**, which over the five years to 2015-16 remained at 1.8%. Australia therefore needs to find new ways to lift its productivity and identify new sources of export competitiveness to ensure its future economic prosperity.

Unmanned vehicles represent one potential solution. As part of the larger autonomous systems sector, **Australian industry and government have identified unmanned vehicles as a critical component in the nation's future economic success**, and the sector **offers Australia an important opportunity to drive the next wave of economic growth**.

Why Australia?

Australia is well-placed to capitalise on the global growth in unmanned vehicles, and **the Australian unmanned vehicles sector offers compelling opportunities** for prospective Virginia-based companies looking to invest or do business in the market.

A number of key characteristics of the Australian economy underpin these opportunities:

- ✓ Natural advantages in key global growth industries;
- ✓ High levels of digital infrastructure maturity;
- ✓ A robust research & development ecosystem in which international collaborators are active and welcomed;
- ✓ A highly-educated, technologically-aware, and innovative workforce in comparison to other OECD nations;
- ✓ A well-educated and tech-savvy consumer market, willing to embrace and adopt new technologies;
- ✓ A stable economic and political environment with robust regulatory protections; and
- ✓ Federal and state governments that actively welcome and support the development of unmanned vehicles and autonomous systems.

Over the next five years, **the Asia-Pacific region is forecast to be the fastest growing sector of the global unmanned vehicles market**. Increased investment in the development and procurement of autonomous systems for defence by countries such as India and China, as well as advances in the manufacturing capabilities of emerging Asia-Pacific economies, are set to drive market growth, with the **region forecast to become the second largest market for unmanned vehicles by 2025** (behind only North America).

Australia's geographic **proximity to these rapidly expanding countries** will be beneficial to Virginian companies looking to explore potential opportunities in the wider region.

Definitions / Terminology in this Report

For the purpose of this industry report, the Australian unmanned vehicles sector has been split into **three (3) component sub-categories**:

1. **Unmanned Vehicles – Air**;
2. **Unmanned Vehicles – Land**; and
3. **Autonomous Vehicles – Road**.

We recognize that the terms 'unmanned vehicles' and 'automated/autonomous vehicles' are often used interchangeably, especially in relation to their land-based applications.

While there is considerable overlap in the underlying technology, for the sake of clarity and ease of discussion, this report takes the sub-categories to mean the following:

- ✓ **'Autonomous Vehicles – Road'** refers specifically to self-driving, road-going passenger and fleet vehicles.

- ✓ Alternately, **'Unmanned Vehicles – Land'** is used to refer to all other applications of unmanned or autonomous ground vehicles (i.e. defence, mining, agriculture, etc.)

Key Findings

1. **Australia is an ideal test bed for unmanned vehicle technologies, for example:**

   a. At present, there are more than **25 world-leading autonomous vehicle (AV) trials already underway** on Australian roads around the country.

   b. Tech giants Google – through their subsidiary, Wing Aviation Pty Ltd – chose Australia to **trial and develop their world-first drone delivery system** which launched in Canberra in April 2019.

   c. Australia has been **the testbed in which leading mining original equipment manufacturers (OEMs)** – such as as Caterpillar, Komatsu and Atlas Copco (Epiroc) – **have developed advanced autonomous mining equipment**. Consequently, Australia is global leader in the use of unmanned vehicles within the mining & resources sector.

2. Over the last 6 years, the Australian **government has invested more than A$4.6bn (~US$3.2bn) into robotics & autonomous technologies research**, with CSIRO & Data61's Robotics and Autonomous Systems Group a world leader in the development of Unmanned Aerial Vehicles (UAVs), and Unmanned Ground Vehicles (UGVs)..

3. **Defence remains the largest sub-sector of the unmanned vehicles market.** In the wake of the 2016 Defence White Paper the Australian **government made significant investments – totaling more than A$9bn (~US$6.3bn) –** towards the procurement and further development of unmanned vehicle systems for defence & border security.

   a. An example of **a current opportunity in defence** is the Australian Defence Force's (ADF's) search for a Maritime Tactical Unmanned Aerial System (MTUAS) under Project Sea 129 Phase 5, with a **request for tender expected in early 2020**.

4. Australia's **commercial Unmanned Aerial Vehicle (UAV) industry is developing at a revolutionary pace**, with Australia's sheer geographic size and remoteness fueling demand. This report has identified **opportunities for Virginia exporters in mining & resources, agriculture, and distribution services**.

5. **Regulatory hurdles remain the biggest potential challenge for the commercial UAV industry.** However, in contrast to other countries, **Australian industry and regulators enjoy a collaborative relationship**, which is facilitating the expansion of drone activities.

6. Regarding Unmanned Ground Vehicles (UGVs), there are **opportunities for VDEP companies through Australia's robust R&D sector**, which is at the **forefront of developing and commercializing UGV solutions for agriculture, and the increasingly complex last-mile logistics challenges** brought about by rising e-commerce. Key examples include:

   a. The **RIPPA** project developed by the University of Sydney's Australian Centre for Field Robotics (ACFR);

   b. Queensland University of Technology (QUT), lightweight UGV **Agbot II**; and

      c. [Australia Post's](#) trials of **automated last-mile, sidewalk deliveries using UGVs** in Brisbane.

7. **On Australia's roads, the impact of unmanned vehicles is predicted to provide a A$95bn (~US$66.5bn) boost to the Australian economy.**

8. Australian transport authorities and industry are actively working towards the near-term introduction of autonomous vehicles on Australian roads, with **an ambitious end-to-end regulatory system due to be in place by 2020.**

9. Due to Australia's world-leaving AV trials, **the majority of OEM car manufacturers and emerging AV developers have a strong presence within the Australian market.** Virginia companies with established supply chains or complementary technology for the AV market should therefore consider Australia as a priority.

Current Trends Summary

Australia's Unmanned Vehicle Sector

Australian government and industry have **identified the development of the unmanned vehicles sector as a priority** central to Australia's continued economic growth and long-term prosperity.

✓ While there are no specific figures available for Australia's unmanned vehicles sector, it forms **part of the larger 'Automation Opportunity' set to deliver a A$2.2 trillion (~US$1.5 trillion) boost** to Australia's national income by 2030 (Source: AlphaBeta, _The Automation Advantage_, 2017).

Australia is **well-placed to capitalise on the global growth** in the unmanned vehicle sector:

✓ Australia is an **established and globally-recognised leader in robotics and autonomous systems research**;

✓ Australian state and federal governments have both made **concerted efforts to grow the sector**;

✓ Australia industry has demonstrated a **willingness to adopt and integrate unmanned vehicles into operations** – i.e. Australia is a world-leader in the development and use of unmanned vehicles in the mining and resource sectors;

✓ **Australia represents a perfect test bed for trialling new unmanned vehicle technologies**, as is evidenced by the testing of drone delivery solutions in Australia by tech giants such as Google. Australia has:

o A large land mass with scattered settlements (i.e. a low population density, with 85% of the Australian landmass classified as regional or remote);

o A wealthy population of early adopters of technology; and

o Progressive regulators that generally work well with industry.

✓ With the global market for unmanned vehicles still relatively immature outside of defence and border security, **Australia represents a perfect proving ground for new technologies and solutions which can then be exported worldwide.**

✓ Australia also offer's Virginia companies the opportunity to **develop the vital hands-on experience that will differentiate global market leaders in five years' time**

Current Status of Unmanned Vehicles in Australia

Mirroring the global market forecast**, the Australian unmanned vehicle sector is set to expand rapidly** in the next 5 years.

Unmanned Vehicles – Air

✓ Unmanned Aerial Vehicles (UAVs) or Remotely Piloted Aircraft Systems (RPAS) are the **fastest growing sectors in the modern aerospace industry**, with the **global market worth US$18.14bn in 2017**, and **predicted to grow to US$52.3bn by 2025**, at a CAGR of 14.15% (Source: MarketsAndMarkets).

- ✓ **Defence & border security remain the largest sector of the market**, with the rising procurement of military UAVs by defence forces worldwide driving market growth.

- ✓ However, like the internet and GPS before them, **drones are fast evolving beyond their military origins**. Having already made the leap to the consumer market, the **civil and commercial usage of UAVs is growing rapidly**.

  - o The **civil & commercial sector is projected to be the fasted growing sector** of the UAV market from 2017 to 2022 (Source: MarketsAndMarkets)

  - o **Global market for personal & commercial drones was worth over US$6bn in 2017**, and **forecast to reach US$11.2bn by 2020** (Source: Gartner).

- ✓ In addition to the market for UAVs themselves, in 2016 the **emerging global market for business services using drone technology was valued at over US$127bn** (Source: PwC, *Clarity from Above: PwC global report on the commercial applications of drone technology*, May 2016)

- ✓ This has caught the attention of leading consultants such as McKinsey & Company (*Commercial drones are here: The future of unmanned aerial systems*, December 2017), and the Boston Consulting Group (*Drones go work*, April 2017) confirming that this is an area of significant commercial interest.

- ✓ These **global trends are being mirrored in the Australian market**:

  - o The Australian UAV industry is **developing at revolutionary pace**:

    - ▪ In 2017, the number of remote pilot licences holders grew by 65% to 7,380; and grew by 49% again in 2018 to 10,999.

    - ▪ In 2017, the number of RPAS operator certificate holders grew by 70% to 1,283; and then by a further 17% in 2018 to 1,504 (Source: CASA).

  - o The Australian commercial drone industry is **maturing in terms of technology, safety and sophistication** as regulators, operators and the public start to come to terms with the emerging technology.

- ✓ **Regulatory hurdles are one of the biggest challenges facing the industry**.

  - o However, as experience with drones has grown, **Australia's regulators are displaying greater confidence, and an increased willingness to enable drone activities, in direct contrast to other countries.**

  - o Major aerospace industry players – such as Boeing Australia – are investing significant sums into researching and devising innovative solutions for difficult regulatory problems.

  - o Alongside local Australian companies, these industry leaders are playing a key role in interfacing with regulators, with their **collaborative efforts leading to a noticeable shift in perspective on behalf of regulators,** including the Civil Aviation Safety Authority (CASA).

  - o CASA's 2016 overhaul of Part 101 of the *Civil Aviation Safety Regulations 1998* marked the first major amendment in drone regulations since they were introduced in 2002 when the drone industry was still in its infancy.

- In particular, **new rules for commercial operations of 'sub 2kg' drones have seen substantial utilisation** with CASA receiving 6,000+ notifications of intent within the first 18 months since introduction.
  - The future regulatory landscape in Australia is evolving, with CASA taking a 'fast-follower' approach, with a view to aligning with other jurisdictions. **CASA's forthcoming regulatory roadmap will provide key insights**.

Unmanned Vehicles – Land

- ✓ The **global unmanned ground vehicles (UGVs) market is projected to grow at a CAGR of 14.81%, from US$2.7bn in 2018, to US$7bn by 2025.**
- ✓ The military application of UGVs is forecast to lead market growth, with the Asia-Pacific region projected to be the fastest growing market. (Source: MarketsAndMarkets).
- ✓ The Australian UGV market is set to expand in line with these global trends, with **significant opportunities in defence, primary sectors such as agriculture and mining** – where Australia is already a world leader – **and tertiary service sectors** like emergency, logistics & distribution, and healthcare.

Autonomous Vehicles – Road

- ✓ The **future of Australia's public and private transport sector** is being shaped by a combination of **technological disruption, strong regulatory and policy leadership, and investment opportunities**.
- ✓ Australia is rethinking its transport infrastructure to address increasing urbanisation, rapid population growth and environmental sustainability, and Australia is committed to leveraging autonomous vehicle technologies to improve the safety, efficiency and sustainability of its transport system.
- ✓ The **global autonomous driving market is forecast to be worth US$173.15bn by 2030** (Source: Frost & Sullivan, _Global Autonomous Driving Market Outlook_, 2018).
- ✓ According to bullish predictions made by Intel, **autonomous vehicles are set to create a US$7 trillion-a-year global industry by 2050**.
- ✓ **Australia's future transport market – worth A$211.2m (~US$147.8m) in 2016** – is **expected to grow significantly** over the next few years, and is **predicted to generate more than A$16.08bn (~US$11.25bn) in revenue by 2025** (Source: Austrade, _Future Transport and Mobility: Australian Capabilities and Opportunities_, 2018).
- ✓ **Self-driving vehicles are estimated to provide a A$95bn (~US$66.5bn) economic opportunity to Australia:**
  - This includes a potential annual saving of A$80bn (~US$56bn) from the 'avoidable costs' of road accidents and traffic congestion in Australia cities (Source: Centre for Robotic Vision, _A Robotics Roadmap for Australia_, 2018).
  - As the peak industry advisory body – the Australia & New Zealand Driverless Vehicle Initiative (ADVI) – has highlighted, this saving forms a baseline to which the economic benefits of jobs and investment will then be added.
- ✓ In 2019, **Australia was ranked 15th** in KPMG's Autonomous Vehicles Readiness Index – down one place from 2018.
  - Industry bodies have flagged their determination to improve this position; and
  - There **remains strong government support at all levels** for the development and further implementation of automated vehicle technologies.

Recent Developments

Government Policy Leadership

✓ In order to position Australia to fully capitalise on the opportunities presented by unmanned vehicles, the Australian government is working with stakeholders across industry and the research sector on initiatives to enable the development and implementation of unmanned and autonomous vehicle technologies.

✓ Since 2015, the **Australian federal government has flagged emerging technologies, such as unmanned vehicles, as an essential aspect of its National Innovation and Science Agenda (NISA)**, and made a concerted effort to support and drive investment in the sector.

✓ In 2017, a report by the House of Representatives Standing Committee on Industry, Innovation, Science and Resources highlighted the opportunities unmanned and autonomous vehicles present to Australia, and recommended that "*the Commonwealth Government facilitate and encourage trials of automated vehicles in Australia.*"

✓ In June 2018, the government-funded Australian Centre for Robotic Vision released *A Robotics Roadmap for Australia*, detailing how Australia can best harness the economic and social benefits of new robotic and automated technologies, including unmanned vehicles.

✓ In December 2018, the federal government published its national digital economy strategy *Australia's Tech Future: Delivering a strong, safe and inclusive digital economy*.

  o As part of the larger autonomous systems sector, *Australia's Tech Future* identified **unmanned vehicles as a critical growth industry** for Australia's future economic prosperity.

Government Funding for Research & Development

✓ Over the last six years, the federal **government has invested more than A$4.6bn (~US$3.2bn) into robotics and autonomous technologies**.

✓ In the 2018-19 federal budget, the government increased the Commonwealth Scientific and Industrial Research Organisation's (CSIRO) funding by **over A$40m (~US$28m)**, taking its **total funding allocation to A$843.7m (~US$590.5m).**

✓ CSIRO's digital research network Data61 houses **the Robotics and Autonomous Systems Group, one of the world's leading research groups** in this field, with strong capabilities in Unmanned Aerial Vehicles (UAVs), and Unmanned Ground Vehicles (UGVs).

  o **The Robotics Group has developed unmanned vehicles for industrial, natural and mining environments**, used for area mapping, scene understanding and manipulation. In developing these technologies **CSIRO is engaging with industry partners** such as Boeing, Rio Tinto and Caterpillar.

  o In October 2018, **the Robotics Group won up to A$6.4m (US$4.5m) in funding** to develop UAV and legged robotics technology to rapidly explore and map challenging underground environments as part of the **US Defense Advanced Research Projects Agency's (DARPA) SubT Challenge**.

  o In March 2019, CSIRO's Data61 announced the **launch of its new A$3m (~US$2.1m) Robotics Innovation Centre in Queensland**, a purpose-built research facility to support the development of defence and civilian robotics and autonomous systems.

✓ In addition, both state and federal governments have made concerted efforts to provide funding and grant programs to speed the uptake of UAV and UGV technologies in sectors such as agriculture. Specific examples will be discussed further in the 'industry opportunities' section of this report.

Transformed Defence Innovation System

Defence remains the largest market for both UAV and UGV systems. As such, it is important for interested Virginian companies to be aware of the new approach to procurement that has been brought in since 2016 through the **transformed Defence Innovation System**.

✓ In February 2016, the federal government released the **2016 Defence White Paper**, setting out a comprehensive, long-term plan for Australia's future defence:

    o The White Paper outlined the Australian Defence Force's (ADF) strategic direction and future capability requirements, providing a blueprint for transforming the ADF into an innovative, integrated, and networked force.

    o The White Paper **identified unmanned vehicles and systems as a core component of the ADF's future capabilities**.

✓ Alongside the White Paper, the government also released the **2016 Defence Industry Policy Statement**, signposting **a complete redesign of the relationship between Defence and businesses operating, or looking to enter the defense industry**:

    o The statement **outlined a new Defence Innovation System**; and

    o Flagged a **change in Defence's culture and business processes** to systematically remove barriers to innovation, and provide incentives for companies to innovate in Australia.

✓ This was supplemented by the introduction of the Defence Industrial Capability Plan (2018) outlining the government's long-term vision to "build and develop a robust, resilient and internationally competitive Australian defence industry base that is better able to meet defence capability requirements."

The Transformed Defence Innovation System:
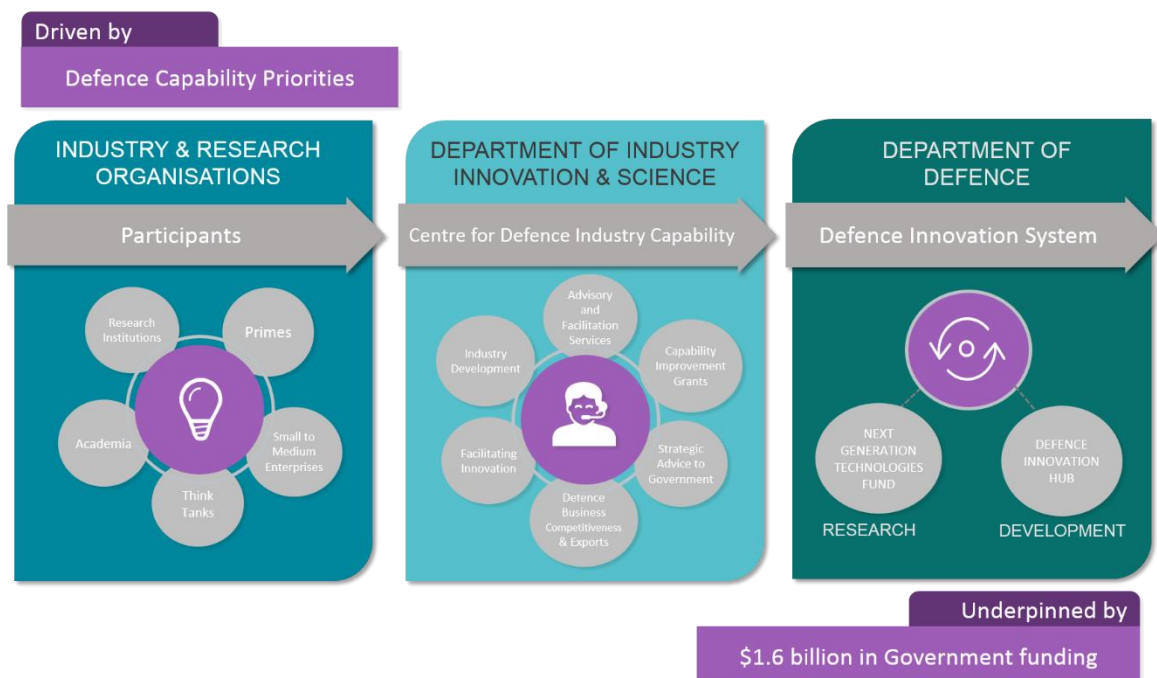
The new Defence Innovation System involves:

- ✓ The **creation of a Defence Innovation Portal** as part of the Centre for Defence Industry Capability (CDIC). The Portal will **facilitate engagement** between Defence and innovation activities across Australia, and **provides vital connections between SMEs and defence**. It is responsible for overseeing:

  - o The **Next Generation Technologies Fund** – **A$730m (~US$510m)** over the ten years between 2016-2026 to be invested in strategic next generation technologies that have the potential to deliver game-changing capabilities; and

  - o The **Defence Innovation Hub** – **investment of A$640m (~US$448m)** over the ten years between 2016-2026 to enable industry and Defence to undertake collaborative innovation activities throughout the Defence capability life cycle.

    - ▪ The Innovation Hub works with industry partners to fund technologies so that they are developed in accord with the needs of ADF capabilities.

    - ▪ The Hub seeks proposals aligned with the following 6 capabilities:

      1. Intelligence, Surveillance, Reconnaissance, Electronic Warfare, Space and Cyber;

      2. Key Enablers;

      3. Land Combat, Amphibious Warfare and Special Operations;

      4. Air and Sea Lift;

      5. Maritime and Anti-Submarine Warfare; and

      6. Strike and Air Combat.

    - ▪ Innovation priorities within these streams are announced for each financial year – View current Defence Innovation Hub priorities here.

    - ▪ The Hub's Special Notice platform allows capability managers to call for industry and research organisations to submit proposals in response to specific capability challenges. Whereas Innovation Proposals are accepted all year round, Special Notices are published as needed.

- ✓ In addition to the Defence Innovation Portal, **the new Innovation System also incorporates a number of new Grants for the defence industry**:

  - o Capability Improvement Grant of up to $250,000 to engage a consultant or expert to implement business improvements

  - o Sovereign Industrial Capability Priority Grant of up to $1 million to invest in projects that build capabilities aligned with Defence's stated Sovereign Industrial Capability Priorities

  - o Defence Global Competitiveness Grants of up to $150,000 to invest in projects that overcome barriers to accessing export opportunities

  - o Australian businesses and research organizations can also apply for matched funding of up to A$1m through the New Air Combat Capability – Industry Support Program (NACC-ISP) to invest in projects that will help them win work with the Joint Strike Fighter (JSF) Program.

Autonomous Vehicles – Road

✓ Australian **transport authorities and industry are actively developing autonomous vehicle technology** as well as the **necessary policy and regulatory infrastructure** to allow autonomous vehicles to operate on Australia's roads.

✓ Australia has announced an **ambitious reform agenda** to have **an end-to-end regulatory system in place by 2020** for Automated vehicles at all levels of automation.

   o The **National Transport Commission (NTC)**, an independent advisory body to Australian transport ministers, is undertaking the phased regulatory reform program.

   o The NTC **aims to remove regulatory barriers** to automated vehicles and advises Australian governments on end-to-end regulation, embracing innovation and ensuring automated vehicles are safely deployed.

✓ In 2016, the **Transport and Infrastructure Council** – an arm of the Council of Australian Governments (COAG), Australia's peak intergovernmental forum – published the **National Policy Framework for Land Transport Technology, Action Plan 2016-2019**.

   o The Policy Framework **sets out a nationally consistent, principles-based approach** to the timely deployment of emerging transport technologies, including autonomous vehicles.

✓ In **May 2017, Australian transport ministers agreed to the Guidelines for Trials of Automated Vehicles in Australia.** The Guidelines provide a clear and nationally consistent approach that balances safety and innovation.

✓ In October 2018, the federal government established the **Office of Future Transport Technology** to:

   o Enhance the federal government's strategic leadership role;

   o Improve intergovernmental and industry cooperation; and

   o Facilitate Australia's preparation for the imminent arrival of automated vehicles and other transport innovations.

✓ **Australian state governments are also taking an active role** in developing the industry. For example:

   o In May 2018 the New South Wales government launched first-of-its-kind Future Transport Digital Accelerator, which enables innovators and startups to collaborate directly with Transport for NSW to deliver future transport projects.

✓ Australia has **commenced a wide range of connected** (using both cellular V2X and DSRC) **and automated vehicle trials**, with **over 15 world-leading transport technology trials** taking place across individual states and territories.

✓ To support these trials, Australia is investing in the appropriate physical and digital infrastructure to support autonomous vehicles:

   o **Austroads** (the peak organization for Australasian road agencies) Connected and Automated Vehicles program is working closely with key government and industry stakeholders to establish the frameworks to support the introduction of vehicles with increased level of wireless connectivity and automated driving capability.

   o In January 2017, the **federal government committed A$12m (~US$8.4m) to test the next generation of Satellite-Based Augmentation System (SBAS)** technology across a number of sectors, including road transport.

- This infrastructure is designed to improve and augment the accuracy, integrity and availability of basic Global Navigation Satellite System (GNSS) signals, and could be an important enabler of connected and automated vehicles.

- A number of industry groups have participated in the test bed, and **in 2018-19 Federal Budget the government committed a further A$160.9m (~US$112.6m) over four years to support the continued development of operational SBAS.**

✓ The road-going autonomous vehicles sector is also supported by a **robust research and development infrastructure**, including:

  o The national science agency **CSIRO's Data61;**

  o The **Australian Integrated Multimodal EcoSystem (AIMES)**, a world-leading 'living laboratory' road-testing highly integrated transport technology, and based out of the University of Melbourne; and

  o The **iMOVE Cooperative Research Centre (CRC)**:

    - The iMOVE CRC **brings together more than 44 government, industry and research partners** to develop applied research relating to smart transport and infrastructure, enhanced personal mobility and end-to-end freight solutions.

    - In March 2017, the federal government announced **A$55m (~US$38.5m) over 10 years** for the iMOVE CRC, to be **matched by A$178.8m in cash and in-kind participant contributions** from industry and academic stakeholders.

Industry Opportunities

Unmanned Vehicles – Air

Foley & Associates have identified the following **six (6) sectors**, which present current opportunities for Virginia-based companies in the Australian Unmanned Vehicles – Air market:

1. **Defence & Security**
2. **Mining & Resources**
3. **Agriculture**
4. **Emergency Services**
5. **Logistics (Air Freight)**
6. **Other**

Defence & Security

Defence and Security remain the largest segment of the Australian unmanned aerial vehicles sector, with the **2016 Defence White Paper identifying a clear need to expand the Australian Defence Force's (ADF) UAV capabilities**.

As a result, the federal government has delivered **significant investment into the procurement and further development of UAV technologies**.

In the last two years, the following procurements have been announced:

✓ In February 2019, the federal government announced an **A$40m (~US$28m)** investment **to further develop a 12-metre prototype combat drone** being developed domestically by Boeing Australia.

  o The multi-role aircraft has a range of 3,704km.

  o It can perform like a fighter jet, and also fulfil other roles including electronic warfare, intelligence, surveillance and reconnaissance.

  o For more, see here and here.

✓ In November 2018 the federal government announced **the selection of the General Atomics Aeronautical Systems** MQ-9 Reaper variant **as Australia's first armed UAV** to be acquired under the ADF's Project Air 7003 Phase 1 (Armed MALE UAS).

  o Government announced that, pending negotiations, **12 to 16 aircraft would be acquired for between A$1-2bn (~US$700m-1.4bn),** and be delivered by 2023.

  o The medium altitude, long endurance (MALE) aircraft will watch and protect ADF land forces, and provide reconnaissance support for search and rescue, humanitarian assistance and disaster relief operations.

✓ In June 2018, the federal government announced a **A$7bn (~US$4.9bn) acquisition of six (6) Northrop Grumman MQ-$C Triton unmanned surveillance aircraft**.

- o The White Paper identified a specific requirement for high-altitude, long-endurance unmanned surveillance aircraft under Project Air 7000 Phase 1B.

- o Triton will provide real-time intelligence, surveillance and reconnaissance over Australia's vast ocean and coastal regions, providing unprecedented maritime domain awareness, target acquisition, fisheries protection, oil field monitoring and humanitarian relief.

- o Deal includes an A$200m (~US$140m) joint program with the US Navy for the development, production and maintenance of the Tritons.

- o For more, see: here and here.

✓ **Currently, the federal government is looking for an unmanned aircraft system** to operate from 12 Arafura offshore naval patrol vehicles (OPVs) and 9 Hunter-class future frigates, **under the ADF's Project Sea 129 Phase 5 – Maritime Tactical Unmanned Aerial System (MTUAS).**

- o The program is **currently at the request for information stage**, with a **request for tender expected in early 2020,** and an Initial Operating Capability (IOC) planned for the mid-2020s.

✓ In September 2018, the **ADF announced the roll out of two fleets of handheld drones** to complement its existing fleet of larger, catapult-launched Textron Systems Shadow 200 Tactical UAVs.

- o The latest acquisition is the **FLIR Systems Black Hornet Nano**, which recently completed trials and is being rolled out across the entire conventional army at a **cost of A$18m (~US12.6m).**

- o The Black Hornet complements the **AeroVironment Wasp Small UAS**, **which entered service in 2017** and is being rolled out to every combat team in the army **under the A$101m (~US$70.7m) ADF Project Land 129 Phase 4A**.

- o NB. Defence is now looking to replace the Shadow 200 UAV fleet under ADF Project Land 129 Phase 3, with an **approach to market expected in Q3 2019**.

✓ In addition, the **federal government has also made significant investment in R&D programs designed to further develop the ADFs UAV capabilities**:

- o In September 2018 the federal government announced **two contracts as part of the Defence Innovation Hub** initiative:

  - ▪ A **A$2.1m (~US$1.5m) contract with UAV Vision / AVT Australia** to allow the company to develop a lightweight, compact micro gimbal with integrated systems to enhance performance and accuracy; and

- A **A$283,000 (~US$198,000) contract with [Textron Systems Australia](#)** to develop a small UAS including communications systems, sensors and ground control systems.

  o In [June 2018](#), as part of the [Small Business Innovation Research for Defence (SBIRD)](#) initiative of the [Next Generation Technologies Fund](#), the **ADF invited SMEs to submit proposals for new technologies to protect ADF small, fixed-wing UAVs by making them harder to detect**.

    - Funded proposals are **eligible for up to A$100,000 for completion within nine months,** and if successful, SMEs will then be eligible to apply for a **maximum additional A$750,000** in funding to support further research and concept maturation within 24 months.

  o In [April 2018](#) the **ADF partnered with the [Defence Innovation Hub](#) award three innovation contracts totalling A$783,000 (~US$548,000)** to Australian industry and research organisations to develop next-generation small UAVs:

    - The contracts were selected as part of the Defence Innovation Hub's [Special Notices](#) platform and included:

    - **A$275,000 (~US$192,500) for [JAR Aerospace](#)** to develop a hybrid vertical take-off and land, fixed wing UAV incorporating target tracking, encryption and acoustic sensing and analysis at range.

    - **A$258,621 (~US$181,000) to [SYPAQ Systems](#)** to further develop their [Corvo X](#) small UAS; and

    - **A$249,524 (~US$175,000) for the [University of Sydney](#)** to develop a lightweight UAS combining vertical take-off with horizontal fixed-wing flight for extended speed and endurance.

  o Although there are currently no [Special Notices](#) called in relation to UAV technologies, it remains a priority area, and interested Virginia companies are therefore encouraged to check back in the future.

Mining & Resources

Mining & Resource operations **account for 40% of Australia's exports and over 8% of GDP**, and are vital to sustaining Australia's ongoing economic prosperity.

Australia leads the world in mining automation technologies, allowing the resources sector to operate safely and more efficiently in harsh conditions, and the remote and regional areas they tend to be located in.

Australian mining & resource companies are increasingly **turning to UAVs to conduct exploration, asset inspection and maintenance, and advanced mapping operations** in order to realize **improvements in safety, increased efficiencies, and cost savings**.
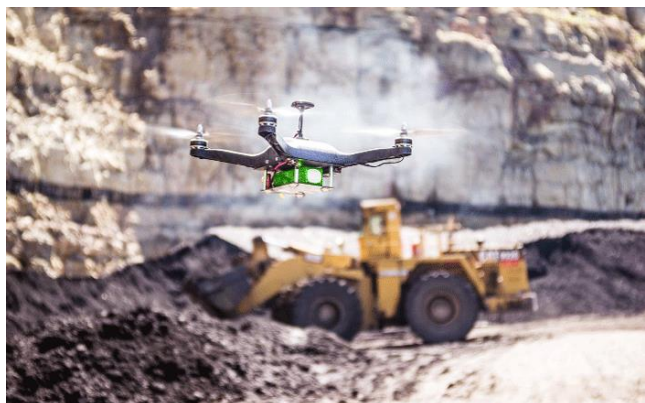
- ✓ Mining giant [BHP Billiton](#) was one of the first companies to begin using UAVs, employing them in various operations across its Australian mine sites [since 2015](#):

  o Used to ensure areas are clear before blasting, and to track fumes post-blast;

- o Used to improve road safety by monitoring traffic, road conditions, and hazards;

- o Used to help inspect overhead cranes, towers, and roofs of tall buildings to avoid working at height; and

- o Fitted with military-grade cameras to provide real time aerial footage, and develop 3D maps of mine sites allowing BHP to constantly monitor the mines' progress and safety and identify minerals for potential extraction by looking at mineral patterns. BHP estimate that using drones instead of planes for survey work will save over A$5m (~US$3.5m) annually on their Queensland sites alone.

- o Additionally, BHP are also adopting UAV technologies in their ocean freight operations, achieving enormous safety benefits and efficiency gains.

✓ Similarly, resource giant Rio Tinto has also been an early adopter of UAV technologies for monitoring, inspection and advanced mapping operations in its Australian business.

✓ The **use of UAVs in the mining and resource industry is forecast to expand further in parallel with current and future advances in UAV technology**:

- o In November 2018, startup company Emesent – a spin out of CSIRO / Data 61's Robotics and Autonomous Systems Group specializing in developing drones for underground environments – raised A$3.5m (~US$2.45m) to commercialize its first product Hovermap.

  - ▪ Hovermap is a 3D LiDar-mapping and autonomy payload for industrial drones enabling them to fly in and collect data from challenging and dangerous underground and GPS-denied environments, such as 3D scans of mine stopes.

✓ There is also a **significant energy and utilities market** for UAV technologies:

- o Australia's **geographic size and remoteness** ensure **UAV solutions are attractive to energy and utilities companies**, allowing them to make their day-to-day operations easier, safer, and more efficient.

- o In particular, UAVs are increasingly being **used for asset inventory and maintenance management** of power, solar, water, and wind infrastructure networks.
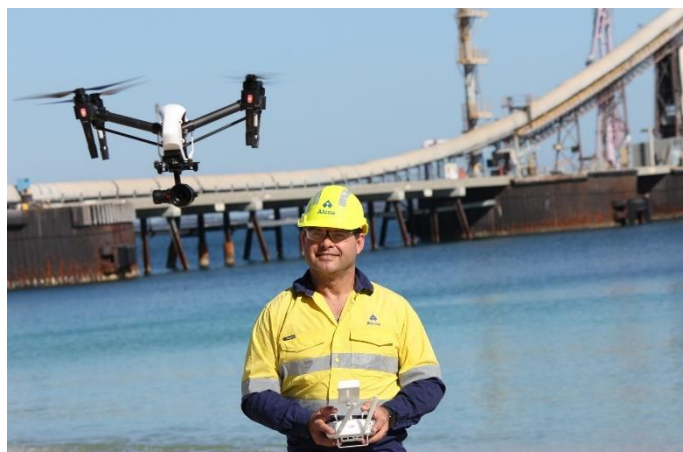
Agriculture

Australia's **agricultural sector generates A$60bn (~US$41.7bn) in annual revenue**. It is one of Australia's most productive sectors technologically, with **AgTech set to become Australia's next A$100bn (~US$70bn) industry.**

- ✓ Farmers have described UAVs as the 'most exciting' tool in agriculture in 20 years, with the **global market for agricultural UAVs valued at A$42.2bn (~US$29.5bn).**

- ✓ **Australia represents a 'perfect test bed for collaborations',** with Australian airspace regulations easily allowing trials, tests and training.

- ✓ **Regulatory reforms in 2016,** allowing private landowners to fly drones of up to 25kg in weight over their own property without requiring a license or operating certificate, **have seen growing numbers of farmers adopt UAV technology**.

- ✓ In particular, the use of UAVs to map crops and properties is building momentum as the new buzzword in 'smart farming', **delivering low-cost precision agriculture**:

  - o Using thermal infrared cameras, drone mapping provides farmers with real-time, accurate data collection facilitating increased efficiencies in regard to weed & vermin control, crop management, and improved irrigation practices, ultimately paying huge dividends to farmers' financial bottom lines.

- ✓ UAVs are also increasingly being used for spot spraying, seed planting, pollination and to check infrastructure such as silos, guttering on sheds, and solar panels, boosting farm efficiency and safety.

- ✓ Meat & Livestock Australia (MLA) – Australia's meat and live-stock industry marketing and research body – is currently driving an extensive A$60m (~US$42m) program of advanced 2D and 3D imaging technologies, encompassing the full 'paddock to plate' red meat value chain.

  - o Part of this involves developing imaging technologies for use in on-farm livestock and pasture management using UAVs.

- ✓ In August 2017, CSIRO's Data61 announced a partnership with Australian-listed agribusiness network Ruralco to develop data-centric and emerging technology solutions to improve the efficiency and sustainability of the agricultural sector.

  - o This includes exploring the use of drones for livestock detection, long-range sensing, the adaption of geospatial tools for improved decision-making; and fertilizer, nutrient, and water malmanagement.

- ✓ Both federal and state governments have made concerted efforts to increase the amount of funding available to aid Australian farmers adopt UAV technologies.

- ✓ In March 2019, consulting firm EY published their report *Agricultural Innovation – a national approach to grow Australia's future*, which was commissioned by the federal Department of Agriculture.
  - o The report provides a roadmap for developing a world class agricultural innovation system to ensure Australia reaches its target of a A\$100bn (~US\$70bn) agricultural sector by 2030.
- ✓ In May 2017, the federal government announced an **investment of more than A\$1bn (~US\$700m) to carry out phase two of the National Landcare Program**, due to be delivered between July 2017 and June 2023.
  - o This includes **the A\$134m (~US\$94m) Smart Farms program** to support "the development and uptake of best agricultural practice, tools and technologies" – including UAVs – with the program to run over six years from 2017-18.
- ✓ The majority of **state governments have also made funding and grants available** for the adoption of UAV technologies. For example:
  - o In February 2019, the New South Wales government announced an extra \$2.8m in farm safety funding for the **Quad Bike Safety Improvement Program**, with the program now expanded to include a **\$500 rebate for one drone per eligible business.**
  - o In February 2019, The Western Australian government opened applications for the fourth year of its **Agriculture and Aquaculture Entrepreneurship Program**, which offers grants of up to A\$20,000 (~US\$14,000) and has so far awarded A\$300,000 (~US\$210,000) to innovative Western Australian farmers looking to adopt and trial new technologies.

Emergency Services

Australia's vast remoteness, and expansive coastal and rural areas underpin the growing emergency services market for UAV solutions. UAVs are increasingly being used to locate missing persons in search and rescue operations, provide real-time assessment of firefighting tactics, improve emergency responders' situational awareness, deliver remote medical supplies, and are capable of doing so more quickly, effectively and affordably than conventional aircraft and helicopters.

- ✓ Drones are increasingly been used by Australia state emergency and fire services:
  - o For example, according to the Queensland government's *Queensland Drones Strategy* (2018), Queensland's emergency services are utilizing drone technology in an operational capacity, with potential application for forensic purposes, disaster response, bushfire monitoring, and search and rescue

  - o Since 2016, Fire & Rescue NSW have been using UAVs to provide fire-fighters with real-time images of areas too dangerous to access and enable damage assessments.
- ✓ In May 2019, the Australian Helicopter Industry Association (AHIA) and Aerial Application Association of Australia (AAAA) issued a combined statement calling for

a coordinated national approach to aerial firefighting to determine the optimal mix of aircraft types (including UAVs) and ensure supply of appropriate aircraft through industry partnerships.

✓ In early 2018, Surf Life Saving NSW (SLSNSW) ran **the largest UAV operations trial ever conducted in Australia**:

- o The trial consisted of **more than 8,000 flights at 20 trial locations** along the NSW coast, with 350 volunteers trained as drone pilots for the trial.

- o The trial was a **collaboration between SLSNSW and the state government who committed A$430,000 (~US$301,000)** towards funding the use of drone technology on the NSW north coast in December 2017.

- o The trial used the **Westpac Little Ripper Lifesaver** UAV, and **focused on rescue, and preventing shark attacks** through AI detection system SharkSpotter (video available here):

  - ▪ In January 2018, a UAV was used to save two teenage swimmers at Lennox Head, dropping an inflatable flotation device within 70 seconds to the pair who were 700m offshore in a swell of about 3m.

  - ▪ Over the course of the trial, 370 sharks were spotted, with NSW beaches closed 50 times due to sharks coming within 200m of swimmers.

✓ Surf Life Saving Australia (SLSA) is now looking to expand its UAV program to more beaches around the country, as well as **conducting further drone trials equipped with thermal cameras** to pick up the heat signature of someone lost in rough seas (or at night), as well as detect heat signatures from predators such as crocodiles.

✓ There is also a **significant market opportunity for UAV systems in the delivery of emergency medical supplies** – such as blood transfusions, organ transplants, vaccines and medicines – to remote and rural areas.

- o Demand is being driven by the unique problems posed by **Australia's expansive rural and regional areas**, and facilitated by Australian operators' **history of early adoption**.

- o Thanks to Australia's progressive and flexible civil aviation authority (CASA), **Australia is ahead of the curve** with regard to the regulatory aspect for longer range, large payload drones.

  - ▪ The greatest barrier to drone operations anywhere in the world – regulatory permission to fly beyond visual line-of-sight (BVLOS) – is less of a barrier in Australia thanks to CASA's more flexible regulations.

  - ▪ Due to Australia's extremely low population density in rural and remote areas, **CASA has granted more BVLOS waivers than any other country**.

o In an expanding global market, the leaders in this space in five years' time will be those that possess the most experience – either directly or through partnerships. Australia represents the perfect proving ground in which to gain this vital experience.

o Currently, Australian rural and remote medical service providers – such as CareFlight and the Royal Flying Doctor Service – are actively investigating the best ways in which to introduce drones into service.

Logistics & Distribution Services

✓ The **distribution services sector is valued at A$273bn (~US$191bn)** and accounts for 16 per cent of Australia's GDP.

✓ Australia is one of only 3 countries worldwide (alongside Switzerland and Rwanda) where regulations allow for routine deliveries by UAV.

✓ Australia's total market for drone delivery solutions is only a small percentage of the global market. However, it still represents an **opportunity in the US$10s of millions for the civilian market alone**, and one that **offers the chance to develop market-leading experience and prove solution which can then be rolled out worldwide**.

✓ The **constructive relationship between industry and Australian regulators** such as CASA, is facilitating Australia's involvement in world-leading trials of drone delivery operations.

✓ In April 2019, Wing Aviation Pty Ltd – a subsidiary of Google's parent company Alphabet – secured approval from Civil Aviation Safety Authority (CASA) for one of the world's first drone delivery systems in North Canberra, Australia.

o Wing have been testing and refining their drone delivery system in Australia since 2014, and received regulatory approval after an 18-month pilot program, in which they completed over 3000 deliveries of food, small household items, and over-the-counter pharmacy products.

o Since launching in April 2019, Wing's service has allowed customers to order a variety of items on Wing's mobile app, and have them delivered directly to their homes via UAV in minutes.

o Wing's launch in Australia means it has beaten rival Amazon to the punch:

▪ Amazon CEO Jeff Bezos had initially predicted Amazon's commercial drone-based delivery service would be available to the public by 2018.

▪ Having proven its technology in Australia, Wing is therefore in the driving seat in terms of targeting the larger and more lucrative markets
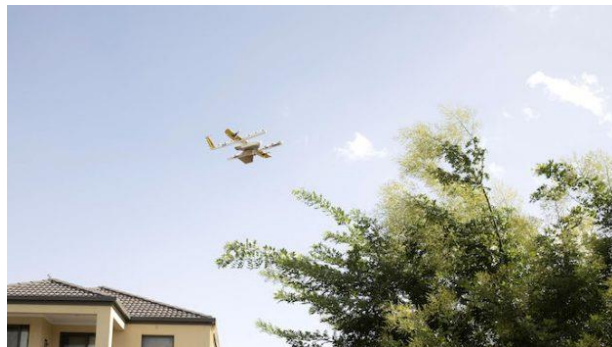
such as [Europe](), where it has begun trials in [Helsinki, Finland]() off the back of its Australian success.

✓ There are also market **opportunities for long-range UAV delivery systems to supply essential parts and equipment** – i.e. tools and small items such as electronic parts or components for solar panels, and hydraulic systems – in rural Australia.

Aerial Imaging

✓ The aerial imaging capabilities offered by **drones are transforming Australia's construction, real estate, insurance, and media & entertainment industries**.

Real Estate	✓ UAV aerial photography and video have become key tools for selling homes and commercial property, with the use of drones [now standard operating procedure]() for progressive real estate agents. ✓ Drone imagery allows agents and vendors to enhance their sales and marketing strategies by allowing them to tell potential buyers more compelling stories about properties and prospective neighbourhoods.
Insurance	✓ UAVs are used to record images and videos of the damage to homes and buildings after natural disasters, and automobiles at crash sites. ✓ This can expedite claims, loss adjustment and assessment of damages, as well as cut claims-processing costs, accelerate customer service, and generate additional underwriting data. ✓ By combining drones with machine learning, insurance companies are able to improve predictions of damage, assess risks better, and thereby set premiums more accurately. ✓ In their widely covered [drone report]() Goldman Sachs, estimated that the global insurance claims drone market was worth US$1.4bn.
Construction & Engineering	✓ UAVs have swiftly become crucial tools for conducting [site and asset inspection]() work in safer, more efficient and cost-effective ways. ✓ Insurance provider [QBE's]() portfolio shows a strong emergence of drone operators among surveyors and civil engineers, [particularly amongst those contracting in the infrastructure and energy sectors.]() ✓ Utilising UAV-based high-resolution imagery, 3D modelling, and real-time surveying, offers the potential to [elevate the construction and engineering industry to new heights.]()
Media & Entertainment	✓ UAV technology offers journalists the ability capture video footage and photography across the globe in hard to reach spots, taking viewers on unique story-telling adventures. ✓ Similarly, today's cinematography requires technically-complex, precision image capture balanced with high degrees of flexibility. ✓ Traditional means of hoisting cameras or using helicopters for above ground shots are rapidly being superseded by UAVs, allowing cinematographers to capture never-before-possible shots, with high-quality imagery in a fraction of the time, and at much less cost (Source: Centre for Robotic Vision, *A Robotics Roadmap for Australia,* 2018).

Unmanned Vehicles – Land

Foley & Associates have identified the following **five (5) sectors**, which present current opportunities for Virginia-based companies in the Australian Unmanned Ground Vehicle (UGV) market:

1. **Defence & Security**
2. **Mining & Resources**
3. **Logistics & Distributions Services**
4. **Agriculture**
5. **Healthcare & Emergency Services**

Defence & Security

As with UAVs, the **2016 Defence White Paper identified a clear need for Australia to expand the ADF's future UGV capacity**.

- ✓ The **ADF has made UGVs a priority**, seeking to develop significant combat advantages from the sensors, smarts, protective and lethal systems that UGVs carry.

- ✓ The Army **anticipates further investment in UGVs** for reconnaissance, logistics and casualty evacuation, and manned and unmanned teaming between helicopters and future UAVs.

- ✓ Over the past ten years – in Afghanistan and Iraq – the ADF has employed UGVs for a variety of security roles including reconnaissance, vehicle inspection, and the detection and identification of enemy improvised explosive devices (IEDs).

- ✓ The ADF continues to invest in Chemical, Biological, Radiological, Nuclear, and Explosive (CBRNE) capabilities and autonomous systems, with a number of strategic procurements being processed.

  - o This includes recent upgrades to the ADFs fleet of QinetiQ TALON counter-IED robots, originally procured in 2009 under a A$23 (~US$16.1m) contract.

  - o In March 2018, Brisbane-based EPE – Trusted to Protect was awarded a A$220,000 (~US$154,000) contract under the Defence Innovation Hub to develop a ground penetrating radar (GPR) capability (Amulet) that can be deployed remotely using TALON for mine detection.

- ✓ In October 2018 October 2018, Rheinmetall Defence Australia and the Department of Defence's Defence Science and Technology Group signed a five-year strategic R&D alliance to work collaboratively to develop autonomous vehicle systems for land warfare platforms in Australia.

- ✓ In June 2018, the Australian Army announced the purchase of four UGVs and accessories from Praesidium Global at a total acquisition cost of A$2m (~US$1.4m) for a 12-month user evaluation trial.

- ✓ In addition, a number of Australian companies are also working to develop technology in this space:

- o In February 2019, Australian space and defence company Electro Optic Systems, announced its co-operation with the unmanned warfare systems developer Milrem Robotics to introduce lightweight 30mm lethality to the UGV market.
- o Queensland-based, Praesidium Global is an Australian technology company specializing in the design and manufacture of military UGVs.
  - Praesidium Global's range of modular UGVs are designed to be adaptable to support military missions including surveillance and reconnaissance, direct fire support, casualty evacuation, and battlefield logistics.
  - In September 2017 Praesidium launched 'Pathfinder', the world's first air-deployable UGV system.
- o Sydney-based Marathon Targets use UGV technology to develop and manufacture robotic targets for military and law enforcement marksmanship training.
  - The company has supplied target systems to special forces, conventional armed forces, and law enforcement across Australia, North America, the Middle East and Europe.

Mining & Resources

Australia is a global-leader in the use of unmanned ground vehicles and automation technologies within the mining & resources sector.

Although the Australian market leads the world, it continues to grow, presenting significant opportunities for interested companies, particularly in regard to solutions driving better safety outcomes, higher productivity, and providing more economical remote and small-scale extraction (Source: Centre for Robotic Vision, *A Robotics Roadmap for Australia*, 2018)

- ✓ The global market for electric and autonomous mining vehicles is **forecast to be worth US$15bn by 2028**.

  - o Within this period, the **Autonomous Mining Vehicles (Trucks) sub-sector is expected to reach US$5bn** as leading players Caterpillar, Komatsu, and Hitachi continue to develop and roll out respective autonomous haulage technologies.

- ✓ Because of the **remote geographic locations, and harsh conditions** in which the Australian mining & resources sector typically operate, as well as the **huge size of Australian mines, leading original equipment manufacturers (OEMs)** such as Caterpillar, Komatsu and Atlas Copco (Epiroc) **see** Australia as **the ideal testbed for advanced autonomous mining equipment.**

- ✓ **Australian mining companies** – such as **Rio Tinto** and BHP Billiton – are **leaders in mining automation systems and operate extensive networks of autonomous and intelligent vehicles on their Australian mine sites.**

- o In December 2017, Rio Tinto committed to expanding its fleet of autonomous haul trucks at its 'Mine of the Future' iron ore operations in the Pilbara in Western Australia by more than 50% by 2019.

- o In 2018, Rio Tinto's **unmanned fleet accounted for one quarter – more than 1 billion tonnes** – of the total material moved across the company's five Pilbara mine sites. Each truck was estimated to have **operated 700 hours more in 2017 than conventional trucks**, with around **15% lower load and haul unit costs.**

- o Rio Tinto is also employing unmanned vehicle technologies in its **AutoHaul autonomous heavy-haul rail system**.

- o Similarly, BHP Billiton is deploying unmanned vehicles at its Mount Whaleback and South Flank projects, which are also located in the Pilbara.

- ✓ These **companies have made, and continue to make, significant investments into researching and developing autonomous vehicle technologies**:

  - o **Rio Tinto**, in particular, has taken a leading role in bolstering R&D, and since 2010, **has spent over A$1.5bn (~US$1bn)** on technology programs and automation efforts

- ✓ With UGVs having been involved in Australian operations for a number of years, **demand is continuing to increase as a result of the clear economic benefits** produced by employing autonomous haulage systems (AHSs), i.e.:

  - o 10% reduction in fuel consumption;

  - o 14% reduction in maintenance costs;

  - o 12% reduction in tyre wear;

  - o 5-10% reduction in labour costs;

  - o 12% increase in truck lifetime; and

  - o 12% increase in productivity.

- ✓ Demand for AHSs are therefore high, typically to enhance existing mining trucks with robust autonomous sub-systems. For example:

  - o Komatsu introduced its FrontRunner® autonomous haulage system (codeveloped with Modular Mining Systems, USA) for use at Rio Tinto's Pilbara iron ore operations in Western Australia

Agriculture

Australia's **agricultural sector generates A$60bn (~US$41.7bn) in annual revenue**. It is one of Australia's most productive technological sectors, with **AgTech set to become Australia's next A$100bn (~US$70bn) industry.**

- ✓ Approximately **two-thirds of Australia's land mass is dedicated to farming**, which cattle-grazing the country's highest-value farm production sector, followed by wheat, dairy, vegetables, fruit and nuts, and lamb meat and wool.

- ✓ As highlighted in the Unmanned Vehicles – Air section of this report, both **state and federal governments have made concerted efforts to increase the levels of**

funding available to facilitate the adoption of emerging technologies – such as UGVs – by Australian farmers. For instance:

- The federal governments **A$134m (~US$94m) Smart Farms program**, which forms part of a **more than A$1bn (~US$700m) investment** to carry out phase two of the National Landcare Program between 2017 and 2023.

✓ Australian agriculture has been an **early adopter of unmanned ground vehicles**, and Australia is **home to ground-breaking research** into the use of unmanned vehicles and automation in agriculture.

✓ The University of Sydney's **Australian Centre for Field Robotics (ACFR)** is recognized internationally for its world-leading research, development, commercialization and theoretical contributions to the development of farm robots and UGVs.

- One of ACFR's key projects is **RIPPA** (Robot for Intelligent Perception & Precision Application), has the capability to operate autonomously 24 hours a day, seven days a week;

- RIPPA can automatically detect and remove weeds and foreign objects; determine crop health and soil status; conduct autonomous precision spraying on individual plants; and monitor crop growth and estimate yield through intelligent data analytics.

- **Ladybird**, another ACFR initiative is an autonomous, lightweight vehicle which has the autonomy to conduct a full range of sensing and manipulation tasks, including mapping, classification, detection, weeding and harvesting of a wide array of vegetables.

✓ The Queensland University of Technology (QUT), is another major Australian academic institution working with the nation's agriculture industry and technology companies to develop farm-focused UGVs.

- QUT's Agbot II is a lightweight, golf cart-sized intelligent UGV, which uses inexpensive sensors to target and spray weeds and is capable of covering a 4,000 hectare (9.8 acre) wheat farm in a single operating session.

✓ In addition to these research developments, there are also **significant opportunities in terms of the autonomous control of tractors and combine harvesters**.

Logistics & Distribution Services

The **distribution services sector is valued at A$273bn (~US$191bn)** and accounts for 16 per cent of Australia's GDP.

With e-commerce growth accelerating rapidly, and consumer appetite for on-demand delivery continuing to increase, **optimising 'last-mile' delivery presents a key opportunity for unmanned ground vehicles**.

✓ The so-called **'last-mile' of delivery is one of the most complex tasks in the supply chain,** and is often the least efficient and most expensive part of the process.

✓ The use of UGVs as autonomous last-mile delivery robots – providing more efficient, affordable and sustainable delivery options – is starting to gain traction globally.

✓ Although so far deployments of delivery UGVs have not progressed beyond pilot phase, the **market is expected to shift quickly in the next 5 to 10 years with up to 80% of last-mile deliveries predicted to be autonomous by 2025** (Source: Gartner – summary article available here).

✓ Australia Post – alongside FedEx, Amazon, and Starship Technologies – has been an early mover in experimenting with UGVs as delivery vehicles.

   o In November 2017, Australia Post ran a four-week trial of automated last-mile, sidewalk delivery using an autonomous ground vehicle developed by Sydney-based robotics firm Marathon Targets, and industrial design consultancy Design + Industry.

   o In the trial, UGVs made more than 100 after-hour, on-demand deliveries in the Brisbane suburb of New Farm, autonomously travelling over 140 kilometres.

   o In October 2018, Australia Post announced it had received 'regulator support' to conduct further trials of UGVs as autonomous last-mile delivery options.

Healthcare & Emergency Services

✓ **Healthcare dominates public sector expenditure and the health sector is Australia's largest employer.**

✓ Recently, **Australian hospitals have been trialling the use of UGVs to increase the efficiency** of hospital infrastructure and essential logistics operations:

   o Lamson Concepts' partnership with the Sunshine Coast University Hospital (SCUH) has seen the deployment of the Lamson Automated Guided Vehicle (AGV) system, Transcar, which automatically transports meals, laundry, waste and supplies through the hospital.

      ▪ 16 Transcar vehicles make more than 900 journeys every day to transport ~500 trolleys to 124 drop-off stations around the hospital.

      ▪ The AGVs can transport up to 500kg and travel along 2.3km of pre-determined track.

      ▪ Lamson Concepts supply a range of autonomous solutions for hospital use and are also working with Sydney's Royal North Shore Hospital.

✓ The automated transport of goods:

   o Reduces injury to hospital staff;

   o Reduces wear and tear on hospital infrastructure;

   o Enables just-in-time delivery and full transparency and control of the delivery processes; and

- o Frees hospital staff to concentrate on patient care and high-skilled activities (Source: Centre for Robotic Vision, *A Robotics Roadmap for Australia*, 2018).

✓ **Australian emergency services are also looking invest in UGV technologies** in order to boost their operational capabilities, **particularly in relation to urban search & rescue, bomb-disposal, and firefighting.** For instance:

- o Fire and Rescue NSW have been using fire-fighting UGVs since 2015, and a Chinese-built urban firefighting UGV recently attracted significant interest from Australian services at the 2018 Australasian Fire and Emergency Council convention in Perth, Western Australia.

Autonomous Vehicles – Road

The Australian market for autonomous road-going vehicles presents **significant potential opportunities** for interested Virginian companies **in regard to public transport, and both private passenger and fleet vehicles.**

- ✓ Self-driving vehicles are thought to **provide a A$95bn (~US$66.5bn) economic opportunity to Australia**, and Australia's future transport industry is **predicted to generate more than A$16.08bn (~US$11.25bn)** in revenue by 2025.

- ✓ In November 2016, Australian transport ministers agreed to develop a nationally consistent regulatory framework.

  - o This **end-to-end regulatory system is scheduled to be completed and in place by 2020**, meaning that **automated vehicles will legally be able to operate freely on Australian roads from 2020 onwards.**

At present, with the regulatory framework for autonomous vehicles still in development, Virginia companies looking to enter the Australian market are **encouraged to explore opportunities to partner with Australian governments and industry in developing autonomous vehicle trials.**

- ✓ In May 2017 Australian transport ministers agreed to the [Guidelines for Trials of Automated Vehicles in Australia](#), enabling **Australian states and territories to commence a wide range of autonomous vehicle trials**.

- ✓ **In the last three years over twenty-five (25) connected and automated vehicle trials have been carried out in Australia.**

- ✓ A full list of Australian transport technology trials is available on the [Austroads website](#).

Examples of autonomous vehicle trials in Australia by state and territory include:

Australian Capital Territory

- ✓ The ACT Government is supporting a **two-year [CANdrive automated vehicle trial](#)** that will include testing driver monitoring systems on 40 residents driving semi-automated vehicles for up to two weeks at a time

New South Wales

- ✓ The **NSW government is trialling [automated vehicles on Sydney's major motorways](#)**, with motorway operator Transurban and some of the world's leading carmakers taking part in the project

- ✓ NSW is also **trialling [automated shuttle buses](#) at Sydney's Olympic Park**, as well as two highly automated [EasyMile EZ10](#) small buses in the **NSW regional centres of Armidale and Coffs Harbour**.

- ✓ In its [2018 Budget](#), the **NSW government budgeted an additional A$10m (~US$7m) over four years** for further autonomous vehicle trials.

✓ Away from the road, the NSW government's **A$8.3bn (~US$5.8bn) Metro Northwest Project** – which opened in May 2019 – **is also utilising autonomous vehicle technology** with its fleet of driverless trains.

Northern Territory

✓ In November 2017, the **NT government completed a six-month trial of an EasyMile Driverless Shuttle Bus Trial** on the Darwin Waterfront Precinct. Now in its second stage, the vehicle is moving people to and from restaurants and shops in the area.

Queensland

✓ The QLD state government is delivering **the Cooperative and Automated Vehicle Initiative (CAVI), which will be the largest on-road testing trial seen in Australia**. The project has four components:

   o The Ipswich Connected Vehicle (ICV) Pilot;

   o The Connected and Highly Automated Driving (CHAD) Pilot;

   o The Vulnerable Road User (VRU) Pilot; and

   o A change management project to enable the transition.

✓ In addition, Queensland has also hosted a **small Driverless Shuttle Bus Trial**, undertaken by EasyMile and Transdev in Cairns, Mooloolaba on the Sunshine Coast, Ipswich, and Cleveland.

South Australia

✓ South Australia was **the first Australian state to showcase automated technology**, in a 2015 trial with Volvo featuring automated software.

✓ The SA Department of Planning Transport and Infrastructure recently conducted a live demonstration of V2X integrated with an automated vehicle, and a further demonstration of advance localisation using V2X communications.

✓ South Australia is also conducting multiple trials of automated, electric shuttle buses, supported by **the state governments A$10m Future Mobility Lab Fund**:

   o **A five-year, A$4m (~US$2.8m) trial** using Navya Arma electric shuttles operation between the Tonsley Park Innovation District, and Flinders University.

   o The Tonsley Innovation District is also the venue for another, **separate autonomous vehicle trial** being carried out by Aurrigo.

- o The state government is also about to trial a [10-passenger automated shuttle](#) on the beachfront at Glenelg, a one-kilometre trip along automated stops. South Australian company [SAGE Automation](#) will partner with US manufacturer [Local Motors](#) to run **the A$1.6m (~US$1.1m) trial**.

Victoria

- ✓ The Victorian government has **led a two-year trial of semi-autonomous vehicles** which has **involved [passing enabling legislation](#)**, and aims to inform the development of regulations and infrastructure for wider self-driving technology.

- ✓ Victoria is home to the **[Australian Integrated Multimodal Ecosystem (AIMES) Test Bed](#), incorporating 100 kilometers of Melbourne roads** on the fringe of the CBD and including the EastLink motorway.

- ✓ [VicRoads](#), the [Transport Accident Commission](#), and [Bosch](#) have partnered to build the first Australian-developed vehicle with self-driving capabilities, following a **[A$1.2m (~US$850,000) investment from the Victorian State Government](#)**.

- ✓ The Victorian government **awarded Bosch a [A$2.3m (~US$1.6m) grant](#)** to put the first driverless car on Victorian roads, as part of the Victorian [CAV Highway Pilot Trial](#).

  - o In [January 2019](#) Bosch announced they plan to conduct tests of an autonomous vehicle on **high-speed rural roads by mid-2019**.

- ✓ The Victorian government's has also **allocated A$9m (~US$6.3m) in funding** to their [Towards Zero Connected and Automated Vehicle Trial Grants Program](#).

  - o As part of this, the Victorian government **awarded a $3.5 million grant to Telstra and Lexus Australia** to run Australia's first connected vehicle field trial using advanced 4G mobile networks.

    ✓ Finally, [VicRoads ITS Grant Program](#) is designed to facilitate and improve the understanding of emerging technologies and their uses on the Victorian road network. Announced projects include:

    o A [driverless shuttle bus trial](#) at La Trobe University in Melbourne.

Western Australia

- ✓ Western Australia was the host of Australia's [first automated bus trial on public roads](#), which commenced in September 2016.

  - o Run by [RAC](#) in partnership with French company [Navya,](#) and the Western Australian state government.

  - o In the third, passenger carrying phase of the trial, the RAC made around 1500 thirty-minute trips, carrying more than 4300 passengers on the open road in its first year of operation.

✓ More recently, Perth was announced as [one of three cities in the world](#) to host a trial of electric-powered autonomous vehicles, produced by French company [Navya](#), and Main Roads WA has also partnered with industry to launch a trial of autonomous heavy vehicle platooning.

Key Players

Industry Bodies

The **relevant industry associations** for the Australian unmanned vehicles sector are:

The Australian Association for Unmanned Systems (AAUS)

- ✓ AAUS is Australia's largest industry advocacy group for unmanned systems.
- ✓ Represents unmanned systems across all three domains: land, sea and air.
- ✓ Focuses on facilitating awareness, integration and collaboration between industry, academia, government and defence, and promoting the adoption and integration of unmanned systems into applications that serve civilian and military needs.
- ✓ Offers members a range of benefits and services, including:
    - o Industry advocacy, representation, and advice;
    - o Networking and promotional business opportunities; and
    - o Discounted insurance.
- ✓ A list of AAUS corporate and academic members is available here.

Australian Certified UAV Operators (ACUO)

- ✓ ACUO is the peak industry body for the unmanned sector of Aviation.
- ✓ Boast the largest membership of certified UAV Operators in Australia, consisting of:
    - o Ordinary members (CASA Certified UAV Operators);
    - o Associate Members (CASA Certified UAV Controllers, Licenced Remote Pilots, or UAV Maintenance Controllers); and
    - o Industry members (Related industry professionals representing the wider commercial RPAS industry across all states and territories).
- ✓ ACUO's main aims are to:
    - o Protect the interests of CASA Certified UAV Operators;
    - o Establish the association as a responsible authority; and
    - o Promote the growth and expansion of Australia's commercial UAV industry.
- ✓ Lists of ACUA Ordinary members are available here, and Industry members here.

Australian & New Zealand Driverless Vehicle Initiative (ADVI)

- ✓ ADVI is the peak industry advisory body servicing the wide ecosystem of automated vehicle activities across Australia.

- ✓ Vision is to accelerate the safe and successful introduction of driverless vehicles onto Australian roads, and to help Australia become a global leader in driverless vehicle technologies and invigorate its automotive and technology sectors.

- ✓ ADVI are supported by over 120 partners from across government and the automotive, insurance, transport, communications, banking, logistics, defence, technology and research sectors. A list of ADVI partners is available here.

- ✓ ADVI's core activities include:

    - o Education, advocacy and demonstration efforts to help inform and raise awareness, encourage community acceptance, and promote understanding of the economic and lifestyle benefits of automated vehicles;

    - o Undertaking independent research to assist partners and the community better understand the opportunities and barriers to the introduction of driverless technology; and

    - o Developing and sharing expertise through thought leadership papers, and providing opportunities for Australian companies and researchers to collaborate in national and international projects.

Intelligent Transport Systems (ITS) Australia

- ✓ ITS Australia is an independent not-for-profit incorporated membership organisation representing ITS suppliers, government, academia, and transport businesses.

- ✓ Affiliated with other peak ITS organisations around the world, ITS Australia is a major contributor to the development of the industry.

- ✓ Aim is to promote the development and deployment of advanced technologies to deliver safe, efficient, and sustainable transport across all public and private modes.

- ✓ Key activities include:

    - o Convening national summits and international conference;

    - o Facilitating dialogue between transport modes and across government jurisdiction; and

    - o Promoting research, development, and the export of Australian technologies.

- ✓ A list of ITS Australia members is available here.

Roads Australia (RA)

- ✓ Roads Australia is a not-for-profit, industry association representing all of Australia's road agencies, major contractors and consultants, motoring clubs, service providers and other relevant industry groups.

- ✓ RA brings together road and transport agencies and industry players to engage on a range of practical and policy issues that are – at their core – about delivering the best transport outcomes for all Australians.

- ✓ A list of RA's 140+ members is available here.

Government Departments and Agencies

Prospective entrants to the Australian unmanned or autonomous vehicle market need to be aware of the role of the following key government departments and agencies:

Department of Industry, Innovation and Science (DIIS)

✓ DIIS is charged with overseeing government's attempts to develop and implement automation technologies within the Australian economy.

✓ Responsible for direction of government investment into unmanned and autonomous vehicle capabilities.

✓ Key policy and planning documents to be aware of:

  o The National Innovation and Science Agenda (NISA), announced in December 2015;

  o The National Strategic Innovation and Science Plan: *Australia 2030: Prosperity through Innovation*, released in November 2017; and

  o The National Digital Economy Strategy, *Australia's Tech Future: Delivering a strong, safe and inclusive digital economy*, released in December 2018.

CSIRO (Commonwealth Scientific and Industrial Research Organization)

✓ CSIRO is Australia's government-funded, national science research agency.

✓ CSIRO's Data61 is Australia's leading digital research network.

✓ Data61 house CSIRO's Robotics and Autonomous Systems group:

  o The group is one of the world's leading robotics and autonomous systems research groups;

  o It develops foundational and applied research across a broad range of domains including: agriculture, advanced manufacturing, mining, and others.

  o Core capabilities include Unmanned Aerial Vehicles (UAVs), and Unmanned Ground Vehicles (UGVs).

CSIRO & Data61 play an important role collaborating with industry, working with corporates and high-growth SMEs to transform their products and services using data driven research and technology

Department of Defence

✓ The primary role of the Department of Defence and the Australian Defence Force (ADF) is to defend Australia and its national interests.

✓ The long-term strategic direction for Australia's defence policy was set out in the 2016 Defence White Paper, which identified unmanned vehicles as a critical component of the ADF's future capabilities

✓ Defence is responsible for overseeing the new, post-White Paper **Defence Innovation System** as well as the strategic procurement of unmanned vehicles and autonomous systems for the ADF.

Civil Aviation Safety Authority (CASA)

✓ CASA is the independent statutory body that regulates Australian aviation safety (i.e. the Australia equivalent of the US Federal Aviation Administration, or FAA).

✓ CASA is responsible for licensing pilots and aviation operators, registering aircraft, and overseeing and promoting aviation safety.

✓ In regard to unmanned vehicles, CASA is responsible for granting Remote Pilot Licences (RePLs), RPA Operator's Certificates (ReOCs), and developing and enforcing the regulations concerning the operation of UAVS.

✓ CASA is approachable, open and eager to work constructively with industry to shape the evolving future regulatory landscape in Australia.

  o In 2019, CASA is planning to introduce a UAV registration and accreditation scheme – more information can be found here and here.

Department of Infrastructure, Transport, Cities and Regional Development

✓ The Department of Infrastructure, Regional Development and Cities is responsible for the design and implementation of the Australian Government's infrastructure, transport and regional development policies and programs.

✓ The Department is responsible for overseeing Australia's preparations for the arrival of autonomous vehicles.

✓ In October 2018, the Office of Future Transport Technology was established as a strategic portfolio within the Department.

✓ The Office's key responsibilities are:

  o To help prepare Australia for the pending arrival of automated vehicles and other transport innovations;

  o To enhance the Federal Government's strategic leadership role; and

  o To enable more cohesive coordination between federal government agencies, state governments and industry in implementing future transport technologies.

National Transport Commission (NTC)

✓ The NTC is an independent advisory body that provides impartial advice and proposals to government on national land transport regulatory and operational reform.

✓ It does so through the Transport and Infrastructure Council, which consists of the relevant responsible Commonwealth, state and territory ministers.

✓ The NTC contributes to the achievement of national reform priorities which are agreed upon by the council. The Council's current strategic reform priorities are:

  o Sustainable funding for transport and infrastructure;

  o Embracing innovation and technology in transport and infrastructure;

- o Productive and liveable cities and regions; and
- o Maximising freight productivity.

✓ The NTC is responsible for delivering a phased reform program so that conditionally automated vehicles can operate safely and legally on our roads before 2020, and highly and fully automated vehicles from 2020.

Austroads

✓ Austroads is the peak organization of Australasian road transport and traffic agencies, with its members collectively responsible for the management of over 900,000 kilometers of roads valued at more than A$250bn (~US$175bn).

✓ Its purpose is to support their member organizations deliver an improved Australasian road transport network that meets the future needs of the community, industry and economy.

✓ Austroads Connected and Automated Vehicles projects are helping to establish the regulatory and operation frameworks required to realize the benefits of emerging autonomous vehicles technologies.

✓ Members include:

- o Roads and Maritime Services New South Wales;
- o VicRoads (Roads Corporation Victoria);
- o Queensland Department of Transport and Main Roads;
- o Main Roads Western Australia;
- o Department of Planning, Transport and Infrastructure South Australia;
- o Department of State Growth Tasmania;
- o Department of Infrastructure, Planning and Logistics Northern Territory;
- o Transport Canberra and City Services, Australian Capital Territory;
- o Department of Infrastructure, Transport Cities & Regional Development;
- o Australian Local Government Association (ALGA); and
- o New Zealand Transport Agency.

Competitive Landscape

Unmanned Vehicles – Air

Defence remains the largest segment of both the global and Australian UAV market. Consequently, the **Australian UAV sector is dominated by the global leaders in the field, who operate alongside local companies offering supplementary, and niche service offerings**.

Companies of note include:

✓ **Leading global firms:**

✓ **Local companies offering supplementary technology or niche service offerings:**

	AVT Australia ascentvision.com AVT Australia is the APAC hub for Ascent Vision Technologies, which manages regional sales, support, R&D and in-house system development for customers.AVT Australia maintains three office locations across the continent and is able to fully develop and manufacture various systems in support of the APAC market.
	Carbonix carbonix.com.au Carbonix are a NSW-based company using state-of-the-art technology to develop robust, lightweight UAV systems using advanced composites. Carbonix's drones are capable of vertical take-off and landing, and in 2018 the company signed a strategic alliance with Hitachi.

	Emesent emesent.io Emesent is a UAV autonomy and data analytics spin-out from CSIRO's Data61. Emesent was launched in November 2018 after the company raised $3.5 million in venture capital to commercialize its first product, Hovermap. Hovermap is a 3D LiDar-mapping and autonomy payload for industrial drones operating underground and in GPS-denied environments and is already been used by early adopters in Australia, the US, Canada, China, and Japan.
	JAR Aerospace www.jar-aerospace.com.au JAR Aerospace specialise in the training, design, manufacturing and sustainment of high performance Unmanned Aerial Systems. In 2018, JAR Aerospace was awarded A$275,000 (~US$192,500) through the Defence Innovation Hub, to develop a hybrid vertical take-off and land, fixed wing UAV for the Australian Defence Force (ADF).
	SYPAQ Systems www.sypaq.com.au SYPAQ is an innovative engineering and systems integration company, who has recently launched Corvo, a range of next generation unmanned systems including Unmanned Aerial Systems. SYPAQ is developing future Small UAVs for the ADF, and were recently awarded an innovation contract through the Defence Innovation Hub to develop a next-generation battlefield logistics UAS, called the Precision Payload Delivery System (PPDS).
	Swoop Aero: www.swoop.aero Swoop Aero are a Melbourne-based start-up who in have become one of the the first two companies in the world to win an open tender to deliver vaccines via UAV to remote areas.

Unmanned Vehicles – Land

Key players in the Australian UGV market include **leading international defence and mining UGV manufactures and autonomous system developers, as well as local companies and research institutions with more niche focuses.**

Companies of note include:

✓ **Global market leaders in defence & border security, and leading original equipment manufacturers (OEMs):**

✓ **Local companies**, including:

	Electro Optic Systsm (EOS) www.eos-aus.com EOS is a leading Australian technology company operating in the space and defence markets. Their products incorporate advanced electro-optic applications based on EOS core technologies in software, laser, electronics, optronics, gimbals, telescopes and beam directors, and precision mechanisms. In February 2019, EOS announced it was co-operating with Milrem Robotics to introduce lightweight 30mm lethality to the UGV market.
	EPE – Trusted to Protect www.epequip.com Brisban-based EPE specialise in counter IED, ECM, and CBRN defence; counter drone, intelligence, surveillance and reconnaissance technology; and also supports broader force protection, security and threat mitigation requirements. EPE work with defence, law enforcement, and emergency services agencies across the Asia-Pacific region.

	Lamson Concepts lamson.com.au Lamson Concepts are an Australian owned provider of material handling solutions, with a national presence and international offices in Kuala Lumpur and Macau. Lamson Concepts supply a range of autonomous solutions for hospital use, including the UGV system, Transcar, which automatically transports meals, laundry, waste and supplies through hospitals.
	Marathon Targets marathon-targets.com Sydney-based Marathon Targets design and build autonomous robotic systems designed to dramatically increase the level of realism in live-fire training environments. They supplied the world's first autonomous targets to the Australian Defence Force in 2008, and have since expanded operations onto four continents. In November 2017, Marathon Targets partnered with Australia Post in trialing automated, last-mile UGV delivery services.
	Praesidium Global praesidiumglobal.com.au Brisbane-based Praesidium Global is a technology company specialising in the design and manufacture of military UGVs. Praesidium Global's range of modular UGVs are designed to be adaptable to support military missions including surveillance and reconnaissance, direct fire support, casualty evacuation and battlefield logistics.
	Swarm Farm Robotic Agriculture www.swarmfarm.com Regional Queensland-based Swarm Farm develop autonomous robots and farm vehicles for use in horticulture, pasture and livestock systems. Swarm Farm have developed world-leading spraying robots designed to work cooperatively in 'swarms', which are powered by small diesal engines and run completely autonomously using GPS guidance.
	Universal Field Robots (UFR) universalfieldrobots.com.au Founded by local engineer Jeff Sterling, Universal Field Robots is a Brisbane-based robotics company specialising in autonoumous field robots for a broad range of industries including agriculture, construction, forestry and mining.

Autonomous Vehicles – Road

Australia offers a welcoming environment for companies looking to research, develop and trial innovative new technologies and solutions for the Autonomous Vehicles – Road sub-sector.

As a result, **international companies, including major OEM carmakers and emerging automated vehicle providers, are present in the market alongside local Australian start-ups**. Companies of note include:

- ✓ **Major OEM Carmakers & Suppliers** trialling unmanned vehicles on Sydney and Melbourne's intra-city motorways.

- ✓ **Emerging Automated Vehicle Providers** trialling and demonstrating their technology in partnership with Australian universities, local companies and transport authorities.

✓ **Local Start-Ups** including:

BARAJA	**Baraja:** www.baraja.com Baraja is a rapdily growing Sydney-based start-up, developing LiDAR for autonomous vehicles, robotics, site surveing and mining applications. In January 2019, BAraja raised A$45m (~US$32m) in Series A funding, and it is expanding rapidly with offices in Sydney, China and the US.
Cohda Wireless	**Cohda Wireless:** cohdawireless.com Cohda Wireless are an Adelaide-based global leader in connected vehicle technology, with offices in the US, Europe and China. In 2017, Cohda were awarded a A$2m (~US$1.4m) government grant to purchase two autonomous vehicles in order to test its V2X-Radar technology on public roads. They have also used their breakthrough V2X technology to overcome GPS blackspots in New York, City.
SAGE	**SAGE Automation:** www.sageautomation.com SAGE Automation is a South Australian-based automation and control company. SAGE is partnering with US manufacturer Local Motors, to run a A$1.6m (~US$1.1m) trial of an 10-seater automated shuttle bus on the Glenelg beachfront in Adelaide, South Australia.
seeingmachines	**Seeing Machines:** www.seeingmachines.com Seeing Machines are collaborating with Volvo Trucks Australia, Ron Finemore Transport, and Monash University to deliver the first industry-led Cooperative Research Centre program developing technology for Driver Monitoring Systems (DMS) and Autonomous Driver Assistance Systems (ADAS).

Local Legislation & Regulation

Information on Australian Legislation & Regulators

Virginian companies exploring opportunities to invest or do business in Australia are encouraged to take the following local legislative requirements related to the unmanned vehicles sector into consideration.

Company Registration

Companies looking **to set up a company in Australia** must be registered with the **Australian Securities and Investments Commission (ASIC)** before commencing business activities.

For additional background information on how to establish a company in Australia, Virginia companies are encouraged to familiarize themselves with the following resources:

- ✓ ASIC's guide on Starting a Company in Australia;
- ✓ The Legal Essentials for Business section of the Business.gov.au Starting a Business Guide; and
- ✓ The relevant Industry Fact Sheets provided by Business.gov.au.

Regulations concerning the operation of UAVs

- ✓ The **Civil Aviation Safety Authority (CASA)** is the regulatory body responsible for Australian aviation safety.

- ✓ The regulations concerning the commercial use of UAVs or Remotely Piloted Aircraft Systems (RPAS) are split depending on whether the proposed drone is under or over 2kg in weight:

- ✓ If under 2kg, commercial drones can be flown in what is called the 'excluded' category. Under this regulatory provision, **operators do not need a license or certification**, but must:

    - o Apply for an Aviation Reference Number (ARN);
    - o Notify CASA before flying a UAV; and
    - o Operate within the Standard Operating Conditions (SOCs) detailed in Part 101 of the *Civil Aviation Safety Regulations 1998*.

- ✓ If a commercial drone is over 2kg, or is going to operate outside of the SOCs, **the pilot and operator will need to be licensed and/or certified**.

    - o A **Remote Pilot Licence (RePL)** is a pilot's individual permission to fly, and allows them to fly for a certified operator. To get a RePL, pilots need to:

        - ▪ Apply for an Aviation Reference Number (ARN); and
        - ▪ Complete the required training through an approved training organization that holds a ReOC.

    - o Once a pilot has a license, they may operate commercially with an operator who holds an **RPA Operator's Certificate (ReOC)**, or else apply for their own certificate. To gain an ReOC an individual must:

        - ▪ Complete Application Form 101-02 and Form 101-04;

- Complete and submit supporting documentation including the [RPAS Operations Manual](#) and [RPAS Operations Procedures (Library)](#); and

- Pay the assessment fee and participate in an interview with CASA

- The **ReOC will specify a permitted operations and weight category**.

  - This will **generally be up to 25kg**.

  - Aircraft over 25kg may be subject to additional approvals processes, and for particularly large aircraft, operators may also require further advanced certifications, on par with commercial pilots' licenses.

  o Some operations will also require [permission to fly](#) under the drone safety rules set out in part 101 of the *Civil Aviation Safety Regulations 1998*. Operations that require approval are listed [here](#).

  o One such operation is **Beyond Visual Line of Sight (BVLOS)**:

  - Although the regulatory environment for BVLOS operations in Australia is still in its infancy, CASA has been willing to take a progressive approach and has granted more BVLOS waivers than any other country.

  - In particular, CASA have allowed BVLOS permissions in rural/remote areas for medical supply, as well as more recently, in [April 2019](#), for Google's [Project Wing](#) in residential urban areas of Canberra.

✓ NB. **Private landowners flying a drone commercially on their own land**, and not receiving money for that work, also **fall into the 'excluded' category provided the drone's weight is less than 25kg**.

  o If the aircraft weighs between 25 and 150kg, a private landowner **will require a RePL, but does not need an ReOC.**

Regulations concerning UGVs

✓ UGVs – the majority of which are employed in the defence, agricultural, and mining sectors – generally operate on private land or **under specific regulations that are delineated on a case-by-case basis**.

✓ As such, Virginian companies interested in the Australian UGV market will need to address their specific regulatory requirements individually.

Regulations concerning Autonomous Vehicles – Roads

✓ Australia is **currently undertaking a phased reform of transport legislation and regulation** with the aim to **introduce a nation-wide, end-to-end regulatory system for autonomous vehicles at all levels of automation to operate on Australia's road by 2020.**

✓ Until this is completed, however, **regulation remains under the authority of the relevant state governments**, and Virginian companies looking to explore opportunities in Australia are encouraged to **review the relevant sections of the state transport authorities' websites:**

  o [Roads and Maritime Services New South Wales](#);

  o [VicRoads (Roads Corporation Victoria)](#);

  o [Queensland Department of Transport and Main Roads](#);

- o [Main Roads Western Australia](#);
- o [Department of Planning, Transport and Infrastructure South Australia](#);
- o [Department of State Growth Tasmania](#);
- o [Department of Infrastructure, Planning and Logistics Northern Territory](#); and
- o [Transport Canberra and City Services, Australian Capital Territory](#).

✓ Companies interested in proposing or being involved in trials of autonomous vehicles on Australia's roads are also encouraged to review the [Guidelines for Trials of Automated Vehicles in Australia](#), which were agreed upon by Australian transport ministers in May 2017.

- o The Guidelines provide a clear and nationally consistent approach that balances safety and innovation.

Privacy Legislation and Responsibilities

✓ Australia has a robust legislative framework protecting the use of personal data, data privacy and data security requirements.

✓ **Organizations seeking to deploy connected and automated vehicle technologies in Australia will be required to comply with the Australian privacy legislation**.

✓ In Australia, the ***[Privacy Act 1988](#)*** regulates the handling of 'personal information' – i.e. any information or opinion that identifies, or could 'reasonably used' to identify or locate an individual – by government agencies, and businesses or not-for-profit organizations with an annual turnover of more than $A3m (~US$2.1m).

✓ Businesses are subject to the obligations set out in the **Australian Privacy Principles (APPs):**

- o The APPs are a set of technologically-neutral, and legally binding principles that provide the cornerstone of the *Privacy Act*'s protection framework; and

- o They set out the standards, rights and obligations in relation to the handling, holding, accessing and correction of personal information.

✓ **In 2014, a new set of APPs were enacted**, which can be viewed [here](#).

✓ Further information on the APPs and privacy rights and responsibilities in Australia is available through the [Office of the Australian Information Commissioner (OAIC)](#).

✓ The OAIC is responsible for enforcing the *Privacy Act*, and has published a range of privacy guidelines online aimed at assist companies comply with Australian legislation:

- o The [Privacy Management Framework](#);
- o [Australian Privacy Principles Guidelines](#);
- o A [Guide to Undertaking Privacy Impact Assessments](#); and
- o A [Guide to Securing Personal Information.](#)

Market Entry Options

Recommendations

Successful market entry strategies for Virginia companies wishing to explore opportunities in Australia's unmanned vehicles sector have three key common elements:

- ✓ **Understanding the market and customer demand;**
- ✓ **Selecting the most suitable partner and/or establishing a presence; and**
- ✓ **Providing ongoing support in the market.**

Key Steps:

In general, Virginia companies should consider the following key steps:

- ✓ It is important for Virginia companies to first gain a deeper **understanding of the Australian market and demand** for a particular product, its competitive environment, relevant standards and regulations, sales channels etc.
- ✓ Success in the Australian market will often require **establishing a local sales presence**, through either a subsidiary, or the appointment of an in-country partner (agent or distributor).
- ✓ Virginia companies should conduct a **visit to Australia** (individually or as part of a group trade mission) to gain better understanding of the market and meet with prospective partners before making any commitments.
- ✓ Once a suitable partner is appointed, providing **ongoing local support and service** is very important as well as maintaining good communication with the partner.

Engage with Industry Associations

As part of their market research, Virginia companies should consider engaging with the relevant industry associations in the unmanned vehicles sector, including:

- ✓ Australian Association for Unmanned Systems (AAUS)
- ✓ Australian Certified UAV Operators (ACUO)
- ✓ Australian & New Zealand Driverless Vehicle Initiative (ADVI)
- ✓ Intelligent Transport Systems (ITS) Australia
- ✓ Roads Australia (RA)

Establish a Presence in the Australian Market

There are various strategies that prospective Virginia companies may want to adopt when wishing to enter the Australian market. These include setting up a local office, appointing a local distributor, acquiring a local company, or setting up a foreign joint venture/strategic alliance.

Each of the options will have advantages and disadvantages, and the decision on which route to take will ultimately come down to the short, medium and long-term business objectives of the specific company. Some of these strategies are highlighted below for further reference:

- ✓ **Setting up a local office or branch** offers customers a reassurance of your company's commitment to the local market, as well as more control of the business

operations and marketing. Some drawbacks include higher risk and set up capital, initial lack of business contacts, and lack of established reputation in Australia.

✓ **Appointing a local distributor / integration partner** offering similar or complementary products offers the benefits of lower initial investment, established local contacts and a faster time frame for market entry. Some drawbacks include trust issues (regarding liability), lack of control of business operations and possible performance issues if no sales milestones are set in place.

✓ **Acquiring a local company** – May take less time to access and penetrate the market as the company would have an existing distribution network in place. The drawback would be a **large capital investment**, and possible slower post-merger integration.

✓ **Setting up a Joint Venture/Strategic Alliance** – Virginian companies could also consider forming a joint venture, or strategic alliance with a local Australian company. The advantage would be possible faster market entry. However, potential risks could be differing on goals and objectives and also lack of total control of management.

Considering the options listed briefly above, it is our general recommendation that Virginia companies wishing to explore opportunities in the Australian unmanned vehicles sector should **appoint a local distributor / integration partner**. Ideally, these local partners would have established working relationships with key stakeholders in both the public and private sectors, and operate across a range of industries.

Participate in a Market Visit

Before making any commitments, however, **we recommend that Virginian companies should participate in a market visit** in order to gain a better understanding of the market and interview prospective partners. This visit could be undertaken individually, or as part of a group trade mission, such as that being **run by VEDP in October 2019.**