

19 February 2021

NSW Government submission to the inquiry into developing Australia's space industry

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Introduction

On the 11 November 2020 the Standing Committee on Industry, Innovation, Science and Resources published terms of reference for an inquiry into developing Australia's space industry. The inquiry will examine the breadth of opportunities presented by Australia's space industry and what is required to strengthen support of our domestic and international space related activities, with a specific focus on the following:

- Development of space satellites, technology and equipment;
- International collaboration, engagement and missions;
- Commercialisation of research and development, including flow on benefits to other industry sectors;
- Future research capacity, workforce development and job creation; and
- Other related matters

This NSW Government submission has been prepared by NSW Treasury with support from the Western Parkland City Authority and NSW Office of the Chief Scientist and Engineer. The purpose of the submission is to outline initiatives the NSW Government is undertaking to develop the industry and to highlight opportunities that will help the Australian space industry grow.

The NSW Government has established a number of key initiatives that contribute to a strong industry environment that supports a thriving space economy.

NSW capabilities

New South Wales (NSW) is home to the largest portion of Australia's space industry. With almost 300 space businesses, NSW is the lead state for most categories of space business, with strengths in ground stations and satellite communications, space legal and finance, space technical and business consultancy and space startup companies.

The space industry in NSW employs the highest percentage of Australia's space workforce and generates the largest proportion of space-related revenue in Australia. NSW is also the leading state for innovation and entrepreneurship in space. Sydney, as a financial centre, is home to the largest concentration of space startups in Australia.

Key facts¹:

- NSW currently employs approximately 30 per cent of the Australian space workforce.
- Organisations headquartered in NSW generate between 50 per cent and 75 per cent of all space-related revenues generated in Australia.
- 50 per cent of Australian space export revenue is generated from companies headquartered in NSW.
- Around 35% of ground systems businesses in Australia are based in NSW. This includes designing, building, manufacturing and operating ground systems relating to space.
- Just over 40% of businesses in Australia with space-based capabilities are based in NSW, and 38% of all space startups.
- Almost 40% of space-enabled service businesses in Australia are based in NSW.

Higher education and research

NSW has a number of prominent areas of space expertise in its higher education and research institutions. Eight universities in NSW have active space-related programs. Across these universities, 26 separate departments are engaged in space activities. The universities are Charles Sturt University, Macquarie University, University of New South Wales, University of Newcastle, University of Sydney, University of Technology Sydney, University of Western Sydney, and University of Wollongong.

Prominent centres of space and space-related research activity in NSW are listed in Table 1.

¹ Source: Asia Pacific Aerospace Consultants (2017). *Briefing paper to the NSW Government on NSW Space Capabilities and the review of Australia's Space Industry.*

Table 1: Centres of space research activity in NSW

Centre	Activity
<p>Australian Astronomical Optics, Macquarie University</p>	<p>Australian Astronomical Optics (AAO) is a recognised world leader in innovative astronomical instrumentation, software and research. Their expertise includes developing innovative technology for use in astronomical instruments, developing software and data systems for the processing, storage and access of data, and using these instruments for scientific research.</p>
<p>The Australian Centre for Astrobiology, University of New South Wales in Sydney</p>	<p>Researching the mysteries of extra-terrestrial life and is actively involved in the research into the possibility of life on Mars as well as other planets. It is one of only two centres outside the USA which are Associate Members of the NASA Astrobiology Institute</p>
<p>ARC Training Centre for CubeSats, Unmanned Aerial Vehicles, and their Applications (CUAVA), the University of Sydney</p>	<p>The Centre is facilitating the development of new instruments, technology and products to solve crucial problems. They are developing new instruments and technology for Cubesats and UAVS and training the next generation of workers in advanced manufacturing, commercial space and UAV applications.</p>
<p>The Australian Centre for Space Engineering Research (ACSER), School of Electrical and Telecommunications Engineering in the Faculty of Engineering at UNSW</p>	<p>Undertakes advanced work in reconfigurable systems for space as well as GPS receiver developments that could lead to a future constellation of satellites to measure sea state with applications relating to global maritime navigation, operations and safety. ACSER is one of the leading centres in the world researching off-earth mining and is strategically placed to be part of this rapidly developing area of commercial activity.</p>

<p>Bureau of Meteorology's Space Weather Service Division headquarters is based in Sydney</p>	<p>A leading world-wide centre for predicting and warning of strong electromagnetic space weather events that can damage the electricity grid and satellites. The predictions and warnings of this centre are broadcast around Australia and around the world.</p>
<p>CSIRO's Astronomy and Space Science Division headquarters is located at CSIRO's Marsfield</p>	<p>Astronomy, spacecraft tracking and space science activities. Responsible for a world-class national research facility for radio astronomy that includes three existing radio telescopes, including Parkes Telescope, as well as the 36-dish Australian Square Kilometre Array Pathfinder.</p>
<p>International Centre for Neuromorphic Systems (ICNS), Western Sydney University</p>	<p>Design and build high-performance, energy-efficient sensors and processors, ideal for distribute, mobile and autonomous applications in challenging and remote environments. Astrosite, a mobile space situational awareness module developed by ICNS is a biologically-inspired, world-first approach to space imaging.</p>
<p>NSW Node of the SmartSat CRC</p>	<p>The SmartSat CRC is a consortium of universities and other research organisations, partnered with industry to develop and commercialise know-how and technologies in advanced telecommunications and Internet of Things (IoT) connectivity, intelligent satellite systems and Earth observation next generation data services. The NSW Node will support the local development of these technologies and associated intellectual property and specialist industry expertise that will spawn new businesses, create export economic value and generate new high-tech jobs.</p>
<p>Rio Tinto Centre for Mining Automation</p>	<p>Based at the University of Sydney since 2007, the Centre conducts applied research</p>

	<p>in autonomous systems, orebody modelling and systems optimisation to enable fully-autonomous integrated mining operations. It is the largest research group in robotic mining globally, having received over \$50m for research in this area.</p>
<p>Sydney SpaceNET, the University of Sydney</p>	<p>Multidisciplinary research network at the University of Sydney that brings together researchers in areas including spacecraft, systems and instrumentation, rovers and UAVs, processing and integration of space data, and the capture and application of Earth observation data.</p>

Robotics

Australia ranks 14th in the world for research outputs in robotics and autonomous systems, publishing 2% of the world's research in this area. NSW is the leading state in the development of autonomous robotics for unconstrained environments. While the commercial application of remote-control robotics is most evident in the mines of Western Australia, the core research capability is based in NSW.

Australian Centre for Field Robotics - Established in 2010 at the University of Sydney, the Centre is one of the largest robotics research institutions in the world, and focusses on the research, development and application of autonomous and intelligent robots and systems for use in outdoor environments. The Centre is currently building a prototype to increase mobility for planetary rovers so that they are able to drive and climb over unstructured terrain.

Centre for Artificial Intelligence (CAI) – the Centre is based in the University of Technology Sydney (UTS) and focuses on AI, computer vision, machine learning, brain computer interface, social robotics, computational intelligence, Computation intelligence and Brain-Computer Interface (CIBCI) lab.

Centre for Autonomous Systems – the Centre is based in the University of Technology Sydney (UTS) and specialises in robotics research that create positive change for government, industry and the wider community. The Centre is the second largest robotics research group in the world.

Facility for Intelligent Fabrication (FIF) – the Facility is based in the University of Wollongong (UOW) and specialises in the application of welding and automation-related technology in defence industry.

Newcastle Robotics Laboratory – The Newcastle Robotics Laboratory is an interdisciplinary research and training initiative at the University of Newcastle. They provide cutting-edge research in robot control, computer vision, localisation, machine learning, space perception, world modelling, and human-robot interaction to a variety of innovative tasks and projects.

Robotics and Autonomous Systems Research Group – Based at the University of New South Wales (UNSW), this Group conduct research into the design and analysis of robotic systems, through combining their knowledge in control, electrical and mechanical engineering, and computer science.

Robotics, Vision and Signal Processing – Located in Western Sydney University, this research group aims to develop innovative concepts, methodologies and techniques in the field of robotics, computer vision and signal processing to help solve practical problems.

Sydney Institute for Robotics and Intelligent Systems – A multidisciplinary Centre based at the University of Sydney which explores the global impact of robotics and intelligent systems. The Centre looks at the social impact of robots becoming an integral part of the world, with a particular focus in the areas of transportation, health and medicine, the environment, primary industries, emergency services, the workplace and home.

In-situ resource utilisation

University of NSW (UNSW) is the leading centre for space resources and off-earth mining research in Australia. UNSW now focuses specifically on lunar water extraction and has 15 PhD students working on providing a commercial solution.

UNSW also chair the International Future Mining Conference series which attracts multidisciplinary groups to discuss the performance of advanced technologies integrated into mining operations, and sustained innovation with a focus on shaping the future of mining industry.

Sensing

Remote sensing is a significant growth opportunity for the Australian space industry. Established in July 2016 with funding from the NSW Office of the Chief Scientist & Engineer, the NSW Smart Sensing Network (NSSN) recognises that cutting-edge research in smart sensing can play a critical role in solving real world challenges.

The NSSN brings together the world class research taking place in NSW universities with state government agencies and industry to develop innovative solutions to these key challenges and, at the same time, position NSW as a leader in sensing technology.

A number of NSW universities have smart sensing capabilities:

Macquarie University Photonics Research Centre – photonic sources, laser applications, terahertz photonics, novel waveguide lasers, topological beams, untable UV lasers, natural and engineered optical materials, advanced semiconductor materials and applications, astrophotonics, quantum photonics

The University of Sydney Nano Institute – nanophotonics, all-optical and nonlinear signal processing, mid-infrared photonics and single photon generation

University of Wollongong Intelligent Polymer Research Institute (lead node of Electromaterials Science CoE and materials node of ANFF) – intelligent polymers and nanostructures, electrochemistry and applications of organic conductors, chemical and electrical sensing networks

UNSW Biosensors and Biointerfaces Group – biosensors, immunosensors, electrochemical detection, porous silicon sensors, nanoparticle-based biosensors, smart plasmonic sensors

Western Sydney University MARCS Institute for Brain, Behaviour and Development – Neuromorphic systems (BENS); event-based sensors, neuromorphic cognition, microelectronic 3D imaging, neuromorphic recognition, human-machine interaction; multisensory communication; speech and language (partnering with Defence, NATO)

Quantum

Sydney has strength across the end-to-end spectrum of quantum computing and technologies, which could support the development of quantum communication capability. This distinct competitive advantage has developed from Australia's world-leading quantum optics research in 1980s. Since then, Sydney has developed as a world leading quantum hub with a depth and breadth of expertise in:

- quantum physics;
- fabrication, engineering, and quantum architecture design (Sydney Nanoscience Hub, CQC2T);
- quantum applications and software (Q-CTRL, Defence Industry Quantum Research Consortium, Centre for Quantum Software and Information at UTS, QSCITECH);
- education capabilities with the Sydney Quantum Academy; and
- commercialisation (Defence Industry Quantum Research Consortium, Q-CTRL, Silicon Quantum Computing (SQC)).

Specific centres of expertise and capabilities include:

ARC Centre of Excellence for Engineered Quantum Systems (EQuS) at Macquarie University and University of Sydney – A partnership between the University of Sydney, Macquarie University and DSTP, the Centre of Excellence intends to pioneer designer quantum materials, quantum engines and quantum imaging systems at the heat of quantum machines.

ARC Centre of Excellence for Quantum Computation & Communication Technology (CQC2T) – Based at the University of NSW and partnering with the University of Sydney, CQC2T is an international research effort to the develop science and technology of a global quantum computing information network, encompassing ultra-fast quantum computation, absolutely secure quantum communication and distributed quantum information processing.

Centre for Quantum Computation and Communication Technology (CQC2T) at UNSW and UTS – quantum communication for secure information capture, processing, storage and transmission; optical quantum computation; silicon quantum computation; quantum communication, distributed quantum computation, quantum sources, detectors and memory, architectures and control (partnering with NASA, Lockheed Martin, DST, IBM)

Centre for Quantum Software and Information at UTS – quantum algorithms and complexity, AI applications of quantum computing, intermediate quantum computing and architectures, quantum programming and verification, quantum information theory and security

Macquarie University Research Centre in Quantum Science and Technology (QSCITECH) - quantum simulations and algorithms; quantum sensing applications, nano-diamonds for applications in quantum science and biology; quantum optics and photonics; hybrid quantum systems for sensing, communications and computing

Sydney Quantum Academy – The Sydney Quantum Academy is dedicated to postgraduate training and research and has been established in partnership between the University of Sydney, Macquarie University, UNSW and the University of Technology Sydney.

University of Sydney Nanoscience Hub – Quantum Nanoscience Lab and Quantum Control Lab: advanced quantum measurement and instrumentation capabilities, quantum control and metrology (partnering with Microsoft via the global Station Q network)

Defence

NSW has a strong and growing defence research ecosystem, including for defence space applications.

NSW is home to over 80 Defence bases and facilities—more than any other state—and Defence invests \$5.5 billion annually in its operational expenditure in NSW. Defence and supporting industry currently directly employ over 26,500 people in NSW, with an additional 29,500 employed in businesses that indirectly support the sector. NSW has the highest number of workers with skills relevant to Defence and the defence industry of any state.

The establishment of the NSW Defence Innovation Network (DIN) in 2017, comprising seven NSW universities and Defence Science and Technology, has led to an uptick in defence research activities and collaborations across NSW universities, local and international primes and SMEs. The DIN has facilitated numerous collaborative projects including major projects in areas of quantum sensing and communications, robotics, space sensing, aerospace, and other relevant areas of research. The DIN, supported by the NSW Government and Defence NSW, has become a central coordinating body for defence research, building new networks and partners, attracting international defence investment to NSW, and providing industry and researchers with market intelligence on defence needs and technology opportunities.

Space radiation

NSW has strengths in space radiation through the following organisations:

Centre for Medical Radiation Physics – Based at the University of Wollongong, the centre is the largest research body of its kind in the Asia-Pacific region. It is a world leader for silicon microdosimetry, which provides a new metric for the estimation of hazards from ionizing radiation in the mixed radiation fields. It makes an essential contribution to radiation protection in space, where the radiation environment is not easy to predict.

Australian Nuclear Science and Technology Organisation (ANSTO) – ANSTO's Sydney locations are home to the Open Pool Australian Light-water (OPAL) multi-purpose reactor, the Centre for Accelerator Science (CAS), the Australian Centre for Neutron Scattering, the National Research Cyclotron and the National Deuteration Facility. At these facilities they also deliver radiation training and instrument calibration.

Space biology and medicine

The medical technology industry in NSW is the largest in Australia. It generates an estimated \$12.7 billion in revenue per year and employs around 7,000 people.

UTS is a leading university in this field and is developing and exploring key capabilities that can have a significant impact within this area:

- Next-Generation Exo-Spacesuit - currently in discussion with JAXA on the development of a new generation of modular spacesuit that is supported by an exoskeleton technology. This is based off a tactical exoskeleton developed for the military and now translated for space use. This new space suit will also be supported by advanced AI and remote health diagnostic technologies to ensure the health and survivability of the astronaut.
- Space biology research between UTS, Jutendo University, Tokyo Medical and Dental University and University of Tokyo - understand how diseases and the human physiology behave and respond under space microenvironment. This will lead to development of new pharmaceuticals and countermeasures for long-term space flights and Earth diseases.
- Impact of microgravity on cancer cells - This initial research has shown that cells from four common cancers (ovarian, breast, nose and lung) at microgravity are unable to sense each other, no longer grow into tumours, and die.
- Cubesat technology- currently developing an autonomous cubesat for space biology and medicine research with Mitsui Corp.

Communications

Australia's semiconductor design capability is world-class in radio frequency (RF), millimetre wave (mmwave), photonics and radar. This is generally acknowledged even by parties external to Australia, including Defence Primes, but also in the consultations held with

international representative companies, including Broadcom, Qualcomm, AMD, Intel and Applied Materials.²

While most of the Australian RF and mmwave talent is within Australian-based design centres or groups, owned, controlled and managed by multinational companies, these individuals and teams are highly rated for their expertise, experience and delivery capabilities. Such talent pools provide high potential for Australian-based startups or the further encouragement of international companies to base portions of their semiconductor design development in Australia.

Most of the limited ASIC chip design activity is focused on RF Comms, almost entirely for 5G but also for some defence sector-related applications. There is a much wider and deeper pool of field-programmable gate array (FPGA) design engineers and programmers – covering specialised applications in mixed signal and data communications such as satellite communications, audio, video, radar, sonar and telemetry. This provides a niche opportunity for NSW to become a global leader in these areas of space communications.

² NSW Office of Chief Scientist, *Australian Semiconductor Sector study Capabilities, opportunities and challenges for increasing NSW's participation in the global semiconductor value chain* December 2020 p.13

Opportunities

To provide input on the specific areas of concern outlined in the Terms of Reference, the NSW Government has identified the following as opportunities to be addressed through the inquiry process.

Increasing sovereign capability

Sovereign capability in space technologies enhances Australia's economic and national security. Australia, like every other nation, is increasingly dependent upon the space domain for communications, navigation, intelligence, surveillance and reconnaissance, and scientific endeavours. Space will have significant implications for national security, and so Australia needs access to space technologies and the ability to deploy and utilise space assets to support national defence objectives. Relying on other nations to provide critical parts of this capability, such as satellite development, increases Australia's vulnerability.

The devastating 2019 bushfires demonstrated the potential advantages of Australian-managed and owned satellites. The nature of bushfires makes them hard to control, respond to and mitigate, and so responses need to be immediate. We live in a bushfire prone country and in an age of increasing and more intense weather events. While we were able to use the European Union's Copernicus Rapid Mapping emergency satellite service to manage the fires in 2019, Australia should consider investing in owning that capability and data ourselves.

The space industry is growing rapidly, and it is important Australia takes a competitive position in this growing market. Space technologies will provide important inputs (such as data and intelligence) into other industries such as agriculture and infrastructure. Ensuring Australia has capabilities in space technology that are internationally competitive will grow our local space industry, and enhance productivity and economic competitiveness in other upstream and downstream sectors.

The NSW Government is already using satellite data to assess drought impacts across NSW through Geoscience Australia's Digital Earth Australia - a digital infrastructure system that detects physical changes including water quality and changes in a region across time. However the data used by Geoscience Australia is still procured from overseas.

Professor Andy Koronios, CEO of the SmartSat CRC, has publicly highlighted that without sovereign capability, we are going to become reliant on technology from other nations to find out our information. Consequently, we find out our information after other nations and get charged to access it. An example of this is monitoring crop yield. We rely on other nations to provide us information on our crop yields, and so by the time we receive the data, they have

already analysed it. This can have massive flow on impacts on trade and price negotiations as they will know more about our yields than our farmers.³

As part of the *2020 Defence Strategic Update and 2020 Force Structure Plan*, released on in July 2020, the Commonwealth Government committed to investing \$7 billion in the development of sovereign military satellite communication capabilities. This is a welcome investment in the development of sovereign capability to support national security, however, Australia would benefit from a parallel investment in civil space capabilities. There is an opportunity for the Commonwealth to leverage its procurement of space data and access to satellites to support the development of Australian satellite manufacturing capabilities.

In addition to this, the Australian space industry would benefit from the development of a market intelligence function and a better local space ecosystem or network. The Australian Space Agency's efforts have had significant focus on funding, regulatory activities, international partners and investment opportunities, and there is an opportunity for domestic ecosystem building. This could include bringing Australian industry and universities together to develop partnerships and share market intelligence to assist local companies in collaborating to build more developed local supply chains.

Playing to our strengths as a nation

As a nation, we have a broad range of strengths and capabilities across the space sector. However, the strengths and capabilities that each state has to offer need to be identified and mapped so that national initiatives can be strategically designed and implemented in appropriate locations. Australian space sector leaders, including the ASA, should encourage greater collaboration within and between states. This means ensuring that industry is working effectively with research organisations and universities, and that investments in facilities and infrastructure bring together multiple space industry stakeholders with complementary aims. Competition is important in ensuring that capabilities are robust and effective, however as the Australian space industry is still relatively small it is important that collaboration is prioritised.

NSW has several particular strengths that could support the development of a strong Australian space eco-system, in particular our strong manufacturing base.

Manufacturing

NSW is home to highly innovative, competitive and world leading manufacturers that are vital to the diversity and strength of the Australian economy. The State's manufacturers produce almost 30 per cent of the country's total manufacturing output, generating around \$31.1

³ Space Connect, *Australia needs to develop sovereign space capabilities to avoid using other's tech*, www.spaceconnectonline.com.au/r-d/3790-australia-needs-to-develop-sovereign-space-capabilities-to-avoid-using-other-s-tech, October 2019.

billion in industry value. The sector also directly employs around 281,000 people, accounting for almost one third of jobs in the sector countrywide.

Greater Sydney is the manufacturing capital of Australia. In particular, the Western Parkland and Greater Parramatta and Olympic Peninsula are important to growing the advanced manufacturing sector, which will be central to delivering an innovative and internationally competitive economy.

The Western Parkland City and Aerotropolis will be the home of advanced manufacturing in NSW within a region primed to become a leading source of growth and innovation in advanced manufacturing. The Aerotropolis will be a hub for aerospace, aviation and defence, agribusiness, and freight and logistics, and designed-for-business training, education and research programs.

NSW is fast becoming a base for the most valuable and skills-intensive parts of the production process. This includes high-tech design and development, innovative research, product customisation and client-focused support and repair services.

NSW has the industry base to be the home of space manufacturing in Australia.

In-situ resource utilisation

Current expertise in advanced mining and autonomous mine operations will be a natural fit for organisations undertaking in-situ resource utilisation on space missions, while capability in agriculture and construction in hostile environments have the potential to support future space settlements.

In February 2020, the NSW Government signed a memorandum of understanding (MOU) with the Luxembourg Government to support the space industry and collaborate on the exploration, exploitation and utilisation of space resources.

Areas of cooperation under the MoU include:

- Space science, technology and applications, including high-tech instrumentation, ground communications and services, smart payloads development, space and intra-space communications and commercialisation of space data;
- Space policy and law; and
- In particular, the exploration and sustainable utilisation of space resources.

The MOU demonstrates action following the launch of the NSW Space Industry Development Strategy, by providing a strategic contribution to global value chains to deliver economic returns for NSW.

The Luxembourg Government also has an ongoing partnership with the UNSW, with the university proposing the establishment of a Space Resources Research alliance between the University of Luxembourg, Colorado School of Mines and UNSW.

Given Australia's strengths in mining in hostile environments, greater international cooperation is needed and further engagement with Luxembourg is encouraged to develop

our off-earth mining expertise. NSW has an opportunity to lead this, given the existing relationship with Luxembourg and research strength through UNSW.

Communications

Australia's semiconductor design capability is world-class in radio frequency (RF), millimetre wave (mmwave), photonics and radar. The further development of these capabilities can play an important role in the enhancement of Australia's space and space-enabled communications capabilities.

Radio frequency (RF) – RF power semiconductors have seen broad acceptance in wireless communication devices as it efficiently enables RF power amplification. With the arrival of 5G cellular communications, RF power semiconductors are establishing its importance across the wireless communication market. With greater demand for higher bandwidth and operating frequency, the demand for RF power semiconductors is expected to increase.

Millimetre wave (mmwave) technology – enables larger bandwidth and greater resolutions resulting in high quality images through wireless communication. Its smaller component size provide increased security since the signal is only restricted to a small area. This will support development of the space sector by providing smaller componentry and enhanced security, bandwidth and speed in communication.

Photonics – emerging as a crucial enabling technology, photonics have the potential to enhance many space systems. Photonics are expected to make an impact in future space technology by replacing and enhancing conventional electrical approaches to using digital and RF telecom payloads, sensors, micro lidars and spectrometers by reducing the size, weight, power or performance of the systems they replace. It may also enable new bandwidth-hungry applications and significantly boost the space communications industry downstream.

Radar – space-based radar technology offer a multitude of remote-sensing applications such as environmental monitoring, crop detection, soil-moisture determination, coastal erosion measurement and all-weather surveillance.

Medtech and space biology

The ASA has identified biology and medicine as areas of opportunity within the space sector.

Further investment into the space medical industry will have significant impacts both for upstream and downstream applications.

Australia has world-class experience in remote medicine and NSW has a large medtech industry that can be drawn to support long-term space missions, including NASA's Moon to Mars program.

Southern Cross University is pioneering the development of technology that could potentially heal wounds in days rather than weeks without using stitches. The Rapid Repair wound dressing technology changes the way molecules repair, enabling skin to heal more quickly, and potentially removing the need for stitches, staples or glue in many clinical situations.

NSW based company, Romar Engineering is the manufacturing partner for the technology and NASA is also currently investigating its use for space missions.

There is additional significant value from low-earth orbit missions and zero/micro gravity operations to support medical research and pharmaceutical manufacturing.

Researchers at UTS are, in addition to their current ground-breaking research, are exploring partnerships to develop pharmaceutical research under microgravity.

NSW Treasury would welcome further exploration of the potential links between medical research and the space industry and opportunities to draw on Australian strengths in these fields.

Increasing availability of data

One of the most challenging aspects of measuring the domestic space industry is the lack of data that is available on the industry. Due to the lack of Australian and New Zealand Standard Industrial Classification (ANZSIC) codes specifically for the space industry, mapping and tracking the growth of the industry is difficult to plot and understand. There have not been any substantial revisions to the ANZSIC since 2006 and it should be updated to include the space sector. The inclusion and measurement of the space sector would support the tracking of Australia and New Zealand's growth of this high-tech industry, which is expected to grow exponentially in decades to come.

NSW Government activities

NSW Space Industry Development Strategy

The NSW Government is committed to supporting the space industry and has demonstrated this through the launch of the NSW Space Industry Development Strategy in February 2020.

The strategy lays the foundation to ensure the space industry becomes a source of economic strength, job creation and innovation in NSW. This is done by setting out targeted, practical initiatives to grow the sector and build the capability and capacity of businesses, while continuing to foster a supportive business environment.

It consists of five key strategy areas underpinned by initiatives to promote further growth and innovation in the industry. The strategy aims to:

1. Foster collaboration across the industry and with the research community
2. Help to develop a fit-for-purpose workforce
3. Support the growth of industry precincts
4. Maximise NSW space industry activity in the national space ecosystem
5. Grow exports and attract investment

The NSW Government recognises that the sector is diverse and rapidly expanding, and an effective growth strategy will need to include collaboration across Australia and internationally.

Core initiatives out of this strategy include the National Space Industry Hub, a pilot space qualification mission and establishing the NSW Node of the SmartSat CRC.

Through these initiatives, the NSW Government is committed to ensuring the space sector is well positioned to benefit from the continued, rapid-growth and demand for space-enabled technologies.

National Space Industry Hub

The National Space Industry Hub (the hub) aims to complement and add value to the Australian space ecosystem and will house an incubator/accelerator with relevant expertise for the space industry. The hub will accelerate industry growth and encourage connections with other industries and partnerships with large corporations.

The hub will host collaborative activities and shared projects and initiatives with the ASA, the Advanced Manufacturing Growth Centre, the Australian Research Council (ARC) and Cooperative Research Centres (CRCs), including the SmartSat CRC.

The hub provides a collaborative space for startups and researchers to commercialise their technology. Due to the fragmented nature of the space industry, the development of a hub specifically for the sector is imperative to enabling space businesses to scale and grow.

The hub will be based in Tech Central, which includes the Central-Eveleigh corridor, south of the Sydney central business district. By being part of Tech Central, the Hub will operate within a vibrant ecosystem of technology, innovation and creative businesses, while being near universities with key space capabilities, the financial services industry and the broader startup community, all supported by strong transport links. Tech Central is intended to attract space-related technology businesses that do not require large-scale facilities for manufacturing space-related equipment but may utilise the available research and technology in a range of different applications.

By basing the hub in Tech Central, it will operate within a vibrant ecosystem of technology, innovation and creative businesses, while being in close proximity to universities with key space capabilities, the financial services industry and the broader startup community.

To complement and extend the reach of the hub, a NSW Node of the SmartSat CRC will be located in the hub. The SmartSat CRC is a consortium of universities and other research organisations, partnered with industry that has been funded by the Australian Government to develop know-how and technologies in advanced telecommunications and IoT, intelligent satellite systems and earth observation next generation data services. The co-location of the SmartSat CRC will strengthen connections between the local space startups, SMEs, researchers and industry to develop deep know-how and technologies.

The hub will be a focal point for thought leadership for the space sector in NSW – bringing talent and expertise together is crucial for driving collaboration and sparking innovation.

Space Qualification Mission

Becoming space qualified or receiving 'flight heritage' is one of the biggest challenges space businesses face in scaling-up and expanding. As the process to become space qualified is expensive, most space startups and SMEs are not seeing a clear pathway for growth outside of defence R&D.

The pilot Space Qualification Mission program is designed to help NSW space businesses overcome this barrier so that their business and products can continue to evolve, grow and expand the opportunities that innovative space technology brings to other industries. While the program will be suited to testing technologies and proof of concept, participants will be required to have a long-term commercialisation/business plan for their technology.

The outcomes from the pilot program will inform future methods for supporting industry in achieving space qualification.

The Aerotropolis

The NSW and Commonwealth Governments are working together to develop a Western Sydney Aerotropolis (Aerotropolis), adjacent to the new 24/7 Western Sydney Airport (Nancy Bird Walton). The Aerotropolis will be an integrated metropolitan cluster of commercial, educational and research and development activity near the new airport.

Federal, state and local governments have already committed \$20 billion+ in investment in catalytic infrastructure around the Aerotropolis and the broader Western Parkland City. This includes \$2 million from the ASA to support a space testing and manufacturing facility.

At the heart of the Aerotropolis will be the Aerotropolis Core Precinct (Aero Core), a national hub for activity in advanced manufacturing research, development and commercialisation. Commercial activity in the precinct will initially focused on aerospace, space and defence industries.

The NSW Government sees the space industry as critical to the Western Parkland City's transition to a high-tech future. To support the space industry capacity building, the new Precinct will integrate education, training and research and will achieve faster, more tailored workforce development and enhanced rates of research, development, innovation and commercialisation. This will drive creation of high-quality jobs and a trained, skilled workforce.

This new Precinct will focus on Aerospace and Defence Industries (ADI) 'vertical' sectors and the emergent 'horizontal' capabilities of information and communications technologies (ICT), data analytics, electronics, cyber security, advanced manufacturing and systems integration – all of which will support the growth and sustainability of Australia's space industry capability.

Western Sydney already represents Australia's largest advanced manufacturing cluster, with aerospace and defence industry organisations including Northrop Grumman, Thales, Safran Defence, Airbus Group, Hawker Pacific and Aviall. Most of these companies already have strong capability in space.

In the first few years, the Aerotropolis' nascent space manufacturing industry will be situated in the proposed Advanced Manufacturing and Research Facility (AMRF). The AMRF will act as a centre of excellence, bridging industry, academia, and research industries to advance the space manufacturing industry in Australia.

The AMRF will champion innovation ecosystem reform, accelerating the ability of smaller space manufacturing businesses to meet market opportunities. Companies will be able to transcend the gap between R&D and commercialisation by accessing the equipment, resources, personnel and systems within the AMRF.

Verification systems at the AMRF, operated in accordance with and sanctioned by international quality systems, will also play a pivotal role in allowing small and medium companies to access specialised and hard to penetrate markets. The AMRF will provide the platforms for the space manufacturing business to test their products, facilitate accreditation and inspection from the appropriate legal bodies and demonstrate product capability to investors and business partners.

The NSW Government continues to seek suitable anchor tenants, sub-primes and SMEs to develop the space ecosystem in the Aerotropolis and at the AMRF. Concurrently, the NSW Government is preparing a Final Business Case for a 'transitional' AMRF, aiming for completion before early FY22.