



Australian Government
Australian Trade and Investment Commission



AUSTRALIAN DISRUPTIVE TECHNOLOGIES

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INTRODUCTION

Disruptive technologies – innovations that displace existing technologies or create new industries – continue to mature and provide efficiencies that are transforming the global economy.

Fast-moving companies worldwide are establishing entirely new product and service hybrids that disrupt their own markets and generate fresh revenue streams.

Australia's transition from a resources- to services-based economy is driving opportunities in disruptive technologies across multiple sectors including advanced manufacturing, agriculture, services, health, infrastructure, and resources and energy.

Between 2014 and 2020, the contribution of digital technologies to Australia's economy is forecast to grow 75 per cent to A\$139 billion.¹

Australia offers niche solutions and proven capability in additive manufacturing, artificial intelligence, automation, big data and analytics, blockchain, cloud, cyber security, immersive simulation, the Internet of Things and systems integration. Australian companies are well placed to offer advice, technologies, products and services across these areas to global clients and partners.

Its distance from export markets means Australia has typically focused on small, high-value products that can easily access offshore markets to achieve scale and return on investment. Australians are also experts at complex problem-solving, applying and leveraging disruptive technologies to address existing and emerging operational, financial, environmental and social issues.

Australia has a number of key characteristics that underpin its ability to create, develop and commercialise new digital technologies:

- › a robust research and development ecosystem
- › natural advantages in key global growth industries
- › a highly skilled and innovative workforce
- › a stable economic and political environment with robust regulatory protections
- › federal and state governments that welcome and support innovation.

The Australian R&D ecosystem is a tightknit community of businesses, universities, research institutions and public sector agencies that frequently collaborate on innovation projects, ensuring the resulting product, service or technology has commercial applications. Australia has strong patent protection laws and R&D tax incentives that support the R&D ecosystem. International collaborators are active and welcome in this community.

Recognising the transformational potential of the digital economy, the Australian Government has made digital technologies an essential part of its National Innovation and Science Agenda. It has introduced a series of initiatives including the Prime Minister's Industry 4.0 Taskforce to drive innovation, investment and adoption of disruptive technologies across the economy.

With a track record of excellence in complex problem solving and a natural advantage in globally significant industries, Australia offers compelling opportunities in disruptive technologies for buyers, investors and collaborators.

ADDITIVE MANUFACTURING

Additive manufacturing – the process of joining materials to make objects from 3D model data, usually layer upon layer – is streamlining supply chains, reducing inventory requirements, lowering production costs, and driving new intelligent lightweight designs.

Australia's long history of advanced manufacturing has nurtured a favourable environment for additive manufacturing technology applications and accelerated commercialisation.

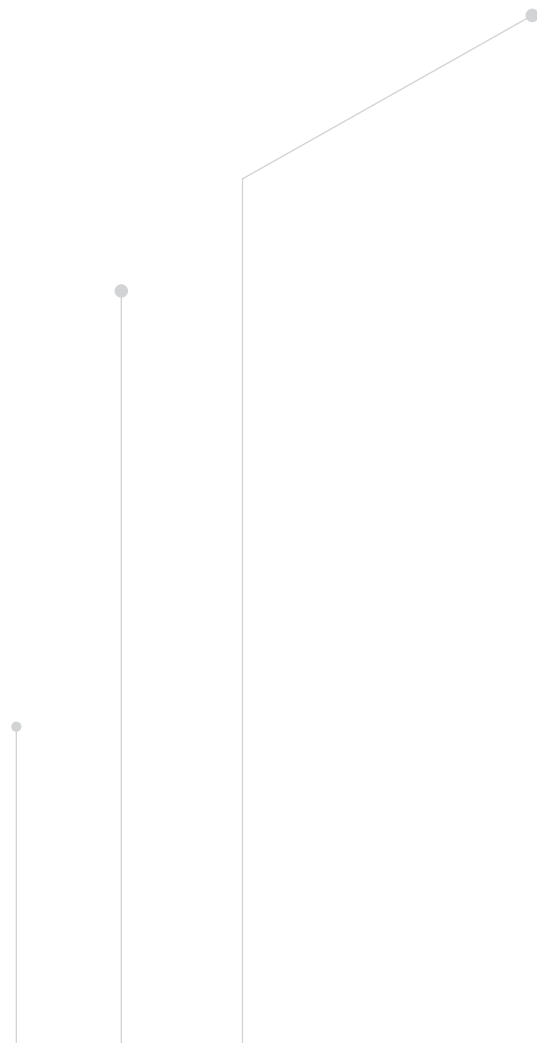
The Australian health, aerospace, maritime, automotive, and mining and energy sectors have integrated a range of additive manufacturing practices into their production lifecycles, including rapid prototyping, additive fabrication, specialised component and part production, moulding and injecting, materials processing, repair and maintenance, and research and development.

Within 3D printing, Australia is at the forefront of metal fabrication. Australian companies offer a range of 3D metal manufacturing services including:

- › production of bio-compatible bone replacements
- › moulds and models for casting
- › affordable metal fabricating 3D printing hardware
- › prototype production.

Australia's aerospace industry in particular has been an innovator of additive manufacturing applications, techniques and processes. Companies in this sector are using intelligent design and tool-less production to manufacture aircraft parts on demand, to specific requirements and in small production runs.

As a result, the sector has been able to lower costs, reduce inventory requirements, test ideas, increase production and shorten delivery turnaround times. The lighter materials used in additive manufacturing also help reduce fuel consumption and carbon dioxide emissions.



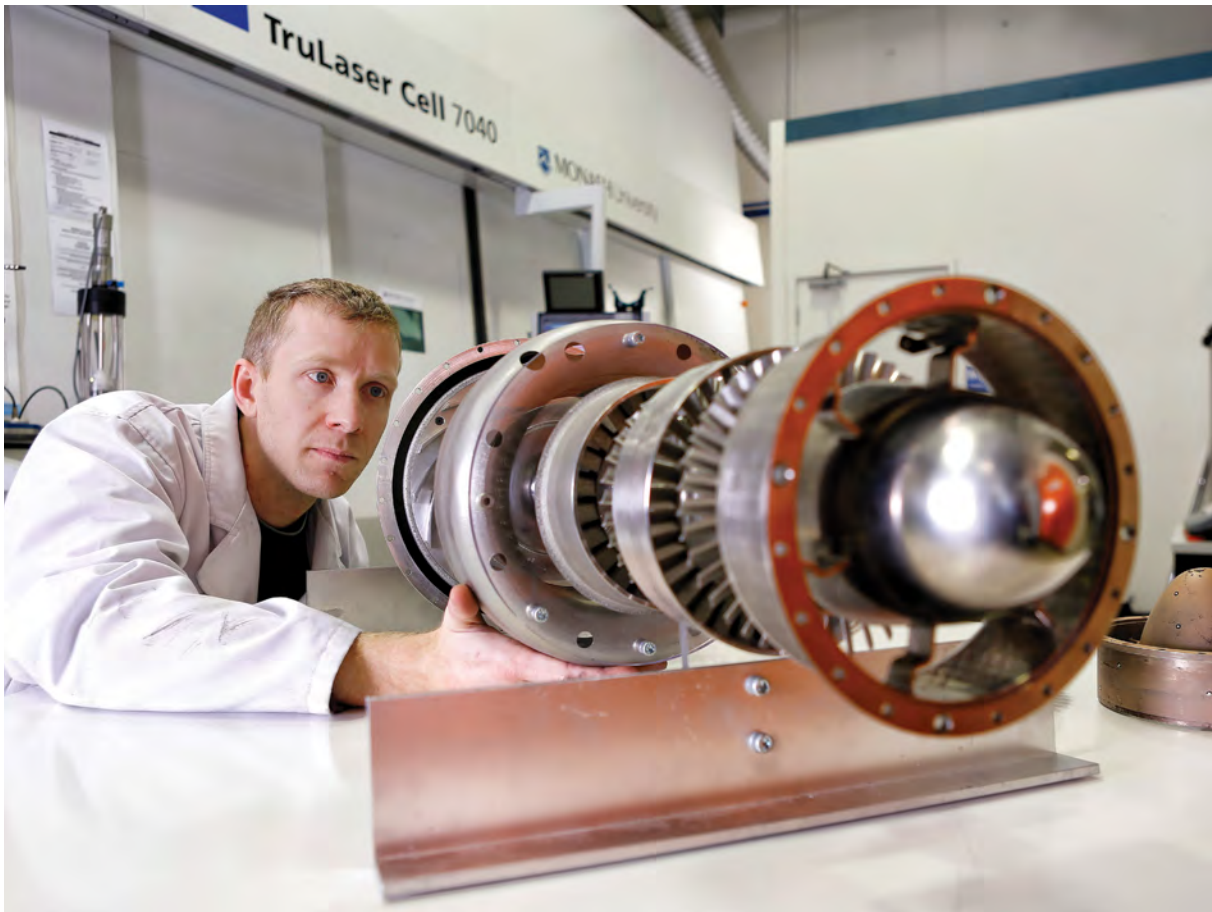


Image courtesy of Amaero. 3D printed jet engine.

CASE STUDIES

Amaero is a private company with manufacturing operations in Australia and France. The company uses additive manufacturing technologies such as Selective Laser Melting and Direct Laser Deposition to manufacture and repair metal components for a range of materials. Amaero services many industries and market segments including aerospace, defence, automotive, tooling, rail, biomedical and natural resources.

amaero.com.au

Anatomics was the first company in the world to develop an interface between a CT scanner and a 3D printer. This led to the development of a series of world-first 3D-printed implants, including implants made of polyethylene, a type of plastic that can be moulded by surgeons and meld with the patient's own bone and tissue. Anatomics also worked closely with CSIRO to design and manufacture the world's first 3D-printed titanium sternum and partial rib cage. The unique titanium technology has a vast range of applications, including skeletal reconstruction and prosthetic devices.

anatomics.com

ARTIFICIAL INTELLIGENCE

Australia's market for Artificial Intelligence (AI) – code and algorithms that give machines the ability to mimic human or cognitive functions – is expected to grow as Australian industry seeks opportunities to broaden its AI strategies and drive innovation.²

Australia's innovation and startup hubs, accelerators and venture capital communities are actively promoting and building capability in AI.

Australia's world-class scientific and academic institutions, high levels of investment in research and development, modern ICT infrastructure and strong intellectual property protection, make it an ideal test bed for developing and applying AI. Australia has niche AI capability in agribusiness, intelligent health solutions, resources and energy, education, financial services and transport.

Australia has a robust AI research and development ecosystem. For example, the University of Technology Sydney's **Centre for Artificial Intelligence (CAI)** is a world-leading research centre in AI. Its vision is to develop theoretical foundations and advanced algorithms for AI and to drive progress in related areas such as computational intelligence, business intelligence, computer vision, data science, machine learning, brain computer interface, social robotics and information systems. CAI consists of five research laboratories: Data Science, Decision Systems, Magic Lab, Knowledge Infrastructure and Brain Computer Interface. The AI techniques and software developed by CAI researchers are recognised by the AI society and used by industry.³

AI is also being applied within industries such as healthcare to find meaning in data for more effective and faster early detection and diagnosis, as well as to reduce the stress of misdiagnosis.

Wearable devices are delivering personal data into machine learning platforms that communicate through AI to forecast decisions.

For example, Australia's CSIRO is analysing a database of healthy individuals and patients with Alzheimer's to learn pattern characteristics of the disease, to identify the Alzheimer's signature from unseen individuals' scans. The clinical report generated allows doctors to diagnose the disease faster and with more confidence.

Australia is also leading research and development in advanced AI applications and equipment for healthcare. Deakin University has developed a remote ultrasound technology – Haptically-Enabled Robotics – which can be applied to abdominal ultrasound imaging to evaluate a patient's kidneys, liver, gall bladder, pancreas, abdominal aorta and other blood vessels of the abdomen. This technology will greatly improve healthcare services in remote and regional Australia and other parts of the world.

“AI and robotic automation is perhaps the biggest economic opportunity that Australia has over the next 30 years. It is by far the largest source of productivity growth and could potentially add up to \$2.2 trillion in value to the Australian economy by 2030.”

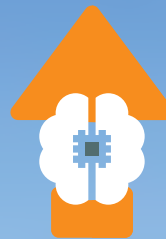
Andrew Charlton, Director, AlphaBeta

CASE STUDIES

The **University of Sydney** has launched a new A\$7.5 million research centre in partnership with world-leading Chinese robotics company, **UBTECH Robotics**, to explore new opportunities in AI. The UBTECH Sydney Artificial Intelligence Centre will bring together a multidisciplinary team of researchers dedicated to undertaking innovative research to solve major problems in AI. Led by one of the world's foremost researchers in AI, Director Professor Dacheng Tao, the Centre will specifically target the challenges of intelligent machines such as robots, self-driving cars and drones. usyd.edu.au

The University of Sydney's **Australian Centre for Field Robotics (ACFR)** has been conducting research in autonomous remote sensing systems, and developing innovative robotics and intelligent software for the environmental and agricultural community for over a decade. One such project is RIPPA (Robot for Intelligent Perception and Precision Application), which aims to increase yield and reduce farming costs. RIPPA has the capability to: operate autonomously 24 hours a day, seven days a week; automatically remove weeds; autonomously detect and remove 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. acfr.usyd.edu.au

Hitachi has worked with the Japanese Government, owners of the Quasi Zenith Satellite System (QZSS), and local Australian partners such as CRC-SI, RMIT, the University of New England and local farmers, to successfully demonstrate the autonomous control of tractors directly from the satellite system, eliminating the need for local ground-based communication networks. hitachi.com.au



62.9%

**CAGR OF THE GLOBAL
ARTIFICIAL INTELLIGENCE
(AI) MARKET
FROM 2016 TO 2022 ⁴**



AUTOMATION

Australian industry was an early adopter of automation – the use of machines and technology to make processes run on their own without input from an operator.

Australia's process automation expertise covers areas such as modelling and learning, robotic vision, mapping and learning, path planning, manipulators, simultaneous localisation and mapping, unmanned aerial vehicles, artificial intelligence, sensing and tracking, and systems and architecture.

Australian companies are experts at bespoke design of integrated automation hardware and software packages, with components tailored to meet a client's specific needs. They have typically focused on small, high-value add software products that can easily access global markets to achieve scale and return on investment. They have also commercialised specialised components for autonomous equipment supply chains.

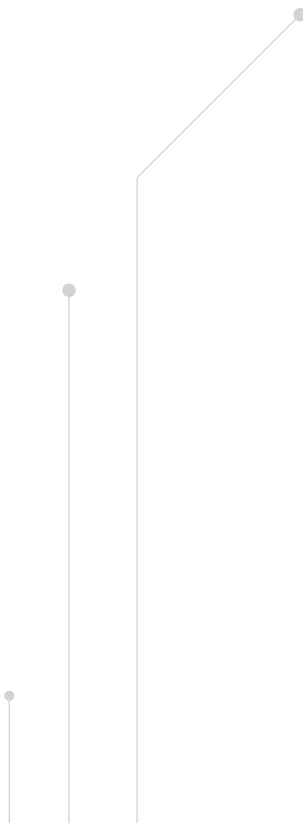
For the Australian agriculture and resources industries in particular, automation allows statistical process control methods to be applied to the highly variable inputs of geology, mineralogy, topography, weather, soil and plant conditions. This eliminates waste in the value chain, reduces in-process inventory, and cuts the total time from order to delivery. The technologies developed for these two industries can also solve similar automation problems in other industries with variable input parameter problems, including defence and aerospace.

Australian industry strengths

RESOURCES AND ENERGY

Australia has many remote mines and oil and gas facilities. Increasingly the trend is to operate, inspect and maintain as much of this equipment from city locations. Australia is also the global hotspot for field-testing the automated variants of underground and open-pit mining equipment from original equipment manufacturers.

In Australia, there is a significant industry providing products and services for remote operations. These products include underwater remote operated vehicles (ROVs), some with manipulators, or Unmanned Aerial Vehicle (UAVs). The ROVs can undertake underwater construction, cable laying, salvaging and maintenance. The UAVs are used for a range of applications including fixed plant equipment inspections, product and pit surveys, and environmental surveys and monitoring.



AEROSPACE

In aerospace, Australia has strong capabilities in Unmanned Aerial Vehicles (UAVs). For example, the UAV propulsion system designed by Australian manufacturer Orbital has increased efficiencies in unmanned aircraft. The system has been fitted to Boeing's ScanEagle UAV, which is used by the US military.

The majority of Australia's aerospace automation capabilities are based on software products that are installed on autonomous or semi-autonomous equipment. A range of functionality is available, including:

- › anti-collision management to complement human pilots
- › automated separation management of both manned and unmanned aircraft in complex airspace environments
- › automated emergency landing that incorporates additional sensors and algorithms to complement a pilot's awareness in emergency landing scenarios
- › automated precision guidance for aircraft flying in proximity to powerlines, assets and vegetation, using LiDAR imagery to detect these objects
- › automated ground observation satellite calibration using autonomous rovers.

INTELLIGENT HEALTH SOLUTIONS

The Australian healthcare industry is an early adopter of advanced robotic technology, and the demand for health-related technologies remains significant. Australian hospitals, such as Gold Coast Surgical Hospital, Royal Prince Albert and Westmead, have been using robotics for precision orthopaedic, eye and general surgeries, hair implants and rehabilitation services. This precision technology shortens patients' hospital stays, facilitates relatively quicker recoveries, minimises blood loss, and reduces the risk of infection and surgical complications.

Australian private hospital groups, such as Epworth, Macquarie and St John of God, have developed advanced capability in using robotics for urology, cardiology, gynaecology and general surgeries. Most recently, the University of Sydney, in partnership with Royal Prince Alfred Hospital, established the Institute of Academic Surgery, Australia's first hybrid robotic surgery training centre.

Other leading Australian universities are also collaborating with the healthcare industry. For example, the ARC Centre for Robotic Vision, based at Queensland University of Technology, is undertaking research to develop technologies that will give robots visual perception – the ability to 'see'.

DEFENCE

Australia has automation expertise in the defence training environment. This includes:

- › providing mobile communication networks or airborne intelligence
- › surveillance and reconnaissance to support vehicle and soldier deployments using autonomous UAV swarms
- › marine unmanned vehicles for mine countermeasures, hydrographic operations and delivery of life-support supplies to disabled submarines
- › autonomous rovers for use in live fire-training scenarios.

CASE STUDIES

Remote Control Technologies (RCT) is one of Australia's leading providers of adaptable remote technologies. RCT's ControlMaster® products provide remote control and semi-autonomous capability to vehicle fleets. The technologies can be scaled from line-of-sight remote control and teleremote control to semi-autonomous and fully autonomous guidance for basic tasks like tramping.

Unlike OEM-based automation solutions, RCT's technology can be fitted to any third-party vehicle. The company's products provide mining companies with greater flexibility on fleet-sourcing strategies. RCT's ControlMaster® technologies are used at mine sites around the world including China, Chile, Mali, Papua New Guinea and Siberia, and have been proven on a range of equipment, including trucks from Caterpillar and Komatsu.

rct-global.com

Marathon Targets designs and builds autonomous robotic systems to dramatically increase the level of realism in live-fire training environments. Marathon delivered the world's first autonomous robotic targets to the Australian Defence Force in 2008. Since then the company has expanded its operations to four continents and established itself as one of the leaders of innovation in the live-fire training market. Marathon remains committed to the defence and law enforcement market, and plans to apply its near decade of experience of robots operating in challenging real-world environments to new markets. **marathon-targets.com**

Australia's automation expertise by sector⁵

	Agriculture	Resources and energy	Defence	Construction and other	Manufacturing	Aerospace
Fully autonomous	●		●	●		●
Semi-autonomous		●				●
Telerobotics		●	●			
Hardware for autonomous applications	●	●		●		
Software for autonomous applications	●	●		●	●	●
System design	●		●		●	

BIG DATA

The capture, collection, integration, analysis and application of big data is at the heart of many disruptive technologies. Australia excels at applying complementary disruptive technologies to extract, process and refine big data, then using the data to solve complex problems.

Australia's strengths in big data and analytics spans the resources and energy, smart cities, transport, agriculture, health, services and education sectors. Key capabilities are in complex problem solving, analytics software, research and development, and education and training, driven by strong connectivity and a favourable federal and state government regulatory environment.

Australia's vibrant startup community is a significant contributor to big data innovations. An Australian survey of startup companies, Start-up Muster 2016, found that 15.1 per cent of respondents were big data startups.⁶

Many startups combined software, analytics and insights – often delivered in a visual format – wrapped in a niche solution. For example, Australian data mining and data analytics startup, Data Republic, provides a secure platform for data exchange and recently attracted A\$10.5 million in investment from the National Australia Bank, Westpac and Qantas.⁷

The Australian data centre services market is undergoing a period of significant growth, and the increase in global mobile data traffic is expected to continue to underpin the demand for data centre services in the future.⁸

The Department of the Prime Minister and Cabinet has also established the Data Integration Partnership for Australia (DIPA), demonstrating Australia's commitment to a data-led economy and data-driven organisations.

Australian industry strengths

OIL AND GAS

Australia's oil and gas industry is using big data analytics to create solutions that are having a real impact in the field. For example, the use of sensor technology and modern communications and data analytics is helping companies increase efficiency and automation, undertake more precise planning, and improve inventory management and uninterrupted remote surveillance of equipment, plant and production sites.

Big data solutions are being used at remote facilities across Australia to predict failures so proactive maintenance can be undertaken. Real-time insights are also improving operational efficiencies. For example, Santos is using big data solutions to improve the efficiency and safety of maintenance crew and the uptime of remote plant and equipment in South Australia, while Origin Energy is using an integrated production modelling simulation suite to run complex scheduling scenarios for its Australia Pacific LNG project.

INTELLIGENT HEALTH SOLUTIONS

Australia is implementing digital health solutions to grow a sustainable healthcare system and respond to system-wide challenges, including increased cost and demand pressures, greater demand for personalised care and an ageing population. Australia is a leader in areas such as health messaging and electronic health record architecture.

Underpinning this shift to digital health solutions is Australia's expertise in data analytics software and big data analysis. In particular, Australia has niche areas of capability in mobile computing platforms for data analysis, clinical analysis of patient data, bio-informatics, precision medicine and medical imaging of patient data.



INTELLIGENT TRANSPORT SYSTEMS

Australia's mining, agriculture and transport industries require intelligent transport systems (ITS) to overcome issues related to high costs, labour intensiveness and geographical spread. Australian governments at every level support ITS and Australia is home to a range of autonomous vehicle test sites and trials.

The ability to analyse data in real time for spatial mapping, asset monitoring, predictive monitoring, road safety and mobility is fundamental to ITS functionality. An Australian Transport and Logistics Living Lab, coordinated by CSIRO's Data61, seeks to increase the productivity, efficiency and safety of Australia's transport and logistics industry by fostering collaborative innovation.

The lab provides a platform for industry, research and government to investigate real-world problems and demonstrate transport and logistics technology. Led by industry members, the lab has more than 50 participants including global companies and research organisations such as the Fraunhofer Society, a German research institution.

The Australian big data market is expected to grow from US\$1.22 billion in 2016 to US\$2.10 billion in 2020.⁹

CASE STUDIES

DownUnder GeoSolutions provides exploration and production services to the global oil and gas industry. It has patents for both seismic processing algorithms and computer hardware solutions and operates some of the largest and greenest super computers on earth. The company has some of the biggest privately owned computers in the world, equipped with revolutionary cooling technology and highly sophisticated software to extract every possible piece of information from masses of geoscience data. **dug.com**

Australian health informatics company **Alcidion** has developed new heart-data technology in partnership with the National Echocardiography Database of Australia (NEDA). The technology extracts, normalises and amalgamates data from echocardiography studies performed around Australia into a single, centralised cloud-hosted database server. The NEDA study will be the largest study of heart function in the world. **alcidion.com.au**



BLOCKCHAIN

Australia is positioned to be a global leader in blockchain innovation, including distributed ledger technology (DLT) – a consensus of replicated, shared and synchronised digital data across multiple sites, countries or institutions.

Blockchain allows for the provision of a secure and trustworthy record of transactions between parties that can prove where information has come from and gone to.

It has potential value for many industries including banking (remittance), professional services (accounting, audit, legal), agribusiness (food provenance), supply chain management and intellectual property. The large size and high demands on Australia's agribusiness industry, for example, mean the demand from the sector for technology solutions is significant.

“Investment by the Australian Government through Data 61 to research this undeniably globally transformative technology puts Australia on the leading edge of nations looking to educate the population on the applications and opportunities presented by blockchain technology.”

Martin Davidson,
Co-founder, Melbourne's Blockchain Centre

Australia is taking a leadership position in blockchain research and strategy, in various ways:

- Australia will manage the secretariat of an international technical committee for the development of blockchain standards after the International Organization for Standardization approved Standards Australia's proposal for new international standards on blockchain.¹⁰
- CSIRO's Data61 published two landmark research papers in May 2017¹¹ and is clearly positioned as the leader on blockchain strategy for Australia.

Australian organisations using blockchain include the Australian Securities Exchange (clearing and settlement for equities), Australia Post (identity, e-voting and registries), WebJet (hotel bookings), AgriDigital (grain supply chain) and Australian banks.

Australia's appreciation of the opportunity, challenges and outcomes from blockchain, as well as its regulatory frameworks, digital literacy, cloud infrastructure, IP management and research, are all contributing to its ability to compete globally in this field.

CASE STUDIES

AgriDigital is Australia's leading provider of blockchain solutions for farmers. In 2016 it executed the world's first live settlement of a wheat deal in Australia. In August 2017, CBH Group – Australia's largest grain exporter – completed a pilot with AgriDigital to trace the movement of oats through the supply chain. It tested origin, quality documentation and match title transfer and payment. agridigital.io

TBSx3 is applying blockchain to defeat counterfeiters in manufacturing, distribution and logistics. The company's technology can mathematically prove whether an item offered for sale is a genuine product. The free app allows consumers to verify that the item on the shelf was genuinely produced by the manufacturer. Each bottle, can or packet can be mathematically identified, making fake product IDs impossible to create. tbsx3.com

Power Ledger is an Australian startup using blockchain to offer a transparent, automated and auditable market trading and clearing mechanism for the sale of excess renewable energy.

Energy is produced onsite at residential and commercial developments, businesses and homes connected to the distribution network. Power Ledger allows for each unit of electricity to be tracked from the point of generation to the point of consumption within the building it is generated, or when sold to other consumers, using the local electricity distribution network. Power Ledger uses a peer-to-peer trading system to allow renewable energy asset owners to decide if, when and who they want to sell their surplus energy to and at what price. powerledger.io

Australian industry strengths

FINANCIAL SERVICES

Australia's major banks and leading financial institutions are trialling and using blockchain applications. For example, the Commonwealth Bank has completed more than 25 blockchain-related experiments over the past year and believes trade finance is one of the areas offering the most potential for blockchain. The bank has also built a blockchain for debt capital markets which has been tested by the Queensland Treasury Corporation to issue semi-government bonds.¹²

Two of Australia's other major banks, ANZ and Westpac, have completed a trial of distributed ledger technology for the bank guarantee process used in commercial property leasing in July 2017.¹³

The Australian Securities Exchange (ASX), in collaboration with Digital Asset Holdings, is examining the use of blockchain technology in its clearing and settlement system for the Australian equity market. The potential outcomes are increased visibility, reduction in transaction times, fraud and errors, and greater confidence and certainty in the equity settlement process.

ASX-listed Kyckr started developing blockchain architecture over 18 months ago. Alongside its work with global banks on 'know your client' (KYC) solutions, it has produced a blockchain delivering corporate identity-vetting for global transactions.¹⁴

CLOUD

Cloud computing – access to computing services (servers, storage, databases, networking, software, analytics and more) via the internet or related telecommunications networks – is a mainstream technology in Australia.

Cloud services are offered through three access models – public (shared), private (dedicated) or hybrid (a mix of public and private). Australia has capacity in all three primary types of cloud service, including Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).

Australia's cloud computing competitive advantage stems from its geographic isolation, availability of low-carbon energy sources for data centres, low sovereign risk profile and a regulatory environment with robust privacy laws.

Australia is home to many global SaaS success stories such as graphic design software (Canva), collaboration tools (Atlassian), workplace safety (Safety Culture) and corporate culture (Culture Amp). These 'born global' companies are benefiting from Australia's active technology community, which facilitates collaborations between universities, research entities and the private sector, as well as research and development tax benefits.

Data centres driving cloud computing

The push towards cloud computing, increased internet use, and the rapid uptake of audio and video content streaming services have created high demand for data storage in Australia. As a result, Australia's data storage services industry has experienced double-digit growth (16.5 per cent) over the five years to 2016–17.¹⁵ This trend is expected to continue for the next five years.¹⁶

In 2016, Australia ranked sixth ahead of Singapore, the UK and South Korea in BSA's Global Cloud Computing Scorecard, which compares the cloud computing readiness of 24 countries that account for 80 per cent of the world's IT markets.¹⁷ This ranking reflects Australia's commitment to developing cloud computing laws, regulations and standards that enable international cooperation, free trade and interoperability.

By 2020, the Asia-Pacific region will have approximately 11.7 billion connected devices. Of that, Australia will have 230 million – 9.3 devices per person.¹⁸ Australia's geographic location provides a natural protection for Australian suppliers of cloud services to the domestic market and, due to time zone advantages, positions Australia as a preferred supplier to nearby Asia-Pacific markets.

As demand for data centre services grows, a number of data centre specialist providers, including NEXT DC, Equinix, Global Switch and Metronode, have expanded their data centre facilities or built new ones. Currently there are 103 co-location data centres in Australia, with the majority located in Melbourne (21), Sydney (20), Brisbane (20), Perth (14) and Adelaide (13).



Infrastructure technology projects

There are a number of major infrastructure projects underway in Australia that will have significant implications for the future development of the digital environment and cloud computing, including the rollout of the National Broadband Network (NBN) and 4G mobile networks. Telstra is also planning a world-first trial of a 5G mobile network during the Gold Coast Commonwealth Games in Australia in 2018.

The NBN will allow consumers to deploy onto the cloud consumer-created or acquired applications. These will enable the Australian ICT industry, the education and health sectors, the Australian Government and research institutions to innovate in the areas of e-learning, e-health, e-government and e-research, and to significantly improve productivity in these sectors.

GLOBAL FIRMS INVESTING IN AUSTRALIA

US company **Equinix** operates four data centres in Sydney and one in Melbourne, providing interconnected facilities that give clients access to a range of network and cloud service providers worldwide. The company invested A\$121 million to construct a fourth data centre in Sydney, bringing its total Sydney footprint to over 24,200 square metres. In Sydney, Equinix runs a business hub for more than 600 companies and offers direct access to over 225 cloud service providers, including Amazon Web Services, IBM, Microsoft and Oracle. Financial service providers, such as Chi-X and Bloomberg, as well as Sydney's growing electronic payments industry, use Equinix's facilities. **equinix.com.au**

CYBER SECURITY

Australia is at the forefront of developments in safety and security in the online environment. With robust legislation, advanced law enforcement capability, rigorous policy development and strong technical defences, Australia is an ideal environment for advanced research in cyber security.

The strength of the sector is characterised by:

- › a string of dedicated research hubs
- › bespoke product development in both hardware and software
- › information security consulting services providing expert advice
- › a wide variety of training and education services covering all aspects of technical and non-technical issues.

Australian industry strengths

RESEARCH AND DEVELOPMENT

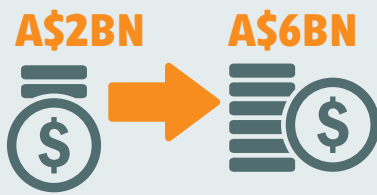
Australia has world-class cyber security research capability, housed within the university, government and private sector. In terms of citation impact, an indicator of research quality, Australian cyber security research ranks ahead of the US, Canada, England, Germany, Japan and Singapore.¹⁹ Some of the best cyber security researchers in the world are also based in Australia.

Australian researchers focus on niche areas of cyber security such as quantum technology, wireless technology and trustworthy systems. Australia ranks fourth globally in patent filings in cyber security research and development.²⁰

This R&D capability makes Australia a popular test bed for new technology.

- › **CSIRO's Data 61**, Australia's largest data innovation group, has developed the seL4 kernel, which provides the strongest operating system security available in the world. The Defence Science and Technology Group (DST) has developed award-winning approaches for the trustworthy use of commercial hardware. Data 61 and DST are partnering to bring together these developments and provide feasible trustworthy software and hardware solutions with broad applicability.
- › An international team of scientists led by Australia's **Swinburne University** has set a new record for the complexity possible on a quantum computing chip.
- › **NEC (Japan)** is establishing a A\$4.38 million Global Security Intel Centre in South Australia.

GROWTH OF THE AUSTRALIAN CYBER SECURITY INDUSTRY



The Australian cyber security industry has the potential to almost triple in size by 2026.²¹



In June 2017, the Australian Government announced that the **University of Melbourne** and **Edith Cowan University** would share in **A\$1.91 million** to lead the effort to boost cyber security capabilities through Australia's first Academic **Centres of Cyber Excellence**



Global security companies that have set up technical operations in Australia to access a skilled workforce include **Akamai Technologies, Context Information Security, iSight Partners, NCC Group** and **Ping Identity**



SOFTWARE AND PRODUCT DEVELOPMENT

A broad range of Australian companies are focused on developing niche value-added cyber security products and services. These companies range from innovative startups through to multinational organisations, and have expertise in identity management, encryption, wireless technologies and trustworthy systems. Many also collaborate with government agencies and the higher education sector. For example:

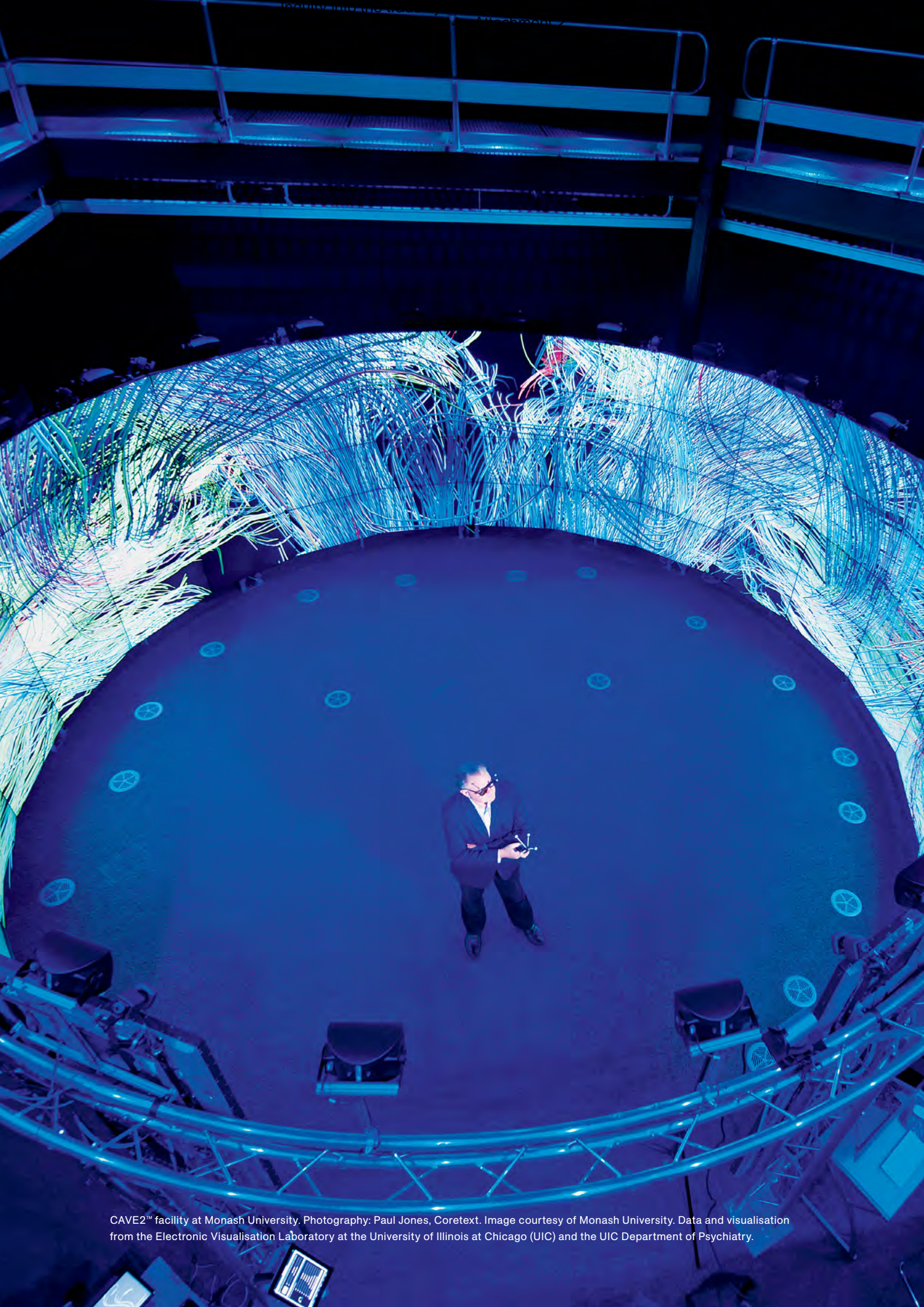
- › **QuintessenceLabs'** industry leading solution is the highly secure Trusted Security Foundation (TSF), which combines advanced encryption key and policy manager with the security of a FIPS 140-2 Level 3 hardware security module and high-speed quantum random number generator. Customers include Westpac Banking Group, leading defence primes, the Australian Department of Defence, the United States State Department, as well as a leading cloud-based document and email management, with hundreds of thousands of users and an expanding network of data centres around the world.
- › **Tesserent** is an ASX-listed company that provides world-class managed security to organisations throughout Australia and overseas. Tesserent has its own MSSP Platform that it licenses to MSSPs abroad (who then sell to end users), enabling the delivery of Security-as-a-Service and tailored solutions to small and large organisations.

CONSULTING SERVICES

Australia has an expert and wide-reaching cyber security consultancy industry, ranging from large-scale firms with broad knowledge bases to sole operators who possess deep knowledge of specific technical hardware or software solutions.

The advice is not only on technical aspects such as network testing, security and penetration testing and security architecture, but also on protecting business assets such as reputation, IP, employees and customers. For example:

- › **Datacom TSS** is an Australian cyber and information security company that secures and defends clients from contemporary cyber threats around the world, around the clock. The company works with some of the world's largest and best-known brands, providing tailored security services to anticipate, plan and protect against cyber threats rather than react to them. Specific services include cyber threat management, vulnerability management and full security incident lifecycle management.
- › **Sense of Security** is a specialist IT security and risk management consultancy. It provides expertise across vulnerability management, incident response, DevOps security, security operations for cloud environments, as well as a full range of technical assurance security testing services for networks, web applications, wireless and mobile. Many large international companies use Sense of Security's specialist technical skillsets including customised penetration testing of hardware (i.e. telecommunication-grade equipment, cable operator end-points and various medical devices) and bespoke software (i.e. satellite control systems, clinical and essential services infrastructure – power, gas and water – environments).



CAVE2™ facility at Monash University. Photography: Paul Jones, Coretext. Image courtesy of Monash University. Data and visualisation from the Electronic Visualisation Laboratory at the University of Illinois at Chicago (UIC) and the UIC Department of Psychiatry.

IMMERSIVE SIMULATION

Immersive simulation technologies – which includes 3D/4D technologies and virtual and augmented reality to place users in a virtual environment – has the potential to revolutionise business models, value chains and organisational structures.

Increasingly, research and development, planning and production are being trialled in virtual worlds before they are physically built or implemented. This enables businesses worldwide to: improve management of complex systems; undertake faster and cheaper design and analysis; identify issues before products reach the market; dramatically reduce risks, costs and unscheduled maintenance; increase trainer effectiveness and efficiency, and maximise productivity.

Australian companies have very strong simulation capabilities and are well placed to deliver solutions across the world. Backed by a strong and active research and development industry, Australia is an ideal place for firms to develop niche solutions across, and spinning off, 3D and 4D technologies, including digital holography and Cave Automatic Virtual Environment (CAVE) systems.

Simulation technologies are used across Australia primarily to enable design, analysis, manufacturing and training to support Australia's world-leading skills in rapid prototyping and 3D printing.

Australia has strong virtual reality (VR) expertise across the aerospace and defence; architecture and building; automotive; consumer; medical; and mining sectors. Australian firms also produce a broad range of design and augmented reality (AR) solutions to help increase efficiency, reduce costs and assist with asset management and resource optimisation. These AR technologies enable remote collaboration and optimised workflows, visualisations, documentation, 3D modelling and navigation.

Australian industry strengths

TRAINING AND EDUCATION

Australian firms with immersive simulation technology expertise have reproduced real-world systems in the virtual environment, enabling safer training across complex and high-risk industries such as mining, defence, health, transport and aerospace. These industries have driven the demand for improved operator knowledge and skill sets to reduce human error, injury and costly delays – and there are still significant opportunities for innovation across these sectors.

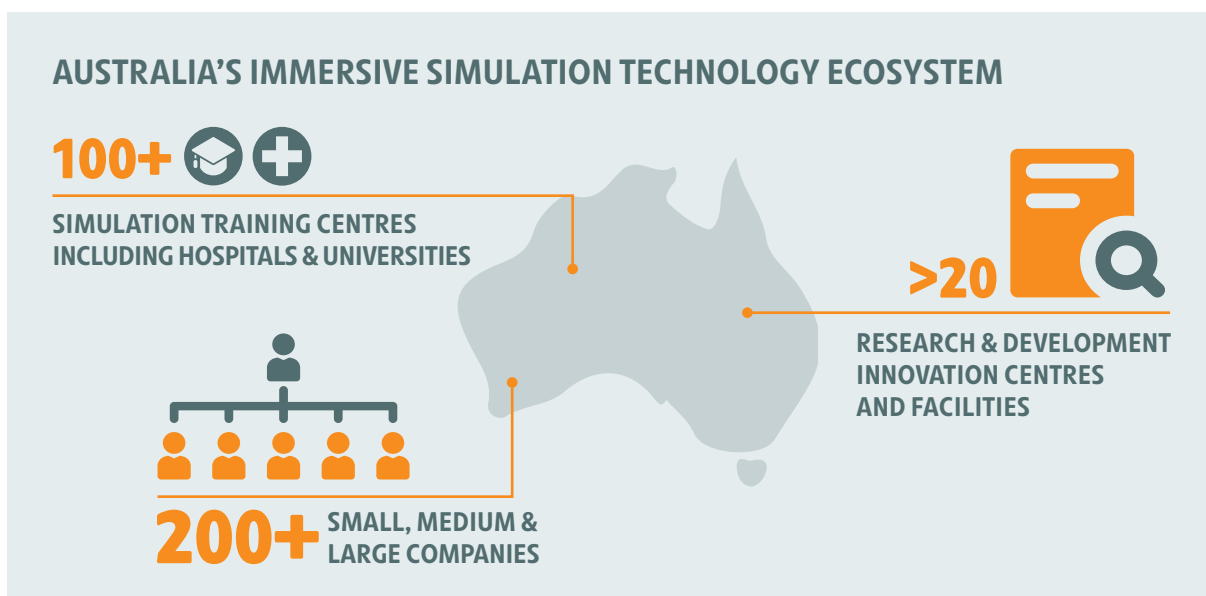
Australian training centres are world leading in their use of state-of-the-art technology and tools to deliver safe and advanced training programs. These immersive training applications improve performance, save lives, and reduce the resources and time required to develop skills during training.

For example, Australia's health sector has incorporated VR technology into its training and delivery methods to reduce the number of preventable medical errors.

Advances in immersive simulation technologies will also help increase efficiency, reduce costs and easily deliver training and education to remote locations.

RESEARCH AND DEVELOPMENT

Australia boasts world-class research and development facilities, capability and outcomes. The country is home to many leading collaborative research institution facilities that provide image analysis, data comprehension and advanced visualisation technology to industry and researchers.



Australia's simulation research and development is knowledge intensive, multidisciplinary and highly skilled. Industry works closely with academia to deliver integration and interoperability through the use of immersive technology.

Australian research is at the forefront of the latest developments in sound and smells, haptic technology, motion platforms, and 3D audio effects, which brings together the immersive simulation experience.

COMPLEX PROBLEM-SOLVING CAPABILITY

With an established reputation for complex problem solving, Australian businesses are creating new transformational technologies and applications in a wide range of immersive environments across key industries including health, education, infrastructure, resources, energy, manufacturing and defence.

The best immersive simulations are emerging from multidisciplinary teams providing a range of skills which enhance visual representations, fidelity, accuracy and validity. Large companies, cutting-edge micro businesses, highly skilled engineers and creative professionals are combining simple and complex hardware and software to enhance service delivery to customers across the world.

The Australian technology ecosystem includes a broad workforce who collaborate to produce advanced solutions. This includes computer graphics designers, software engineers and developers, game designers, digital media entertainment specialists, scientific visualisation specialists, simulator technicians, human factor specialists, and behavioural safety scientists.

These immersive technology providers have formed tightknit clusters in regional Australian hubs – specifically in Victoria and Queensland – to take advantage of the new wave of disruptive technologies and provide solutions and efficiencies.

CASE STUDIES

Bohemia Interactive Simulations is a global software company providing simulation training solutions for military and civilian organisations. BISim develops high-fidelity, cost-effective software solutions for tactical military training. bisimulations.com

Opaque Space has developed a VR game in collaboration with NASA and has now partnered with Boeing Defense Australia to develop future content for its Starliner VR astronaut training program. Opaque Space has progressed its two-year collaboration with NASA Hybrid Reality Laboratory to create a range of technologies, content and assets that are being used by NASA Johnson Space Center and Boeing to develop next-generation training systems for engineers, scientists and astronauts on human spaceflight missions.

opx.space

Real Serious Games (RSG) creates accurate and interactive 3D virtual worlds from real-world inputs for the construction, mining, health and training industries. RSG combines engineering expertise, technical artists, 3D modellers, film directors and game engine development to create high-quality descriptive, illustrative and evidential animations. These animations link the visual display to certified data such as construction schedules, daily diaries, documentation and quality registers. realseriousgames.com





Image supplied by Opaque Space – In game footage of the ISS and earth as seen in Earthlight.

INTERNET OF THINGS

The Internet of Things – connecting data devices, people and processes to the internet – is providing unprecedented amounts of new information to aid decision making through the creation of a ‘network of networks’, where digital data can be analysed and used to drive new applications, services and efficiencies.

The Australian IoT industry has three characteristics that underpin its ability to create, develop and commercialise new IoT products, and to incorporate existing technologies in new applications: a robust IoT industry ecosystem; natural advantages in key industries; and federal and state governments that welcome and support innovation in the IoT industry.

Global leaders like Cisco, Microsoft, IBM, SAP, Ericsson and Bosch are investing or participating in Australia’s IoT capability. Its robust IoT ecosystem is a market with strong potential, as well as a collaborative place where multidisciplinary problems can be researched and solved. Australian consumers are well educated and willing to embrace new technology, while the market itself can scale to be both profitable and a platform for export.

Australia also has specific strengths in research and development, rapid prototyping, transport, agtech, medtech, mining and water. The country’s Industrial Internet of Things (IIoT) technology companies are actively collaborating with domestic research institutions on innovative products and services, and are making inroads into the growing IoT global community, especially in the Asia-Pacific region.

Australian industry strengths

Australia has comparative advantages in IoT applications/capability in:

- › agtech
- › mining technology
- › e-health
- › intelligent transport solutions
- › water management
- › smart energy, microgrids and smart grids.

AGRICULTURE

Australian farmers are using sensor data and data analytics to overcome a complex and harsh environment, limited water supplies and extremely large distances to markets. Data and data analytics are helping farmers make informed decisions about their land, crops and livestock, which is driving efficiency, sustainability and productivity.

The farming of estuary and ocean-based produce such as oysters, prawns, lobsters and fish all benefit from water-quality sensing and food monitoring. For example, individual fish can now be cost-effectively tagged and monitored throughout the growth phase, and tracked during transport and retail sales so quality can be maintained and proven from farm to fork.

Many Australian startups have designed technologies for this market, such as solutions that improve productivity and enable new products to be successful in the food market.



Australian firm Redback uses IoT and cloud technologies to help users manage solar energy generated onsite.

RENEWABLE ENERGY

Australia has developed many of the world's leading renewable energy technologies and continues to deliver new products and solutions to enable the global growth of the sector.

Leading Australian energy technology companies are integrating renewable energy into existing networks. IoT is playing a crucial role in integrating demand-side management into power systems operation, making it possible to monitor and integrate diverse energy sources into power systems while facilitating and simplifying their interconnection.

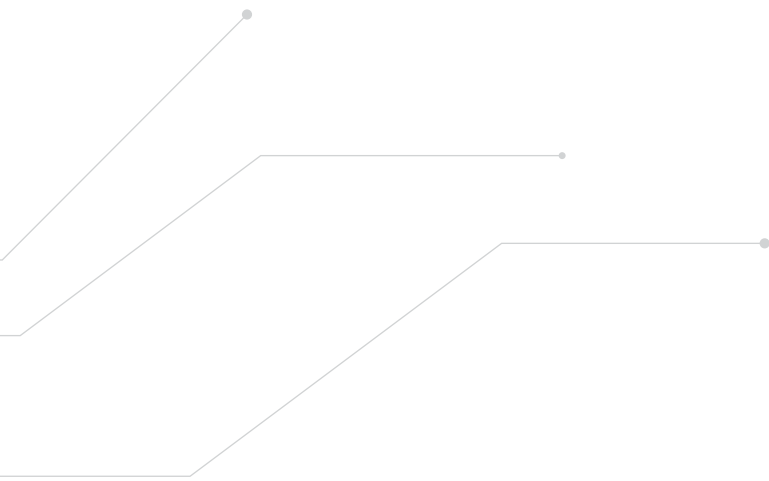
Australia is home to leading IoT companies, such as GreenSync, Wattwatchers and Redback, which are providing smart grid solutions that manage network data, provide demand and capacity management solutions and deliver optimised energy solutions for households, factories, suburbs and remote communities.

MINING

The scale and location of Australia's remote mines have led to the development of advanced communications infrastructure to support remote-controlled, autonomous operations, and highly efficient end-to-end transport solutions.

As such, Australia is a world leader in mining IoT applications – integrating fully autonomous mining systems to make operations more predictable and repeatable through real-time sensors, system-wide integrated software and autonomous mining units. Applying IoT solutions has improved safety and productivity, lowered energy consumption and strengthened environmental management at Australian mines.

Sensor technology in particular is key to optimising productivity across a mine's entire life cycle. Smart sensors collect physical, biological or chemical data and convert this into a digital format. This information provides real-time insights into the performance of mining infrastructure, equipment, mineral processing and employees.



In addition to productivity improvements, the insights help mining companies reduce maintenance and energy costs, lower water consumption and waste, and improve safety. Australia offers IoT technologies across all these areas.

INTELLIGENT HEALTH SOLUTIONS

Australia has extensive capability in smart medical technology solutions. IoT has numerous applications in Australia's healthcare sector from remote monitoring and service delivery, to smart sensors and medical device integration.

Geographic challenges coupled with a world-class research and development environment has created opportunities and driven advances in technologies for the delivery of remote health services.

Three key IoT capabilities include remote health service delivery; remote patient monitoring; and smart wearables using sensors and applications to connect medical devices to healthcare IT systems for customised patient solutions.

TRANSPORT

The Australian transport industry has been an early adopter of IoT to underpin intelligent transport systems (ITS), including traffic management and road safety, and heavy haul, intermodal and freight transport solutions. The country's diverse terrain and openness to ITS and automated vehicles make it an ideal site to test these technologies.

Australia's key capabilities include asset monitoring, predictive maintenance, production and efficiency assessment, road safety, traffic management systems and research and development. Australian companies provide technology, infrastructure and software packages to optimise urban ITS and mine-to-port logistics including transport scheduling solutions.

This expertise is underpinned by an active R&D industry committed to developing Australia's niche capability in autonomous vehicles, particularly in intelligent systems capabilities that will feed into vehicle communications with infrastructure (V2I) and with other vehicles (V2V).

Innovations developed by Australian companies and implemented throughout the world include:

- › rail grinding profile measurement systems
- › fuel optimisation systems
- › multi-factor railway alignment optimisation products
- › weld parameter technology for stress relief in rail welds
- › traffic management systems – V2I and V2V
- › road safety solutions.

FUTURE CITIES

Australia has a network of highly urbanised cities that frequently rank among the most liveable in the world.²²

Key Australian IoT strengths for future cities include features for the built and natural environment such as smart water, carbon mapping, flood protection, Building and Information Modelling (BIM) and e-citizen engagement applications (passive monitoring and social analytics).

Australia has comparative advantage in:

- › V2I Intelligent Transport Systems ITS including regulatory frameworks and training systems
- › remote and resilient smart water, agtech and e-health solutions
- › smart grids, microgrids, peak shaving and energy storage
- › new cyber security solutions for defence and intelligence
- › fintech including innovative and personalised contactless payment methods.

GLOBAL PARTNERSHIPS IN RESEARCH AND DEVELOPMENT

Australia is world-renowned for its robust research and development capability and capacity, supported by a favourable regulatory environment that encourages public and private sector collaboration.

In February 2017, China's leading ICT solutions provider, Huawei, partnered with Queensland's James Cook University (JCU) to develop the latest connectivity innovation through Australia's first Narrow Band IoT (NB-IoT) lab in Cairns.

NB-IoT is a Low Power Wide Area technology that has been developed to connect various devices more simply and efficiently on established mobile networks. Its advantage is that it consumes less power, has wider coverage and is lower in cost. Huawei is providing JCU with the latest IoT technology as well as direct funding for specialised research.

US giant Cisco also chose Perth and Sydney to set up two of its eight global innovation centres. Research focus areas include agriculture, astronomy, resources and smart cities.

According to IDC, the global IoT market spend will be worth US\$1.3 trillion in 2019 – and the Asia-Pacific region will maintain the majority share.²³ Australia's proximity to Asian markets, highly educated workforce, urbanised population and export-oriented culture mean there are strong opportunities for Australian companies and their international partners to participate in this regional growth.

CASE STUDIES

Australian startup **The Yield** is using IoT to help the agribusiness and aquaculture industries improve productivity and reduce waste. The company's technology monitors hyper-local conditions – down to a row of growing vegetables – to enable growers to minimise risk and make informed decisions about when to plant, irrigate, feed, protect and harvest crops. It is estimated that The Yield's Sensing+ Aqua technology can reduce unnecessary harvest closures by 30 per cent by providing reliable local data. **theyield.com**

Trendwise is a visitor analytics platform utilising existing city infrastructure and low-cost smart sensors to translate real-world behavioural data into easy-to-understand optimisation insights for businesses and smarter cities. The Trendwise technology platform can layer anonymous, passive visitor data with third-party social media, weather, point-of-sale systems, marketing calendars and more to increase context and add value. **trendwise.co**

Queensland-based technology company **Redback** is using IoT and cloud technologies to help residential and commercial users maximise their use of the solar energy they generate onsite; reducing costs, payback times on solar panels and reliance on fossil fuel-based energy. A second-generation smart hybrid solar inverter is matched with a proprietary cloud-enabled intelligent system which can analyse and control energy generation and consumption in real time. The Smart Hybrid uses machine learning to gather intelligence over time, learning from user preferences as well as drawing data from external factors like the weather. The system automatically decides how to best use the energy, with an option to override this and operate the system manually. **redbacktech.com**



Image courtesy of The Yield.

SYSTEMS INTEGRATION

Australia has been an early adopter of systems integration technologies – joining different subsystems or components as one large system to overcome complex operational problems, enhance processes and improve outcomes – creating significant specialist expertise across industry sectors.

Australian systems integrators are at the forefront of systems and enterprise architecture services, software and hardware engineering, interface protocol development, and data analytics. They can design or build customised architecture or applications, and integrate it with new or existing hardware, packaged and custom software, and communications infrastructure.

Australia has niche capabilities in cloud computing and software, smart cities, mining, agriculture, aerospace, telecommunication infrastructure, audio visual, logistics and industrial automation.

These capabilities are supported by an extensive education and training, and research and development network. For example, the Australian Technology Network brings together five of Australia's most innovative and enterprising universities – Queensland University of Technology, University of Technology Sydney, RMIT, University of South Australia and Curtin University – to work on real-world systems integration applications.

Multinational leaders with global systems integration platforms such as Accenture, Cognizant, Deloitte, Infosys and Tata have operations in Australia. Partnerships between multinational corporations, small and medium enterprises and startups with specialised systems integration expertise are increasing.

This market composition, combined with the need to overcome challenging operating environments, means Australia is the ultimate test bed to cultivate multifaceted systems integration solutions.

AUSTRALIAN SYSTEMS INTEGRATION MARKET



CASE STUDIES

Meshed is an Australian Internet of Things (IoT) integrator that helps clients build end-to-end public and private IoT solutions, using LoRaWAN technology. Meshed helps improve profitability and identify new opportunities through rapid deployment of innovative technology for smart cities, energy and water management, environmental monitoring and intelligent asset management. Meshed has deployed networks in Melbourne, Sydney, Brisbane, the Gold Coast, the Sunshine Coast, Ipswich and Wollongong for clients such as universities and large corporations.

meshed.com.au

Thomas Global is an industry leader in the design, production and support of innovative electronic systems solutions for aerospace and defence applications. The company delivers expertise in advanced cockpit displays, armoured vehicle electronics and mission system solutions supported by service and support teams around the world.

Thomas Global leverages technologies from the commercial and defence sectors to bring innovative solutions to multiple markets. The company has particular expertise in cockpit display technology across the commercial and military sectors. It is known as the world's leading vendor of support for CRT-based cockpit displays, delivering operators long-term solutions to keep aircraft flying efficiently and reliably. In addition, Thomas Global has developed a range of innovative AMLCD displays, and is a key supplier of biocular and other long-range thermal imaging technology to international customers in the armoured vehicle market.

thomas-global.com

CONTACT AUSTRADE

The Australian Trade and Investment Commission – Austrade – contributes to Australia’s economic prosperity by helping Australian businesses, education institutions, tourism operators, governments and citizens as they:

- › develop international markets
- › win productive foreign direct investment
- › promote international education
- › strengthen Australia’s tourism industry
- › seek consular and passport services.

Austrade helps companies around the world to identify and take up investment opportunities in Australia as well as to source Australian goods and services. Our assistance includes:

- › providing insight on Australian capabilities
- › identifying potential investment projects and strategic alliance partners
- › helping you identify and contact Australian suppliers.

W austrade.gov.au
E info@austrade.gov.au

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Anatomics developed a series of world-first 3D printed implants, including implants made of polyethylene.

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