THE UNIVERSITY of ADELAIDE

FAME Strategy

DIGI+

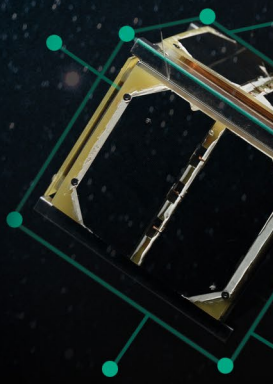
A sustainable, healthier, wealthier and safer digitally-enabled future for Australia

GROUP OF EIGHT AUSTRALIA

make history.

VISION

A SUSTAINABLE, HEALTHIER, WEALTHIER, AND SAFER DIGITALLY-ENABLED FUTURE FOR AUSTRALIA.



MISSION

To assist South Australia's transformation to a high-tech powerhouse by harnessing the University of Adelaide's capabilities, and working in partnership with industry and government to advance our digital future as a society, focussing on:

- **Critical Minerals**
- **Quantum Technologies**
- **Information Capability**
- **Autonomous systems**
- **Energy Systems Transformation**
- **Space Industries**

THE UNIVERSITY of ADELAIDE

FAME

The University of Adelaide prioritises its research at scale within FAME (Foci and Magnets for Excellence) Strategies. Our FAME Strategies provide a platform that enables us to attract the best researchers and partners, and deliver positive impacts for our State and Nation through research excellence and its translation.

OUR DIGITAL FUTURE

Digital technologies, such as mobile, cloud, artificial intelligence, sensors and analytics, are increasingly being embedded in our everyday life.

"Technologies can help make our world fairer, more peaceful, and more just. Digital advances can support and accelerate achievement of each of the 17 Sustainable Development Goals – from ending extreme poverty to reducing maternal and infant mortality, promoting sustainable farming and decent work, and achieving universal literacy. But technologies can also threaten privacy, erode security and fuel inequality. They have implications for human rights and human agency. Like generations before, we – governments, businesses and individuals – have a choice to make in how we harness and manage new technologies."

United Nations, *The Impact of Digital Technologies* (**www.un.org/en/un75/impact-digital-technologies**)

Advances in digital technology are driving breakthroughs in drug manufacturing, food production, transport and sustainability, while being a major contributor to the economy and job growth. Their combined effects with frontier technologies such as quantum materials, photonics and advanced manufacturing show incredible promise for exponential progress, acceleration and transformational impact on the economy and society.

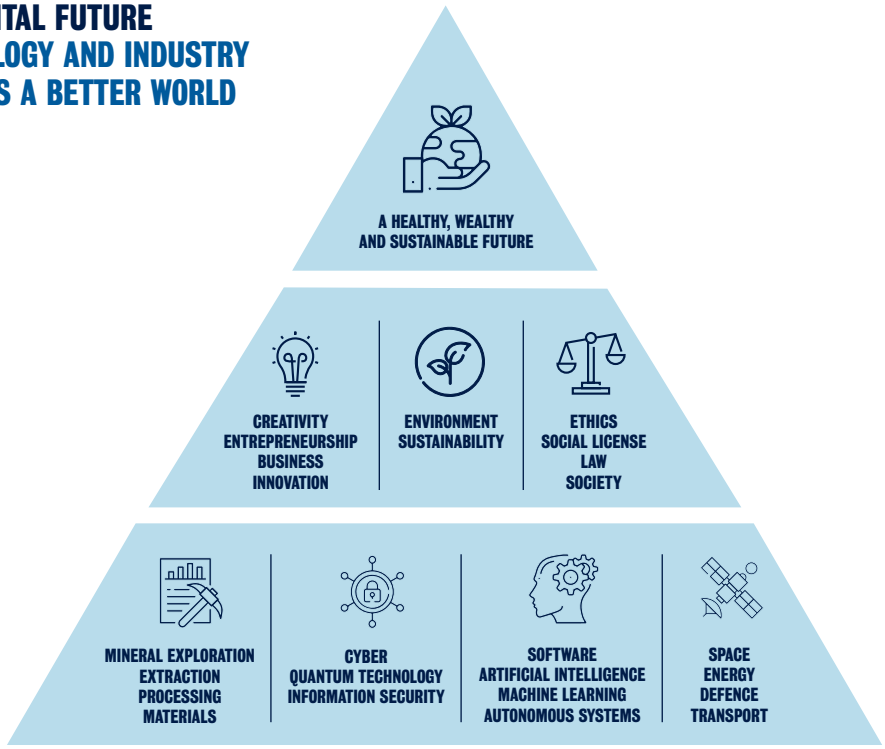
For example, rapid advances in manufacturing are bringing together production, operations, machine learning, and data science to improve processes and efficiency. This is reshaping traditional industry sectors such as energy and mining and defence, while giving rise to new fields of endeavour in areas such as space exploration and hi-tech.

Overseas, Australian and State governments have developed a range of high level strategic initiatives encompassing and facilitating the digital future.

This digitally-enabled future is much more than simply being about software and hardware. It ranges across the critical minerals required to decarbonise energy production, regulatory frameworks to protect our societies, and technologies that will support manufacturing, creativity and decision-making.

At the same time as enabling tremendous technical advancement, the impact of digital technologies on people and society must also be at the forefront of our thinking to ensure we are always seeking to improve the well-being and sustainability of our people, our society and our environment.

THE DIGITAL FUTURE
TECHNOLOGY AND INDUSTRY TOWARDS A BETTER WORLD



GUIDING PRINCIPLES

- **Excellence** in Research and Research Training is fundamental to the discovery, development and successful adoption of new approaches to advanced technologies and related sectors, and to developing the next generation of future leaders and innovators.
- **Collaboration** and partnering with national and international stakeholders will provide new research and translational opportunities and pathways to market, as well as opportunities for the accelerated application of emerging technologies.
- **Public engagement** will be essential for change. The human elements of advanced technology are diverse but include community understanding and acceptance of new products and processes, and involve the intersection of ethics, law and policy in shaping initiatives and values relating to technology and society.
- **State Priorities**, as outlined in the South Australian Growth State Plan, will align the DIGI+ foci and missions with the needs of the Hi-Tech, Defence, Space, Resource and Creative sectors.
- **Transdisciplinarity and innovation** will form the foundation of advancements driven by DIGI+, coalescing the wide range of capabilities at the University of Adelaide for novel outcomes.
- **An entrepreneurial approach**, underpinned by an entrepreneurial mindset, will generate new commercial and social opportunities.
- **Responsible innovation**, ensuring that the broader social and ethical contexts and implications of our research are considered.
- **Magnet for Talent** will build a reputation that attracts outstanding individuals from across Australia and around the world to join the DIGI+ team.

AIMS

The University will:

- **Lead** the discovery, development and translation of advanced technologies and related systems for social and economic benefit.
- **Drive** the advancement of our digital future with a focus on critical minerals, quantum technologies, information capability, autonomous systems, energy systems transformation and space industries.
- **Partner** with industry and other external stakeholders to strive jointly towards achieving a sustainable, healthier, wealthier and safer future for Australia.
- **Align** priorities with those of our strategic partners and support the State in achieving its Growth State Plan priority sectors, where we have the capability to do so.
- **Support** the development of Lot Fourteen as a global innovation neighbourhood of entrepreneurship, research collaboration and cultural activity.
- **Educate** the next generation of research and business leaders, including but not limited to industry-linked higher-degrees and training programs.

RESEARCH MISSIONS FOR TRANSFORMATION

DIGI+, in its broadest sense, encompasses all of the minerals, materials, technologies, systems knowledge and skills required to sustainably put digital technologies to work for society.

DIGI+ will help transform Australia's future through six Research Missions. The mission areas focus on where our unique capabilities align with strategic external opportunities to make a powerful social and economic difference. They are directly aligned with national and state priorities, such as the SA Government Growth Sector Plans (SA GSP), Australian Government Modern Manufacturing Initiative (MMI) National Manufacturing Priorities and DSTG Science, Technology and Research (STaR) Shots.

- **Critical minerals** are of essential importance to a diverse range of technologies, including electronics, renewable energy production, rechargeable batteries, defence applications and superalloys for jet engines.
- **Quantum technologies** have the potential to revolutionise data science, health, manufacturing, defence capabilities and space technologies.
- **Information capability** impacts almost everything in the physical and human environments, a reliance that has increased our vulnerability and to which we must develop rapid and effective defences.
- **Autonomous systems** or semi-autonomous systems are becoming more prevalent across all areas of life, and will play a pivotal role in enabling Australia's transition to a new generation of interconnected, holistic manufacturing processes.
- **Energy systems transformation** to net-zero carbon emissions will be essential to achieving sustainability goals and ensuring energy reliability, security and affordability. It will include the generation, transmission and storage of electricity and sustainable fuels, the management of energy consumption and the mitigation of CO_2 emissions.
- **Space industries** have become fundamental to our everyday lives, allowing us connect, communicate and do business, supporting critical infrastructure such as telecommunications in internet, weather forecasting, emergency services and business across the globe.

FROM FUNDAMENTAL RESEARCH TO UNIMAGINED BENEFITS

Research excellence has defined our history, with pioneering discoveries that pushes the boundaries of our collective understanding and open new vistas through scientific and technological breakthroughs.

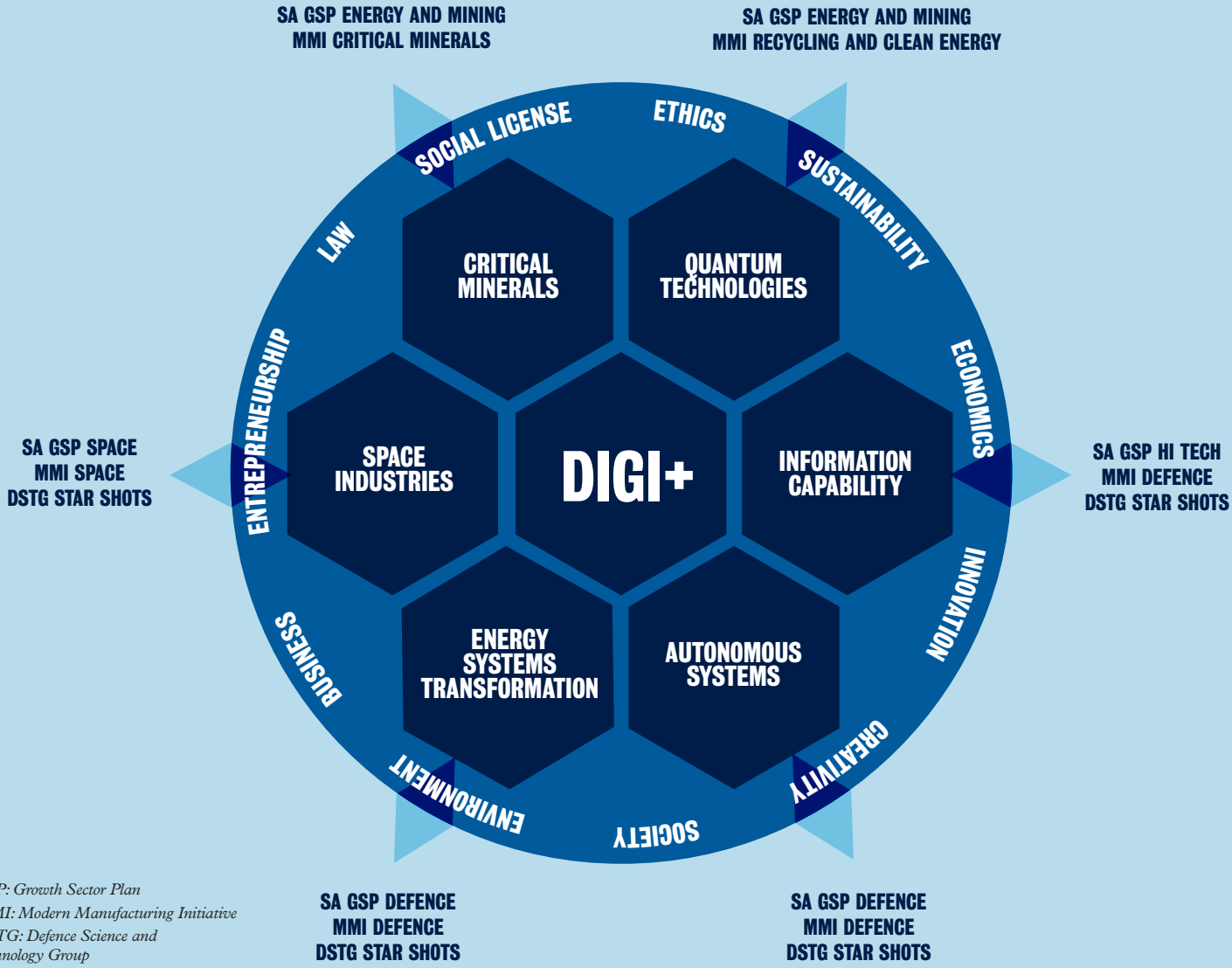
For more than 140 years our researchers have had an impact all over the world – including making vital contributions to the invention of x-ray crystallography, insulin, penicillin and the discovery of gravitational waves. We are a world leader in fields that underpin innovation across industries critical to our global future, and in areas that translate to meaningful socio-economic benefits.

Our research impact is magnified by our innovative and entrepreneurial spirit, with our world-renowned experts joining international teams to solve some of the toughest challenges. We are the only Australian institution, and one of only three internationally, that played a role in all three big physics discoveries of the 21st century: gravitational waves, the Higgs boson, and extragalactic neutrinos. This is a testament to our ability to translate our fundamental scientific advances into next-generation high-tech enabling capabilities.

A prominent example is how the advanced lasers and sensing technologies developed at Adelaide for gravitational wave detection are now set to boost industry and sovereign capabilities in the defence and energy sectors. Our researchers have:

- Contributed to increasing the performance of second generation gravitational wave detectors using the non-classical states of light which has the potential to significantly improve the performance of radar and lidar on the international quest towards quantum radar.
- Developed laser stabilization technology that will make a significant impact, both economic and environmental, in the natural gas industry, enabling enhanced monitoring of aging infrastructures and methane leaks through a cutting-edge laser-enabled airborne mapping system.

OUR RESEARCH IMPACT IS MAGNIFIED BY OUR INNOVATIVE AND ENTREPRENEURIAL SPIRIT, WITH OUR WORLD-RENOWNED EXPERTS JOINING INTERNATIONAL TEAMS TO SOLVE SOME OF THE MOST WICKED CHALLENGES.



GSP: Growth Sector Plan
MMI: Modern Manufacturing Initiative
DSTG: Defence Science and Technology Group

THE DIGI+ ECOSYSTEM – ADVANCING TECHNOLOGY, HELPING SOCIETY, SUSTAINING OUR WORLD

To drive advances in these critical areas, the University of Adelaide's DIGI+ strategy brings together experts from across the University of Adelaide with innovators and entrepreneurs from community, industry and government, unified by a common vision. We will coalesce our range of strengths as a research-intensive university to generate multidisciplinary and indeed transdisciplinary approaches to these challenges. Such capabilities comprise world-class expertise in geology and resource engineering, quantum materials, advanced materials, photonics, artificial intelligence, process engineering, advanced manufacturing, data science, cybersecurity, telecommunications, policy, law, ethics, entrepreneurship, business and economics.

The Research Missions provide a strategic framework for a wide range of partners to form strong university-industry partnerships, leverage joint capabilities and promote translational activities to accelerate innovation, commercialisation and transformation to create a healthier, wealthier and safer digitally-enabled future. We are committed to delivering high-value to our partners through the co-location of researchers, industry workforces, students and technology, for example on Lot Fourteen.

This unique, innovative ecosystem will be an enabler for exploring the impact of technology on society, ensuring that the University of Adelaide is a leader in understanding and promoting the ethical, beneficial and sustainable deployment of new technologies.

Moreover, it will allow industry and government to partner with the University in shaping modern education and training programs, creating the future workforce necessary for high-value and emergent economic sectors and developing the policy frameworks in which they will operate.

Our transdisciplinary approach will tackle fundamental research questions underpinning major global challenges, while developing cutting-edge, ethical solutions for a sustainable, healthier, wealthier and safer digitally-enabled future for Australia.

UNIVERSITY OF ADELAIDE FAME STRATEGY – DIGI+

CRITICAL MINERALS

Advance Australia's position as a supplier of critical minerals through

- Transdisciplinary approaches to exploration, and processing of critical minerals.
- Advanced solutions and technologies for an emerging global commodity market.
- Ensuring that Australia develops a sovereign capability in critical minerals.

QUANTUM TECHNOLOGIES

Build the technological foundation required to enable a Quantum Technologies-based industry, focussing on

- Accelerated material discovery.
- Ultrawide bandgap UV photonics and power electronics.
- Single photon sources, nanoscale solid-state spin qubit, modulators.
- Integrated technologies for defence, space, biological processes, food sciences, and agriculture.

SPACE INDUSTRIES

Enable an R&D ecosystem providing capability, technologies and expertise towards

- Secure and robust communications and sensor networks.
- Processing and manufacturing systems in space.
- Intensive horticulture environments for interplanetary travel.
- International laws and policy frameworks.

SOUTH AUSTRALIA

Research and development of digital enablers

Government and industry partnerships

Innovation, translation and commercial pathways

INFORMATION CAPABILITY

Transform how the information environment is used, governed and protected, through

- Detection mechanisms to identify and counter malign influence.
- Threat monitors and counter-measures by AI-enabled cybersurveillance.
- Advanced RF and quantum sensors for remote operations and navigation.

ENERGY SYSTEMS TRANSFORMATION

Develop the technology and business case for

- Production, use and storage of sustainable electricity and fuels.
- Systems supporting reliable, secure and affordable delivery of energy.
- Next generation, high-performance materials and processes for sustainable energy production, storage and conversion.
- Technology to mitigate CO_2 emissions from industrial processes and fuels.

AUTONOMOUS SYSTEMS

Underpin the drive towards world-leading capability in development and testing of autonomous systems, including

- Algorithm and hardware development.
- Multi-agent systems.
- Human-autonomous interaction.
- Policies for ethical and legal use of autonomous systems.

RESEARCH MISSION 1

CRITICAL MINERALS

Context

Critical minerals are an evolving group of metal and non-metal commodities of essential importance to a diverse range of technologies, including electronics, renewable energy production, rechargeable batteries and superalloys for jet engines. Critical minerals include the rare earth elements, lithium, cobalt, niobium, tantalum, indium, gallium, germanium, vanadium and tellurium.

The demand for rare-earth metals alone is projected to more than double to 315,000 tonnes per year by 2030. Yet their supply may be at risk due to geological scarcity, geopolitical issues, trade policy and other factors.

Mining as the primary source of rare earth elements for industry is extremely challenging. They are scarce, large volumes of radioactive coproducts are produced, and China currently produces over 70% of global supply.

Australia can be a global leader in Critical Minerals. The nation has defined resources in the ground, prospective geology for further resource discovery, the industry willing to develop them; and the training and research institutions to produce the highly-skilled workforce and extraction technologies needed to exploit them safely and sustainably.

Demand for these critical minerals is growing exponentially. Secure supply is vital.

Key state and national priorities include:

- SA Government Growth Sector Plans for Energy and Mining, Hi Tech, Defence Industry and Space Industry.
- Australian Government Modern Manufacturing Initiative (MMI) National Manufacturing Priority for Critical Minerals.

Mission Goals

The Mission will support Australia's drive to become a global supplier of critical minerals by leveraging the University's existing critical minerals capabilities through a series of strategic partnerships and initiatives.

The goals of the mission are to:

- Lead a program of trans-disciplinary research and education that positions Australia as a world-leader in the exploration, processing and purification of Critical Minerals.
- Deliver advanced solutions and technologies for the Australian Critical Minerals sector that provide a competitive advantage for entry into this emerging global commodity market.
- Establish a network of industry and academic experts to address the sustainability and long-term supply of minerals critical to Australia and its sovereign security and capabilities.

Critical Minerals at the University of Adelaide

Australia can be a global leader in supply and utilization of critical minerals. World-leading expertise in the critical minerals sector is already in Australia, with critical mass at the University of Adelaide in multiple Science and Engineering schools working within an interdisciplinary framework. We have strong connections with industry and federal/state governments. We are in dialogue with experts in economics, business and geopolitics in Adelaide and across Australia to meet the grand challenge of ensuring the sustainable supply of critical minerals for Australia, from Australia.

Adelaide is home to Lot Fourteen, where digital capabilities combined with research strengths across critical minerals, machine learning, space and defence, will help Australia establish pre-eminence in critical mineral resource discovery, sustainable exploitation and strategic significance. The University of Adelaide is a home for end-to-end expertise, is well positioned to engage globally with respect to critical minerals and global critical minerals supply chains as well as the National Critical Minerals Facilitation Office, and all key agencies at federal and state levels.

The mission goals will be achieved through the Institute for Mineral and Energy Resources and the Australian Centre for Critical Minerals Research, working with skillsets in the Australian Institute for Machine Learning (AIML) and the Institute for Photonics and Advanced Sensing (IPAS) anchoring interdisciplinary efforts in this area. The University of Adelaide is leading a national bid for an ARC Centre of Excellence in Critical Minerals, as well as leading a CRC focussed on copper. A new and highly needed Master's programme in Minerals Processing will be developed, and the skills needed in industry developed for example, through the ARC Training Centre for Integrated Operations for Complex Ore Resources. Additional needed expertise in water research, social licence and public policy will be leveraged through our centres and institutes.

Key Strategic Partners

Key partners include BHP, OZ Minerals, Santos, Mitsubishi Heavy Industries, Liberty GFG, Department of Energy and Mines, Geological Survey of South Australia, CSIRO Minerals, Geoscience Australia, Lynas, Iluka and FMG.

AUSTRALIA CAN BE A GLOBAL LEADER IN SUPPLY AND UTILIZATION OF CRITICAL MINERALS. WORLD-LEADING EXPERTISE IN THE CRITICAL MINERALS SECTOR IS ALREADY IN AUSTRALIA, WITH CRITICAL MASS AT THE UNIVERSITY OF ADELAIDE IN MULTIPLE SCIENCE AND ENGINEERING SCHOOLS WORKING WITHIN AN INTERDISCIPLINARY FRAMEWORK.

RESEARCH MISSION 2

QUANTUM TECHNOLOGIES

Context

Quantum materials and quantum devices, and their integration into functional systems, have led to a wide range of technologies with great societal and economic impacts.

The first quantum technology revolution created a variety of now common, yet transformative solid-state devices and systems, such as transistors and memory for computers, lasers for medicine and communications, light-emitting diodes for energy-efficient lighting, and devices for power electronics. All of these have fundamentally changed lives around the world. Innovation in this space continues and keeps proving remarkably impactful.

We are now on the cusp of a second quantum technology revolution, one where the quantum-ness is not limited to a single device element but extends over many devices or an entire integrated system, and will create completely new industry opportunities, innovative solutions in defence, and transformative benefits in society.

Quantum materials – semiconductors or insulators, are the bedrocks of both technology revolutions, providing the foundation for individual quantum-device development, which in-turn drives the development of fully quantum architectures. This new revolution will bring data science, applied physics, material sciences and engineering approaches together to interpret and innovate; pushing the very frontiers of advanced technology.

Transdisciplinary teams featuring expertise in government policy, legal frameworks and social license will further accelerate the impact of these technologies within industry sectors such as biomedicine, computing, cybersecurity, and natural resources.

Key state and national priorities include:

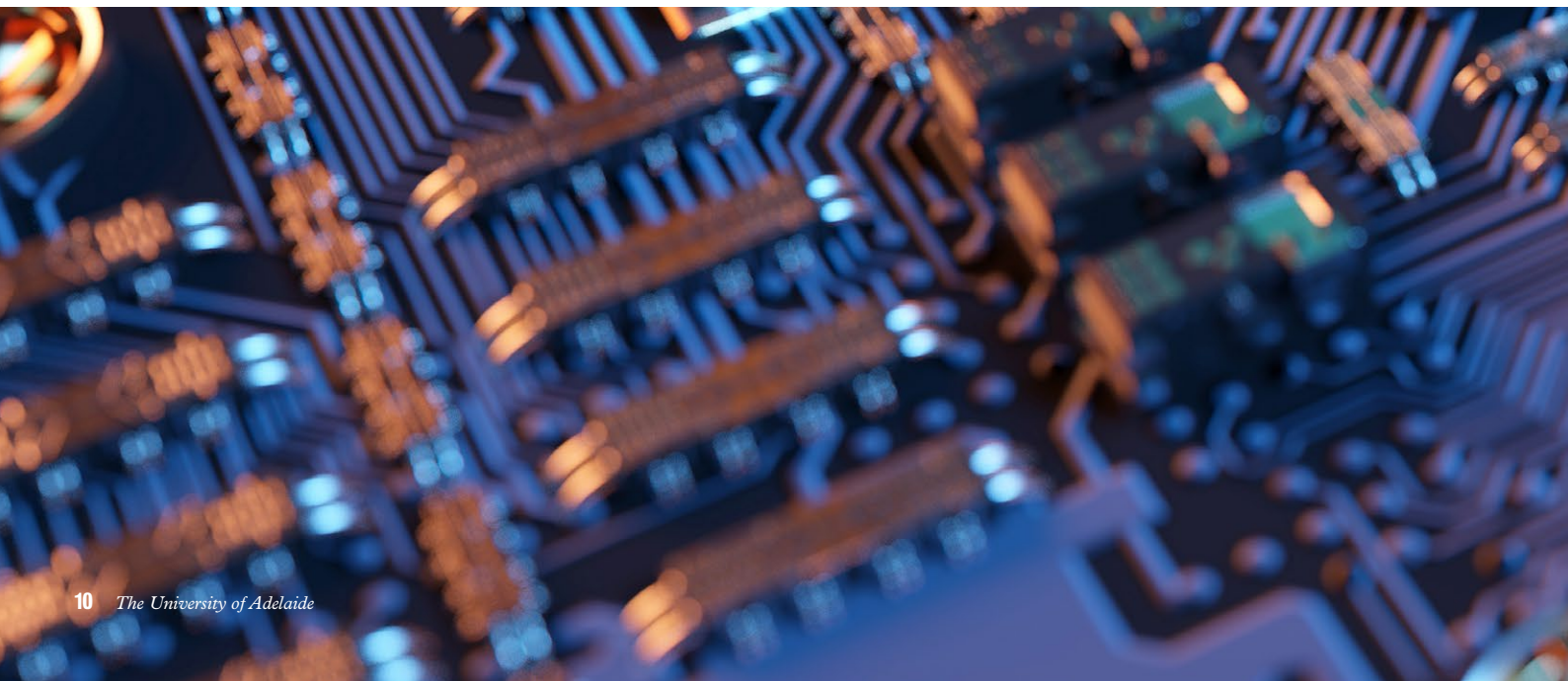
- SA Government Growth Sector Plans for Defence Industry, Hi-Tech and Workforce – skills and innovation.
- Australian Government Modern Manufacturing Initiative (MMI) National Manufacturing Priorities for Defence Industries and Space Industries.
- Department of Defence 2020 Defence Strategic Update & Force Structure Plan and DSTG Information Warfare, Disruptive Weapon Effects Quantum-Assured Positioning, Navigation and Timing STaR Shots.

Mission Goals

The Mission will build the foundation required to build Quantum Technologies-based industry with a value exceeding of $1 billion in South Australia.

The goals of the mission are to:

- Create new sensors for personalised and preventative biomedical diagnostic health services, advanced medical imaging for cancer and neural diseases, and novel micro/nanoscale devices for therapeutic applications.
- Develop scalable manufacturing methods for high-performance quantum materials, as well as novel chip-based technologies for automotive, computing, environmental, infrastructure industries.
- Design new electronics and photonics with ultra-high efficiency, and high energy storage leading to more efficient power networks with lower emissions for electrification and renewable technologies.
- Develop sovereign capability for secure communications, cybersecurity, surveillance and reconnaissance, bio-security sensorsand enhanced navigation.



Quantum Technologies at the University of Adelaide

The University of Adelaide has created a world-leading ecosystem of people, facilities and partnerships in Quantum Technologies. This highly interdisciplinary effort draws on established research excellence of the flagship research Institute for Photonics and Advanced Sensing which brings together lead researchers in Quantum Materials, Quantum Technology, Precision Measurement, Advanced and Photonics Materials, Electronics, Laser Photonics and Advanced Manufacturing.

Located in proximity with Lot Fourteen - South Australia's innovation precinct, which includes Defence Science and Technology (DST), the Australian Space Agency (ASA) and Silanna, the largest semiconductor company in Australia's R&D facilities – this vibrant ecosystem is providing a unique opportunity to translate fundamental research discoveries into practical implementation in industries. The interdisciplinary approach creates a variety of opportunities for postgraduate student education, early career research positions, and industry training with over $60m in state-of-the-art purpose-built infrastructure.

Key Strategic Partners

Key partners include Silanna Semiconductor, the Defence Science and Technology Group, and the Australian Department of Defence.

THE UNIVERSITY OF ADELAIDE HAS CREATED A WORLD LEADING ECOSYSTEM OF PEOPLE, FACILITIES AND PARTNERSHIPS IN QUANTUM TECHNOLOGIES.

RESEARCH MISSION 3

INFORMATION CAPABILITY

Context

The Information Age is characterised by society's comprehensive reliance on the 'information environment' which ubiquitously mediates human control of the physical world and powerfully *influences* human perception of truth. Control of the information environment impacts almost everything in the physical and human environments. As a consequence, it is a new theatre of contest, and even warfare.

The impact of this contest in the information environment stretches well beyond the military environment as our reliance on access to information pervades our everyday lives. This reliance has increased our vulnerability to social manipulation, from debate-changing fake news to identify theft and even hacking of major critical infrastructures, such as transport and financial systems, power grids, telecommunications and satellite navigation systems (GPS). The term 'Information Capability' refers to this broad context covering defence, civilian and commercial interests.

AustCyber, the Australian Cyber Security Growth Centre, forecasts that Australian expenditure on cybersecurity will grow from $5.6 billion in 2020 to $7.6 billion by 2024, with approximately 350 sovereign providers in the sector, supported by 26,500 workers employed in full-time cybersecurity roles. Globally, at least US$147 billion was spent directly on cybersecurity products and services. The sector is characterised by new, innovative small and medium-sized enterprises (SMEs), with 88% of providers having fewer than 100 employees.

Key state and national priorities include:

- SA Government Growth Sector Plans for Defence Industry, Hi-Tech and Workforce – skills and innovation.
- Australian Government Modern Manufacturing Initiative (MMI) National Manufacturing Priority for Defence Industries.
- Department of Defence 2020 Defence Strategic Update & Force Structure Plan and DSTG Information Warfare STaR Shot.

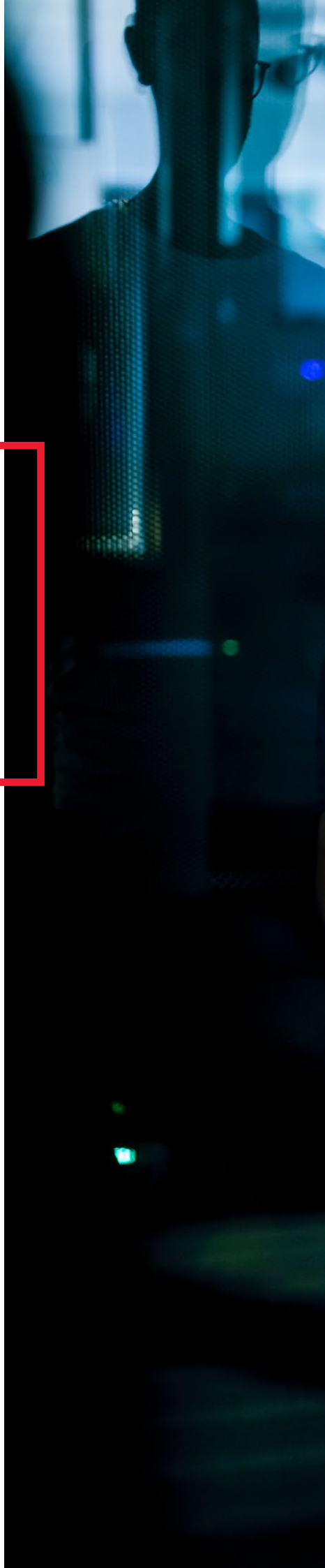
CONTROL OF THE INFORMATION ENVIRONMENT IMPACTS ALMOST EVERYTHING IN THE PHYSICAL AND HUMAN ENVIRONMENTS. AS A CONSEQUENCE, IT IS A NEW THEATRE OF CONTEST, AND EVEN WARFARE.

Mission Goals

The Mission will support Australia in gaining a global leadership position in Information Capability by transforming how the information environment is used, governed and protected. This transformation will result in a new confidence in our reliance on the information environment for defence, business and in our personal lives.

The goals of the mission are to:

- Develop detection mechanisms to identify and counter malign influence.
- Monitor and counter threats by AI-enabled cybersurveillance.
- Deliver advanced RF and quantum sensors for remote operations and navigation.



Information Capability at the University of Adelaide

The University of Adelaide has partnered closely with Defence and DST in traditional areas of defence research for over 70 years. Responding to the information environment challenges illustrated above, and reflecting our strong partnership, the University of Adelaide and DSTG have established a new joint Chair in Cyber-Security. Information Capability necessarily draws from a wide array of our research strengths, including two flagship research Institutes, the Australian Institute for Machine Learning (AIML) and the Institute for Photonics and Advanced Sensing (IPAS), with disciplines spanning from the social sciences, law and ethics, to data science, virtual / augmented reality telecommunications and cyber operations, to physics, advanced material sciences and engineering. The University's plans to develop an Information Capability initiative to work side by side with industry and Defence, building on the proximity of the University to Lot Fourteen, to give Australia an edge in building secure and resilient information systems and environments.

Key Strategic Partners

Key partners include DSTG and the Information Warfare Division of the Department of Defence; the Australian Cyber Collaboration Centre; the State Department of Skills and Innovation; and from industry: Leidos, BAE Systems Australia, Silanna Semiconductor and CEA Technologies.

AUTONOMOUS SYSTEMS

Context

Autonomous and semi-autonomous systems are becoming more prevalent across all areas of life, and will play a pivotal role in revolutionising Australia's manufacturing future. This transition is an essential step for Australian business, transforming the nature of the workforce and resulting in an estimated $2.2 trillion boost to the economy by 2030.

Rising labour costs, increased regulatory burdens, energy sector transformation, uncertain global markets and the need for greater productivity are driving the uptake of automation across a broad spectrum of industries. The significance of this economic shift toward efficiency is underlined in the Australian Government's Modern Manufacturing Initiative which sees automation as a vital driver of global competitiveness for the following Australian industries: resources technology and critical minerals, agrifood and beverage, healthcare, sustainability and clean energy, defence and space.

The Australian Resources Industry is already a global leader in mining automation technologies and it is similarly so in niche areas of advanced manufacturing within health and defence sectors. The successful uptake of automation by these globally competitive businesses, can be directly traced to the long standing investment in strategic R&D partnerships between these industries and the university sector.

The immediate challenge is to increase the rate of adoption of autonomous systems within these industries by partnering with Research Development Corporations to stimulate knowledge transfer. At the same time, there also needs to be a focus on the development of autonomous systems that can cope with a complex environments, so as to be adaptable and resilient across a range of industries. An equally important key challenge is to develop autonomous systems that people trust both in human-autonomous system interactions but also gain wider acceptance within society.

Key state and national priorities include:

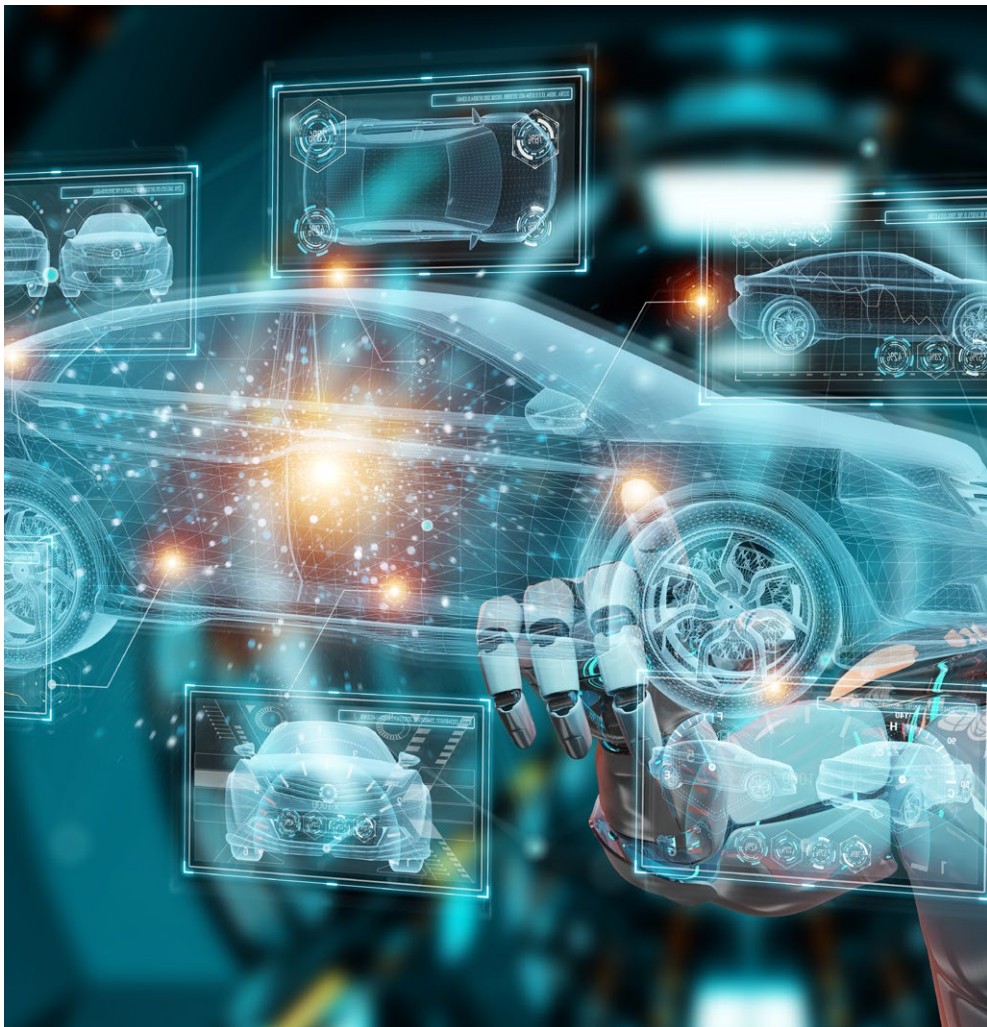
- SA Government Growth Sector Plans for Defence Industry and Hi Tech, and Workforce – skills and innovation.
- Australian Government Modern Manufacturing Initiative (MMI) National Manufacturing Priorities for Defence Industries and Space Industries.
- Department of Defence 2020 Defence Strategic Update & Force Structure Plan and DSTG Information Warfare, Agile Command and Control, and Operating in CBRN environments STaR Shots.

Mission Goals

The Mission will support South Australia's drive to be recognised as a world leader in the development and testing of autonomous systems –from algorithm and hardware development, to multi-agent systems and human-autonomous interaction, to policies around ethical and legal use of autonomous systems. The development of these capabilities will drive innovation across key Australian industries such as Defence, Health and Agrifood.

The goals of the mission are to:

- Develop a series of transdisciplinary initiatives focussed on human-autonomous teaming.
- Support Australian business in the implementation of Industry 4.0, through partnerships which provide commercial solutions as well as education pathways to educate and upskill our future workforces.
- Lead inter-disciplinary research to develop social license for robots.



Autonomous Systems at the University of Adelaide

The University of Adelaide has a long standing reputation for excellence in the field of advanced digital technologies. AIML and IPAS are recognised as global leaders in computer and robotic vision, multi-agent systems, machine learning and photonics and have a track record of creating commercial pathways for these technologies. Additionally the French-Australian CROSSING (laboratory) is a new strategic partnership with focus on humans-autonomous agents teaming: an area of research at the interface of artificial intelligence, computer science, engineering, technology, human factors and psychology.

The planned investment in Lot Fourteen will create a destination for the University's advanced technology capabilities with strategic proximity to hi-tech businesses and stakeholders allied with the defence and space industries. More broadly there is also opportunity for the University to connect these capabilities to strategic initiatives within resources and critical minerals on North Terrace, the State's health precinct and to Agrifood via the Waite and Roseworthy campuses. With autonomous systems playing such a vital role in all aspects of modernising the future Australian economy, the opportunity to develop strategic partnerships based on large scale industry-wide initiatives in all sectors presents a compelling case on which to grow our research portfolio.

Key Strategic Partners

Key partners include DSTG; the State Department of Skills and Innovation; BAE Systems Australia and Lockheed Martin.

ENERGY SYSTEMS TRANSFORMATION

Context

A global challenge in energy decision-making for governments and industry is the balancing of societal demand for net-zero carbon energy with ever increasing energy demands.

Targets such as global net zero emissions by 2050 and South Australia's 100% net renewables by 2030 (and 500% by 2050) illustrate global commitment to renewable energy and act at a lever for private investment to transform the energy sector. This is exemplified by the 95 large-scale renewable energy projects in development across Australia, set to deliver over $19.8 billion in capital investment, deliver over 11,200 MW of new renewable energy capacity and create almost 14,000 direct jobs.

Achieving sustainability goals and ensuring energy reliability, security and affordability requires a well-planned transformation of the complete energy value chain, ranging across generation, storage, transmission, transport and consumption. This transformation requires the improvement of current infrastructure; the use of smart technologies, sensing and automation; integrated system management, optimisation and forecasting; and the use of new, high-performance materials and processes throughout the technology chain.

Australia is highly regarded around the world as a leader in the use of renewable energy and is well placed to act as an incubator for the research, technologies, systems and policy frameworks fundamental for a renewable energy future. Our access to solar, wind, wave and hydro energy coupled with our dispersed energy grid and remote industry operations provide an opportunity to be a global leader in renewable energy integration. More locally, South Australia's adoption of renewable energy generation and storage technologies over the past decade, together with its hydrogen initiatives, has seen the State take a world-leading position in renewable energy solutions.

Key state and national priorities include:

- SA Government Growth Sector Plans for Energy and Mining, and Land, Water and Environment.
- SA Government Plans and Initiatives - Electric Vehicle Action Plan and Hydrogen Action Plan.
- Australian Government Modern Manufacturing Initiative (MMI) National Manufacturing Priority for Recycling and Clean Energy.

Mission Goals

The Mission will help position Australia as an acknowledged global leader in the development of technology, social and policy pathways for net zero emission energy systems, and considered a preferred destination for investment and partnership in renewable/sustainable energy research and development.

The goals of the mission are to:

- Provide sustainable energy production, use and storage pathways for industries transitioning towards a net zero carbon future.
- Utilise smart technologies, sensing and automation and centralised management systems for reliable, secure and affordable power delivery.
- Deliver the next generation, high performance materials and processes for sustainable energy production, storage and conversion.
- Develop technology to mitigate CO_2 emissions from industrial processes and fuels, particularly for those processes for which CO_2 is an inevitable by-product, such as cement clinker.
- Provide scalable economic, social and environmental modelling and forecasting to support new energy policy and business operation.
- Design market-based allocation mechanisms that provide appropriate incentives for transitioning to a zero-emission energy future.

Energy System Transformation at the University of Adelaide

The University of Adelaide is home to a network of researchers, professionals and technicians that take a transdisciplinary approach to energy research. Our capability and expertise directly map to the challenges faced by the local and national energy markets and have great impact in areas of energy generation, distribution and storage; decarbonisation of industrial processes; and the optimisation and security of national markets and infrastructure.

Committed to supporting the nation's national energy grid, the University has developed cutting-edge tools, systems and processes that are helping the industry ensure the quality and supply of electrical power for customers across Australia. From the delivery of commercial power system tools and software to future-focused research in mining electrification, energy system optimisation and EV adoption, this work is supporting the renewable energy integration in domestic, commercial and industrial settings alike.

The University of Adelaide is developing cost-effective, industry-relevant materials and catalysts for enhanced energy generation, storage and conversion. Research streams include the design and synthesis of new materials to generate renewable energy, semiconductors for energy generation and transfer, high-performance battery and supercapacitor materials, and low-cost catalysts for fuel-cells and hydrogen production.

In industrial processes, the University has developed a wide range of novel technologies and systems to facilitate lowering of the cost of CO_2 mitigation. This includes five patented platforms of low-carbon routes to hydrogen production and two for low-carbon production of alumina and cement/lime. In addition it has a series of programs to lower the cost of net-zero production of ferrous feed materials for green steel production, together with a program in thermal comminution.

The Australian School of Petroleum and Energy Resources (ASPER) has a long history of research in subsurface CO_2 sequestration.

The University of Adelaide is the lead research partner in the Heavy Industry Low-carbon Transition (HILT) CRC.

Key Strategic Partners

Key partners include state and national utility companies (ElectraNet, SAPN and SA Water) and their support industries, organisations such as AEMO, and the South Australian Government.

ACHIEVING SUSTAINABILITY GOALS AND ENSURING ENERGY RELIABILITY, SECURITY AND AFFORDABILITY REQUIRES A WELL-PLANNED TRANSFORMATION OF THE COMPLETE ENERGY VALUE CHAIN, FROM THE GENERATION OF SUSTAINABLE ELECTRICITY AND FUELS, THEIR TRANSMISSION THROUGH NETWORKS, TO END USER CONSUMPTION AND POTENTIAL STORAGE.

SPACE INDUSTRIES

Context

The role of space technology and space-based information has become fundamental to our everyday lives, allowing us connect, communicate and do business. It supports critical infrastructure such as telecommunications in internet, weather forecasting, emergency services and business across the globe.

This increasing reliance has seen a heightened demand for space-borne services, in turn resulting in a range of opportunities for start-ups, public-private partnerships and leading to a rapid diversification of the Low Earth Orbit (LEO) economy. For example, the LEO micro-gravity environment is the destination for manufacturing next generation materials and products such as optical fibres, semiconductors and pharmaceuticals, vastly superior to those produced on Earth. Making space manufacturing a commercial reality will rely on a rapid communication and sensing data stream between Earth and LEO to ensure these autonomous facilities can be controlled remotely and in real-time.

To deliver these critical services, secure communication networks and control systems are essential for both civilian and defence operations, allowing continuous global connectivity and maintaining sovereign security. These networks and systems require a new generation of real-time positioning and location, sensing technologies and situational awareness systems as well as the international laws and policy frameworks that govern them.

The exploration of space is a goal that underpins the space programs of many nations. Long-term habitation of the moon and Mars requires a fundamental rethinking of the technologies, processes and materials required for living off-world. Missions will rely heavily on exploration, mining and use of *in situ* resources for the manufacturing and construction of infrastructure and to support space horticulture for producing food.

THE UNIVERSITY OF ADELAIDE HAS A LONG HISTORY IN SPACE-RELATED RESEARCH, INCLUDING THE DEVELOPMENT OF A VARIETY OF COMMUNICATION, SENSING AND OBSERVATIONAL HARDWARE AND SOFTWARE TECHNOLOGIES WHICH HAVE BEEN APPLIED ACROSS THE CIVILIAN AND DEFENCE SECTORS

The global space economy is large and rapidly growing, potentially valued at US$1.1 trillion by 2040. Yet, Australia's contribution is estimated to be less than 1% of the current global total. The Australian Space Agency is supporting the development of Australia's space industry, looking to triple the sector's contribution to GDP to AUD$12 billion per year while generating 20,000 jobs by 2030.

Key state and national priorities include:

- SA Government Growth Sector Plans for Space Industry, Workforce – skills and innovation, and Trade and Investment.
- Australian Government Modern Manufacturing Initiative (MMI) National Manufacturing Priority for Space Industries.
- Department of Defence 2020 Defence Strategic Update & Force Structure Plan and DSTG Resilient Multi-Mission Space STaR Shot.
- Australian Space Agency Advancing Space – Australian Civil Space Strategy 2019-2028 Priority Areas: Position, Navigation and Timing; Earth Observation; Communications technologies and services; Space situational awareness and debris monitoring; Leapfrog R&D; Robotics and automation on Earth and in space.

Mission Goals

The Mission will help develop an R&D ecosystem in South Australia that provides a core educational and research contribution to the Australian Space Industry. It aims to drive growth in Australia's multi-billion-dollar space sector by providing highly sought-after capability, technologies and expertise for the global space industry.

The goals of the mission are to:

- Deliver secure and robust communication, observational, management and operational hardware and systems for space assets.
- Develop adaptable and scalable processing, construction, and manufacturing systems, robotics, and technologies for use in LEO, lunar, Martian, and other deep space missions.
- Develop closed-system, optimised and autonomous intensive horticulture environments for food production in space and on the moon and Mars.
- Support the development of international laws and policy frameworks that govern our future in space.

Space Industries at the University of Adelaide

The University of Adelaide has a long history in space-related research, including the development of a variety of communication, sensing and observational hardware and software technologies which have been applied across the civilian and defence sectors, supporting our industrial partners, fostering new start-up businesses and building sovereign capability.

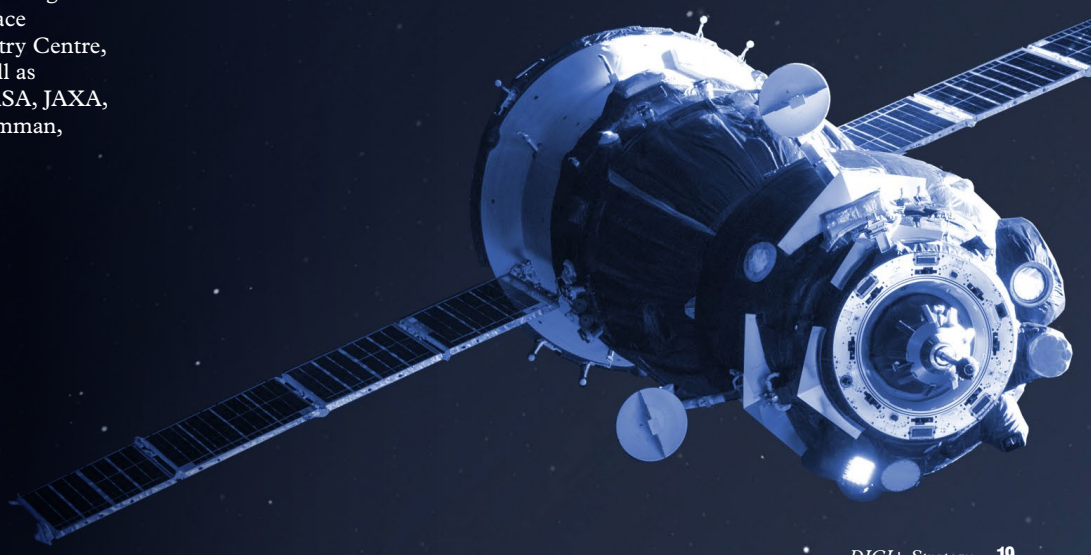
Our people are continually applying advances in artificial intelligence, precision timing, and autonomy to drive new developments in secure communications, situational awareness and a new generation of earth observational technology. This includes focus on the LEO economy, developing the processing, sensing and production technologies for manufacturing in the zero-g environment for experiments in pharmaceutical production and their longevity in space and the application of microfluidic production technologies for material production.

Transdisciplinary research programs examine the utilisation of in situ resources on the moon and Mars in support of near-term requirements for construction, civil engineering, and space horticulture activities necessary to facilitate long-term human presence.

The University of Adelaide is one of four international partners collaborating on key contributions to articulating and clarifying the law in relation to regulation of modern space activities, including both military and commercial uses of space.

Key Strategic Partners

The University of Adelaide maintains strong local connections to the Australian Space Agency, South Australian Space Industry Centre, DefenceSA, and SmartSat CRC as well as international collaborators such as NASA, JAXA, Space Tango, Corning, Northrop Grumman, Airbus, iSpace, DASS.



LOT FOURTEEN

Lot Fourteen is an exciting initiative bringing together South Australian capabilities in space, defence, hi-tech and entrepreneurship, leveraging these skills in a collaborative ecosystem that will foster the industries and careers of the future.

More than 6,000 people will ultimately work in the precinct, plus 1,000 students and researchers exploring solutions to tomorrow's problems, in an environment dedicated to fostering entrepreneurship in South Australia. The proximity of Lot Fourteen to the University and alignment of technology focus areas will see a strong array of collaborations between researchers, students and industry.

Indeed, Lot Fourteen is a key component of The University of Adelaide's research and innovation strategy and a rapidly growing research has already been established.

The Australian Institute of Machine Learning (AIML) is an anchor tenant at Lot Fourteen. Its work covers the themes of machine learning theory, robotic (computer) vision, medical machine learning, trusted autonomous systems, surveillance and tracking, photogrammetry and 3D modelling. It has joined forces with the Defence Artificial Intelligence Centre to create Poppy@AIML, an R&D collaboration for the rapid development of artificial intelligence and machine learning prototypes for the Australian Defence Force. The lab will also work with organisations such as Lockheed Martin Australia's STELaRLab and the Defence Science Technology Group.

At the Sentient Satellites Lab at AIML researchers are developing algorithms that enable intelligent capabilities on satellites and rovers, such as visual-guided flight navigation, robotic manipulation and GPSdenied positioning. Such capabilities will be crucial for future space missions such as onorbit servicing, in situ resource utilisation and space exploration.

QuantX Labs, a start-up company spun out from the Institute for Photonics and Advanced Sensing at the University of Adelaide, is a world-leader in high performance clock technologies delivering ultra-stable timing and ultra-pure frequency signals, primarily focussed in the Defence and Space sectors. Their flagship product "Cryoclock" is the world's most pure frequency signal and is being incorporated in the AIR2025 JORN HF Radar Phase 6 upgrade program. Their production and test facility, based at Lot Fourteen, is providing a unique sovereign industrial capability to support Australian Defence and Space programs.

The University of Adelaide, in partnership with the Cyber and Electronic Warfare Division of DSTG, has established a joint Cyber Innovation and Research Centre (CIRC at Lot Fourteen, embedded within the Australian Cyber Collaboration Centre (A3C). The primary research focus for CIRC is "autonomous cyber operations", sometimes referred to as cyber AI and is funded under Defence's Next Generation Technology Fund. In addition to this research, CIRC also hosts the 12-week DSTG Cyber Scholarship Program, the Missing Persons Hackathon, the Winter Workshop on Autonomous Cyber Defence; and anticipated future NATO-led cyber wargames. The University's Defence and Security Institute is also located in the CIRC facility.

"The University of Adelaide plans to bring its world-leading DIGI+ capabilities together into a globally connected hub on Lot Fourteen to give Australia the edge in building both secure and resilient information systems and capabilities. This will help to position the University and Lot Fourteen as a powerhouse of future-facing jobs and industries leading to a more sustainable, healthier and wealthier Australia."

University of Adelaide's Deputy Vice-Chancellor (Research) Professor Anton Middelberg.

Image: Lot Fourteen, North Terrace, Adelaide, South Australia. Precinct vision (indicative April 2021). Image courtesy Lot Fourteen.

STEPPING UP ON THE GLOBAL STAGE

Established in 1874, the University of Adelaide is renowned as one of Australia's premier 'Group of Eight' universities, and among the most respected research institutions in the world.

Our reputation for excellence is founded on a rich history of achievement—we're associated with four Nobel Prize-winning researchers—and strengthened by elite, contemporary talent.

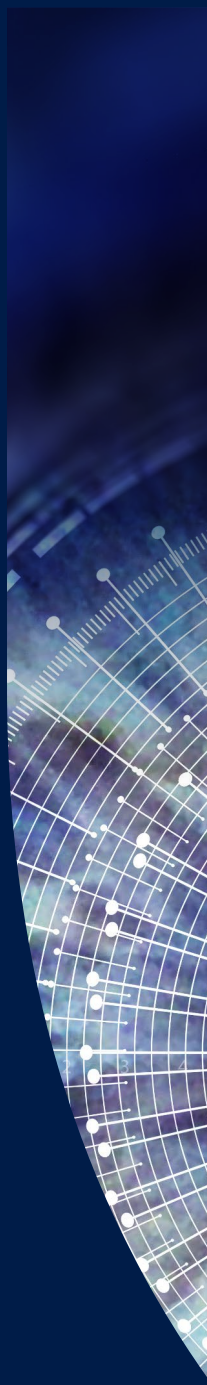
In the 2020 Clarivate world Highly Cited Researchers list, 16 of our academics were recognised for the scale of their global influence across nine fields—three in multiple fields. And in each of the past two years, we've had a young researcher recognised in MIT Technology Review's prestigious Innovators Under 35 list*. In 2020, we were the only Australian university represented; in 2019 we were one of just two.

adelaide.edu.au/research

**Asia Pacific region.*

Kaurna acknowledgement

We acknowledge and pay our respects to the Kaurna people, the original custodians of the Adelaide Plains and the land on which the University of Adelaide's campuses at North Terrace, Waite, and Roseworthy are built. We acknowledge the deep feelings of attachment and relationship of the Kaurna people to country and we respect and value their past, present and ongoing connection to the land and cultural beliefs. The University continues to develop respectful and reciprocal relationships with all Indigenous peoples in Australia, and with other Indigenous peoples throughout the world.



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