RESEARCH VISION AND CAPABILITY STATEMENT.

ADVANCED MANUFACTURING RESEARCH FACILITY.

NUW ALLIANCE + UTS

2021

With respect for Aboriginal cultural protocol and out of recognition that its campuses occupy their traditional lands, the NUW Alliance and UTS acknowledges the Darug, Eora, Dharawal (also referred to as Tharawal) and Wiradjuri peoples and thanks them for their support of its work on their lands (Greater Western Sydney and beyond).

CONTENTS.

Artist's Impression of the Advanced Manufacturing Research Facility, Stage 1. Supplied by NSW Government.

WELCOME.

FOREWORD.

To be truly advanced is to recognise that progress can't happen in isolation. The most transformative research breakthroughs universities are responsible for, are almost always forged through collaboration. Experience tells us that commitment from all partners is vital, as is diversity of expertise and scale.

Commitment, diversity, and scale are defining characteristics of our five-university consortium. The University of Newcastle, the University of Wollongong, UNSW Sydney, and Western Sydney University – collectively the NUW Alliance – in partnership with the University of Technology Sydney have committed to developing a shared research vision.

Funded by the NSW Government, the planned Advanced Manufacturing Research Facility (AMRF) - to be adjacent to the Western Sydney International (Nancy-Bird Walton) Airport - is the ideal focal point for the NUW+UTS consortium's research vision. The Western Sydney City Deal commitment to developing a highly collaborative, research intensive and industry engaged ecosystem, via the AMRF, is an approach well aligned to the existing modality of research and development across the NUW+UTS consortium universities.

Combined, the NUW+UTS consortium constitutes Australia's largest, highest-quality, and most industry-engaged research entity. This is an unprecedented grouping of world-class researchers, and a step-change in research capacity. Together, the consortium marshals a network of specialist facilities, institutes, and expertise; driving in-excess of $1.4 billion in industry and community partnered research, backed by nearly 18,000 staff, and over 240,000 students across technology-infused teaching and research infrastructure and precincts.

At the AMRF, the very best of these specialisations will be brought to bear. From innovations in composites, fabrication, through to breakthroughs in neuromorphic science and quantum, the NUW+UTS consortium will catalyse leaps in Australia's advanced manufacturing capability. These world-leading capabilities will be augmented by the intensive and accelerated application of research and development in cyber security, robotics, automation, virtual reality, augmented reality, and human-machine interaction.

We will do these things together. Not for the sake of research. Not to fuel economic growth. And not in service of policy or planning agendas. We collaborate, as the NUW+UTS consortium, to bring purpose, create opportunities, to transform lives and, ultimately, to do good.

Professor Alex Zelinsky AO
Chair
NUW Alliance

Professor Andrew Parfitt
Vice-Chancellor and President
University of Technology Sydney

Professor Patricia M Davidson
Vice-Chancellor and President
University of Wollongong

Professor Ian Jacobs
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UNSW Sydney

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(incoming) UNSW Sydney

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(Research and Innovation)
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Deputy Vice-Chancellor and
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Vice-President (Research,
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Western Sydney University

Professor Glenn Wightwick
Deputy Vice-Chancellor and
Vice-President
(Innovation and Enterprise)
University of Technology Sydney

OUR VISION.

NUW+UTS VISION FOR THE AMRF.

To realise positive social and economic transformation for the Western Parkland City through the application of collaborative research, technology and innovations at the Advanced Manufacturing Research Facility.

THE PROPOSITION.

Universities, by definition, are at the vanguard of social, technological, economic and cultural change.

They are agents of transformation, as well as subject to it. And they navigate and provoke transformation via evidence, rigour and – very importantly – collaboration.

These characteristics position the NUW+UTS consortium perfectly as catalysts for positive change and socioeconomic impact at the coming Western Sydney International (Nancy-Bird Walton) Airport.

Australia's first digital airport, its most sustainable and technologically-infused airport, will attract diverse industry and entrepreneurial interest of a scale and depth unrivalled anywhere in Australia.

The AMRF, to be established adjacent to the new airport will be a significant focal point for the transformation that is to come. Planning for that opportunity is essential.

The intensity and scope of expertise the NUW+UTS consortium can apply at the airport will be without peer. Mapping that, now, and improving it as plans are realised will be critical.

That starts with this document.

1,060,000
GRADUATES

2100 +
UNDERGRADUATE & POSTGRADUATE DEGREE PROGRAMS

44
CAMPUSES ACROSS NSW

16
INNOVATION HUBS ACROSS NSW

50+
YEARS OF WORLD-LEADING IP

THE CONSORTIUM.

Collectively, the NUW Alliance and UTS are ranked 5th in the world by volume of research outputs, 12th in the world by quality of research outputs. The partnership the NUW+UTS consortium is bringing to the Advanced Manufacturing Research Facility (AMRF) will deliver world-class, industry-engaged research across a breadth of practices, including engineering, aerospace, advanced manufacturing, and defence.

The NUW+UTS consortium brings unprecedented scale, expertise, and intensity to the task of transforming the nation's fastest growing region and third largest economy.

As a growing number of thriving hubs around the world demonstrate, higher education and research institutes are a core component of innovation precinct design, catalysing and facilitating commercial and innovation success. University collaborations bring critical scale and capacity to integrate with industry and business to drive new levels of connectivity, collaboration, and innovation.

Recognising that our collective effort is greater than the sum of each University working separately, the NUW+UTS consortium, enriched by the depth and breadth of our staff, networks and evidenced capabilities, will deliver to transform the AMRF into a world-class facility. Realising the vision, shared with the NSW Government, will drive innovation, job creation, and scale-up.

By virtue of their depth of expertise, focus and applied knowledge, universities embed globally competitive technology-driven advantages into all aspects of an industrial ecosystem. This will attract investment, talent and generating measurable direct and indirect society-wide benefits and social good.

The Consortium have existing partnerships and collaborations with industry and government organisations throughout the Western Parkland City, who we seek to engage with further on our vision. We also seek to expand our partnership to ensure a truly collaborative research facility with close links to industry and government.

Industry 4.0 Incubator | University of Technology Sydney

Founders | UNSW Sydney

Maker Space | University of Wollongong

INNOVATION + EXCELLENCE.

University startup incubators have a critical role to play in supporting entrepreneurship. The Startup Muster 2016 survey of startup founders found that more than 21 per cent of startups said they would be looking for acceleration or incubation programs to help progress their startup venture.

A further 24.9% of startups have benefited from acceleration or incubation programs since founding their startups according to the 2018 Startup Muster survey.

Universities and their startup incubator programs are critical in bringing new products and services to the market, opening up export opportunities, creating jobs and delivering economic prosperity for all Australians.

43%

AVERAGE FEMALE FOUNDERS IN THE CONSORTIUM'S STARTUP INCUBATORS.

I2N Integrated Innovation Network

I2N INTEGRATED INNOVATION NETWORK, UNIVERSITY OF NEWCASTLE.

The I2N Integrated Innovation Network fuels the success of entrepreneurs by connecting them to a unique community of founders while taking advantage of direct links to business experts, mentors, students and researchers.

In 2021, the diverse entrepreneurship in the region was evident, with 28% of accelerator participants being first-generation immigrants or refugee founders and 32% being females.

The I2N offers the best co-working spaces in the Hunter region. The I2N Hub Honeysuckle is the epicentre of innovation and entrepreneurship providing support for enterprise skill development, new venture creation and scale-ups. The I2N Hub Williamtown provides development and growth opportunities in the defence, security and aerospace sectors.

12+ WORK INTEGRATED LEARNING PLACEMENTS.

28% FIRST GENERATION IMMIGRANT + REFUGEE FOUNDERS.

11 PATENTS FILED

20 SOLUTIONS BROUGHT TO MARKET

OUTPUTS.

INNOVATION + EXCELLENCE.

FOUNDERS
10x ACCELERATOR

FOUNDERS PROGRAM, UNSW SYDNEY.

The UNSW Founders Program is the biggest student startup program in Australia, supporting over 260 startups each year. The Program is designed to instill entrepreneurial confidence in students, staff and alumni to build entrepreneurship skills.

As Australia's most comprehensive university entrepreneurship program, UNSW Founders comprises multiple programs and services that can take an idea from its earliest stage right through to a startup that's ready to go global. The Program exceeds industry average, with 44.3% of founders being female entrepreneurs.

260+
START-UPS SUPPORTED EACH YEAR.

$250M
ESTIMATED PORTFOLIO VALUE, SEP 2021.

100+
2020

150+
2021 YTD

TOTAL JOBS CREATED.

iAccelerate CENTRE

iACCELERATE, UNIVERSITY OF WOLLONGONG.

iAccelerate is a unique business accelerator and incubator program operating from the purpose-built iAccelerate Centre on the University's Innovation Campus. It is a thriving community of like-minded entrepreneurs with vision, purpose and passion, growing their impact through exceptional education, mentoring and support. iAccelerate empowers startups, scale-ups, social enterprises and intrapreneurs to shape bold new paths to sustainable growth. In 2020, iAccelerate proudly had 46% female founders and an incredible 41 products launched to market.

The program offers a tailored education program that gives entrepreneurs deep knowledge and skills to accelerate and sustain business growth, built around the key knowledge areas required to rapidly build and scale a successful startup.

$196.4M
START-UP TOTAL ANNUAL REVENUE IN 2020.

109
IP APPLICATIONS GRANTED SINCE 2016.

108 IN 2019

167 IN 2020

STUDENT WORK-INTEGRATED LEARNING PLACEMENTS.

LAUNCH PAD

LAUNCH PAD, WESTERN SYDNEY UNIVERSITY.

Launch Pad is a business and innovation support program that provides facilities, assistance and resources for start-up and high growth technology-based businesses. The program drives innovation within the culturally diverse Western Sydney region with 47% of the 2021 accelerator participants being first generation, migrants and refugee founders.

Launch Pad supports business by providing modern but low-cost serviced office and co-working space, specialist business advice, mentoring, events, networking, training and education. Clients work within a highly collaborative environment with other technology-focused entrepreneurs. The focus on female entrepreneurship is evident, with 50% of accelerator participants having at least one female founder in 2021.

47%
FIRST GENERATION IMMIGRANT + REFUGEE FOUNDERS.

$64M
EST. 2021 ADDITIONAL STATE OUTPUT.

170 IN 2019

230 IN 2020

TOTAL JOBS CREATED.

UTS Startups

UTS STARTUPS, UNIVERSITY OF TECHNOLOGY SYDNEY.

UTS Startups is a university-wide program to inspire and support new technology-enabled entrepreneurs, building the largest community of student-launched startups in Australia, then leveraging this community of 380 active startups to inspire and support tens of thousands of people at UTS, in high schools and in the public.

Focused on changing behaviour at scale and feeding the funnel of new startup activity, in the last year we have created 401 paid jobs in new startups, and 2,220 students have engaged with these startups through internships, in-subject projects and workshops. New startups are being inspired, grown and incorporated into teaching in areas including AI, big data, medtech, IoT, advanced manufacturing, logistics, agriculture, environment and construction.

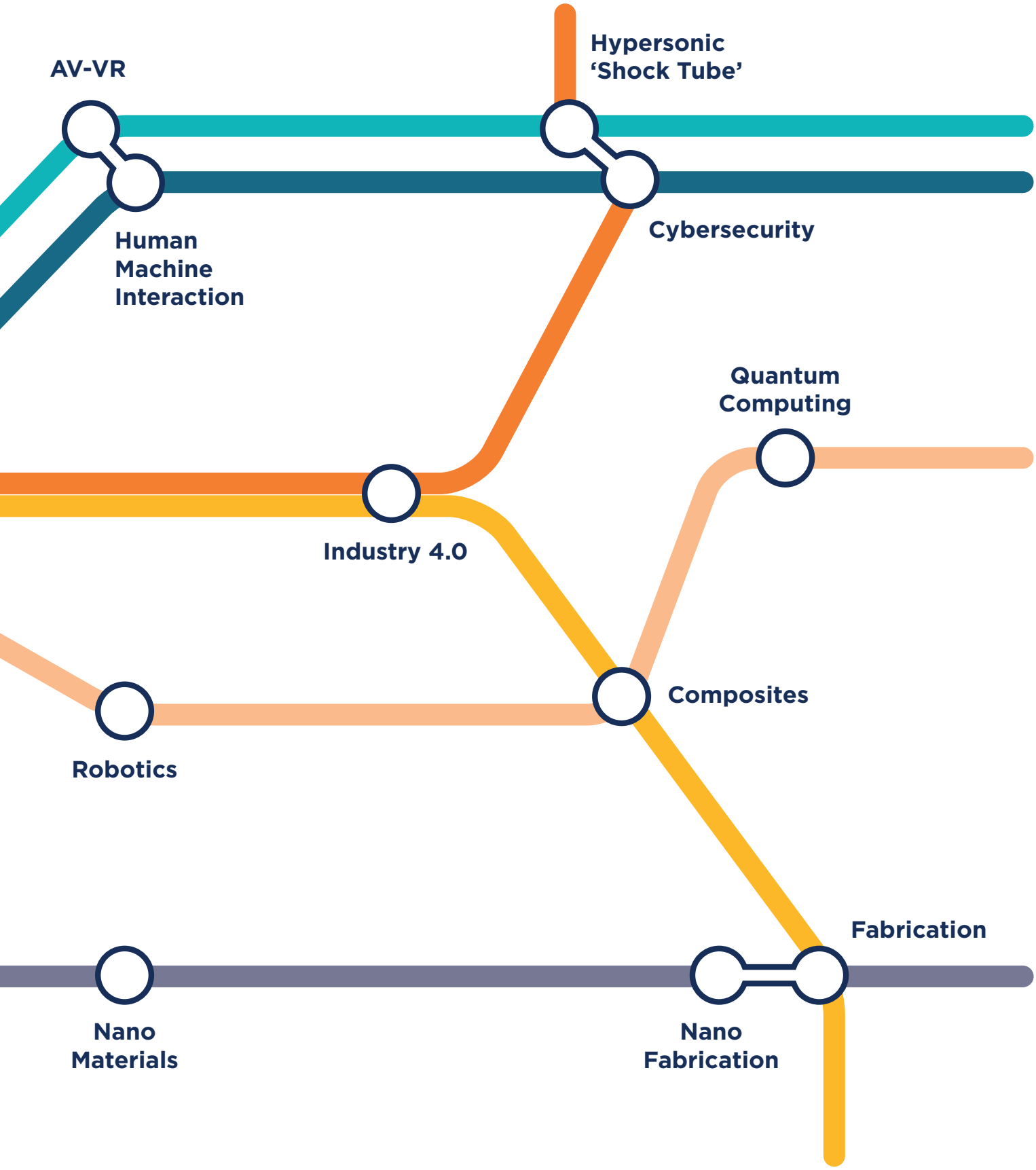
380
ACTIVE START-UPS.

401
PAID JOBS CREATED FROM NEW START-UPS.

The UTS program is geared towards an entrepreneurial experience, creating a diverse and expansive ecosystem, where the currency is exploration, shared practice and networking; a space where you don't necessarily aspire to be the lead entrepreneur or have the great idea, but you do seek to be part of an ecosystem that harnesses expertise, drives understanding, tackles capability development and grows the nations capacity to successfully create and scale businesses.

All this while actively and successfully creating startups, jobs and raising capital.

NUW+UTS R&D CAPACITY NETWORK.


AV-VR
Hypersonic
'Shock Tube'
Human
Machine
Interaction
Cybersecurity
Quantum
Computing
Industry 4.0
Composites
Robotics
Fabrication
Nano
Materials
Nano
Fabrication

ADVANCED MANUFACTURING.

Almost all human activity relies on manufactured goods and manufacturing automation in one form or another. From transportation, construction, medical care or precision machine design.

Advanced manufacturing is transforming products and processes through significant advances in digital connectivity and analytics, which are also playing a role in creating more efficient supply chains and factory floors.

Advanced manufacturing is a critical contributor to many Australian industries, including medtech, clean energy, circular economy, agrifood, critical minerals processing, defence and space. Over the next 20 years, Australia's manufacturing industry will evolve into a highly integrated, collaborative and export-focused ecosystem that provides high-value customised solutions within global value chains.

The NSW Government has recognised the value of advanced manufacturing through its plans for the development of a new city centre. It will be established adjacent to the coming, federally funded Western Sydney International (Nancy-Bird Walton) Airport proximate to Badgerys Creek in Western Sydney.

The Government describes the new city as 'a cybersecure, advanced, green and connected hub for advanced industries'.

SUPPORTING INITIATIVES.

Initiatives the Government has committed to supporting in situ include:

- The National Security Quarter: a new hub for the advanced defence and innovation sectors.
- Advanced Manufacturing Skills: a pilot training program to provide a skilled, engaged workforce ready for the needs of modern manufacturing environments.
- High tech research facility: with shared space and equipment for international advanced industry firms and local manufacturers.

The NSW Government's commitments and expected sustained growth in the sector will require proactive investment and translation of enabling science and technology.

Combinations of sensors and data analytics; advanced materials; smart robotics and automation; 3D printing; and augmented, mixed and virtual reality are emerging as key enablers of future growth.

The NUW+UTS Consortium is positioned to help deliver on the NSW Government's advanced manufacturing goals by providing an opportunity to identify and implement automation-related fabrication technology.

200,000 KNOWLEDGE JOBS.

The Government calculate this new city alone 'will support up to 50,000 jobs', which sits within a wider commitment under the (2018) Western Sydney City Deal to create '200,000 knowledge jobs' throughout the Western Parkland City by 2038.

The City Deal contains an additional skills and employment generation commitment to establish a Multiversity, which the NUW Alliance delivered in August 2021 in partnership with TAFE NSW.

2023
FIRST BUILDING
2,000m²

Next-Generation Fabrication

Broad advanced manufacturing capabilities to support a range of applications, and demonstrate the value chain from research to production.

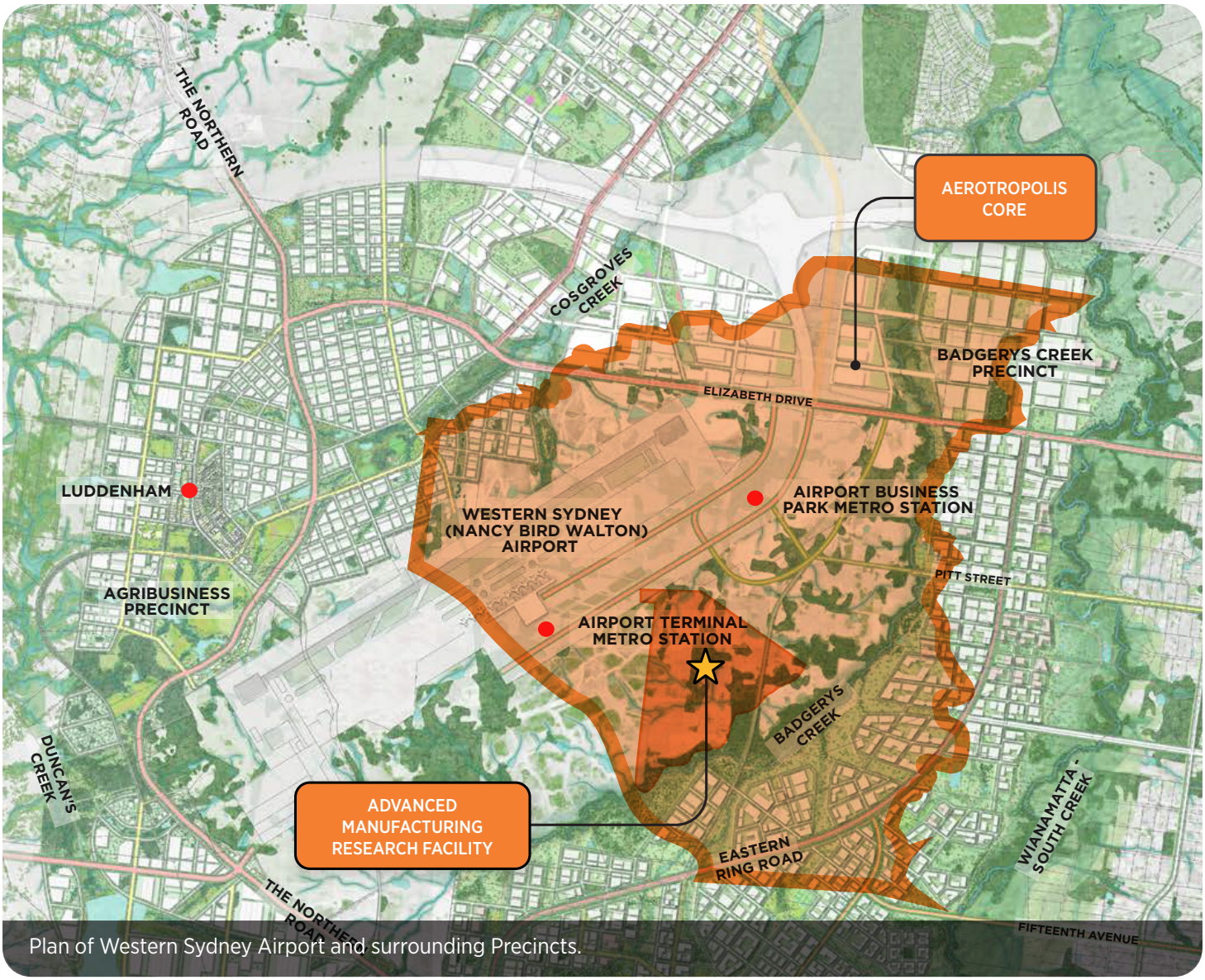
Additive - Subtractive - Composites
Digital - Automated

2026
FULL-SCALE
18,000m²

Advanced Manufacturing and Electronics.

Specialised manufacturing system for high-capability, high-value electronics.

Nanofabrication - Packaging
Neuromorphic Systems - Assembly



Plan of Western Sydney Airport and surrounding Precincts.

Information on this page supplied by the NSW Government.

THE FACILITY.

Planned to be situated in the new city centre adjacent to the Western Sydney International (Nancy-Bird Walton) Airport, the AMRF will be a shared platform for collaboration and innovation.

The AMRF is described as 'a catalytic investment in industrial infrastructure and research', enabling business to develop, prototype and rapidly scale new products and processes.

AN INTERFACE.

The facility is intended as an 'interface between government, industry, TAFE NSW and research institutions. The industrial research facility will house infrastructure and services that businesses can access directly to rapidly scale advanced manufacturing products and techniques.

THE TIMELINE.

The Western Parkland City Authority is the NSW Government body responsible for delivering the AMRF across two stages.

The initial stage will be located in the new city centre's first building, anticipated to be completed by 2023, with the the full-scale AMRF planned to follow by 2026.

A further commitment has been made to deliver a 'full-scale operational industrial research facility' by 2026.

I2N Integrated Innovation Network | University of Newcastle

March 2018	Western Sydney City Deal signed
November 2018	Western Parkland City Authority created
March 2019	Western Parkland City Authority Agriprecinct announced
August 2019	Advanced Manufacturing Research Facility (AMRF) announced
March 2020	Construction of Western Sydney International (Nancy-Bird Walton) Airport begins
November 2020	Visualisations of the AMRF unveiled by NSW Government
	New Education Training Model (NETM) announced by Western Parkland City Authority
June 2021	NUW Alliance Multiversity launched
October 2021	Hassell appointed to design AMRF with $47.8m committed to the build
2023	AMRF Stage 1 to be completed
2026	Sydney Metro – Western Sydney Airport rail link opens
	Western Sydney International (Nancy-Bird Walton) Airport commences operations
	Full scale AMRF to be completed
2026 +	Multiversity Aerotropolis campus opens.

COMPOSITES.

Drawing on the NUW+UTS Consortium high-base of knowledge, capacity and facilities, our strengths as they relate to each specialisation are evidenced following.

Composites are produced by combining two or more materials with different physical, chemical, or electromagnetic properties. The base materials work together to achieve a superior result, enabling composites to be multi-functional, stronger, lighter, more flexible, or more resilient than traditional materials.

The composite technologies market is predicted to reach USD $160.54 billion by 2027 (Grand View Research), fueled by rising demand and investment from a range of industries, including aerospace, defence, mining, biomedical, construction and transport.

HIGHEST LEVEL OF OPERATIONAL EFFICIENCY.

The additive nature of composites manufacturing makes it possible to reduce parts counts, embed sensors for life-cycle monitoring, and combine value-added design, engineering, and production services to create a vibrant supply-chain industry in Australia. An additional target is to produce composite products with the highest level of operational efficiency, paving the way for automation, digital exports, machine learning and AI initiatives.

Many NUW+UTS consortium collaborations are funded by these industries through member university teaching and research concentrations and wider networks, such as the ARC Training Centre for Automated Manufacture of Advanced Composites.

MULTI-FUNCTIONAL STRUCTURES.

Advanced lightweight and multi-functional structures are important in manned and unmanned vehicles, service robots and exoskeletons. Lightweight fuel storage is crucial for low-cost access to space. Although fibre-reinforced polymer composites have been deployed in vehicle and payload components, storage of liquid and gaseous hydrogen (H2) fuel still relies on metallic tanks.

In partnership with aerospace company, Lockheed Martin, a prototype carbon fibre composite tank has been developed with enhanced strength and nano-reinforcements used to mitigate matrix-cracking at cryogenic temperatures.

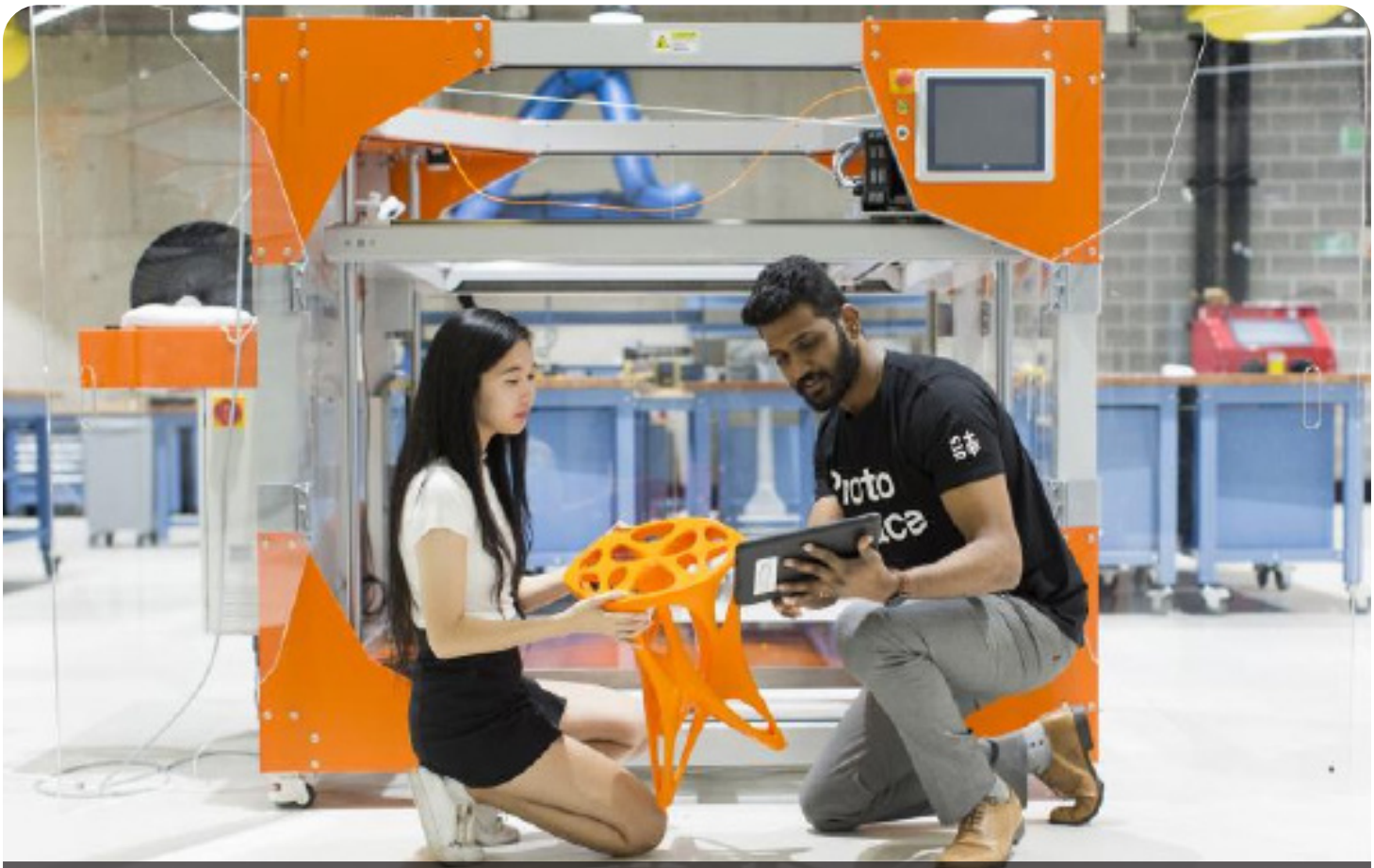
NEAR TERM WINDOW.

Fundamentally enabled by our existing successes and critical mass, cognisant of the momentum across existing projects, the NUW+UTS Consortium believes through targeted investment, the AMRF is well placed to become the advanced composites technology hub of Australia and become a forerunner in the Asia Pacific market and beyond.

Increased adoption of advanced composites opens a near-term window of opportunity to secure local market capability for import replacement and reputation in international supply chains.

Given the current rate of growth and number of international research and development initiatives already underway, it is imperative that Australia move quickly to enter the market, particularly as international supply chain barriers emerge.

Advanced Manufacturing facilities | Western Sydney University



Protospace | University of Technology Sydney

FABRICATION.

Manufacturing is the process of converting raw materials into a product. Fabrication, a part of the manufacturing process, refers to the assembly of products that will be used in the manufacture of a finished piece. Manufacturing a smartphone, for example, requires many separate fabrication steps.

Capitalising on our strengths, the NUW+UTS consortium possess unparalleled expertise across the Fabrication sphere.

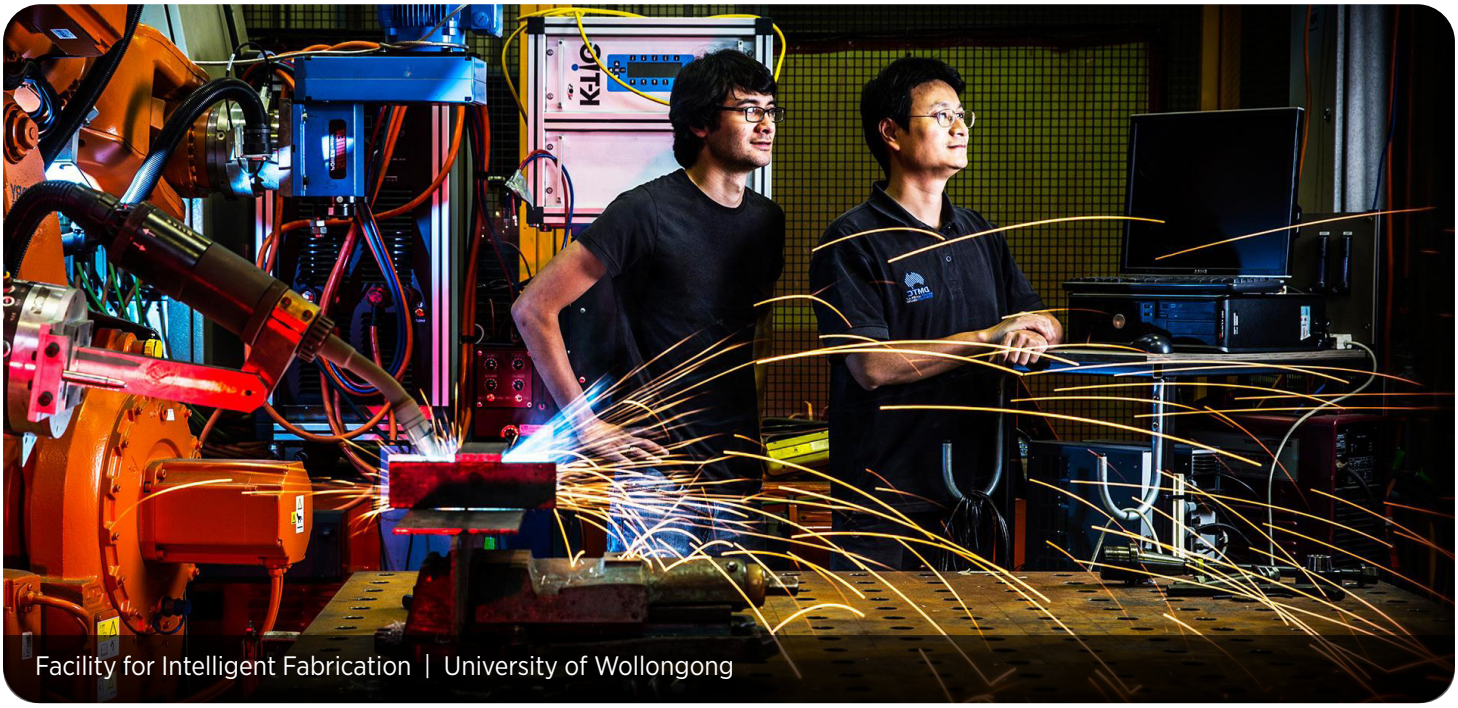
Major projects the NUW+UTS consortium is involved in are producing additional defence related advances in welding, robotics, automation, and materials. This includes collaborative projects that have delivered innovative solutions include the Bushmaster and Hawkei armoured vehicles built by Thales Australia, maritime welding and fabrication for the Collins Class submarines, and the Air Warfare Destroyers.

DIGITAL AND ROBOTIC PRODUCTION.

Metal joining, or welding, is a critical fabrication process used in industries such as defence, aerospace, the automotive industry and the construction sector. Importantly, metal-joining can now be automated, through adoption of new Industry 4.0 digital and robotic production technologies. Industry 4.0, the 'Fourth Industrial Revolution', is the new wave of innovation, centred on automation and data exchange in manufacturing technologies.

Welding and fabrication technology remains an integral part of the manufacturing industry, with many new opportunities for local fabrication companies to participate in intensive projects in the defence and aerospace industries.

Many small and medium-sized enterprises (SMEs) do not have the resources to find the new technologies that best suit



Facility for Intelligent Fabrication | University of Wollongong

their business. Acquiring the skills to use the technologies, or the connections to international supply chains and new markets can also prove challenging.

BUILDING CAPABILITY.

Collaboration is crucial for SMEs to build their capabilities and move to Industry 4.0 best practice by adopting advanced manufacturing methods.

The NUW+UTS consortium works extensively with the Australian Defence Force, providing the technologies needed to optimise defence capability while also creating jobs and boosting many areas of the economy. The AMRF will provide SMEs with the opportunity to identify and implement automation-related fabrication technology, to help businesses adapt and compete in a changing world.

INTELLIGENT FABRICATION.

For instance the consortium's, Facility for Intelligent Fabrication within the University of Wollongong is providing the skills, knowledge and services required to support defence innovation, while also offering new market opportunities for Australian businesses, particularly SMEs.

SUSTAINABLE.

Importantly, fabrication and related technologies driven by the NUW+UTS consortium are closely aligned with a range of the United Nations', Sustainable Development Goals in innovation, gender equality, quality education, decent work and economic growth, reduced inequalities, sustainable cities and communities, and responsible consumption and production.

Fabrication Facilities | UNSW Sydney

NANOFABRICATION.

Nanofabrication is the design and manufacture of devices with dimensions measured in nano-metres and it is critically important to the ongoing development of modern manufacturing. Some of the greatest challenges faced by mankind in energy, environment, health and communication can be solved by reimagining the design, processes and materials used by the semiconductor, transportation, mining, health, information technology and personal electronics industries among others.

Researchers at the NUW+UTS consortium with expertise in manipulation of materials at nano-scale are working on the cutting edge research areas. These include the development of super sensitive gas and biomolecules sensors, magnetic materials, optoelectronic devices, wearable devices, thin film devices, and precisely engineered catalysts using appropriate nanofabrication tools for advancing industrial manufacturing processes.

Current developments in Nanofabrication as it relates to manufacturing include physical, chemical and biological techniques established for the fabrication of nanodevices, nanostructured materials and functional biomolecules for advanced electronic, photonic components and micro-electromechanical systems (MEMS) or nano-electromechanical systems (NEMS) device manufacturing.

The future for nanofabrication may include the precise manipulation of atoms or molecules that will require a combination of different techniques for fabricating complicated devices functioning with super-high precision and high consistency.

The new era of precise atomic and molecular manipulation will include multi-functionalities, manipulation of single atom or single molecules as devices/ sensors, integration of organic/inorganic nanostructures with biomolecules combined with artificial intelligence for mimicking human system to realize a variety of tasks.

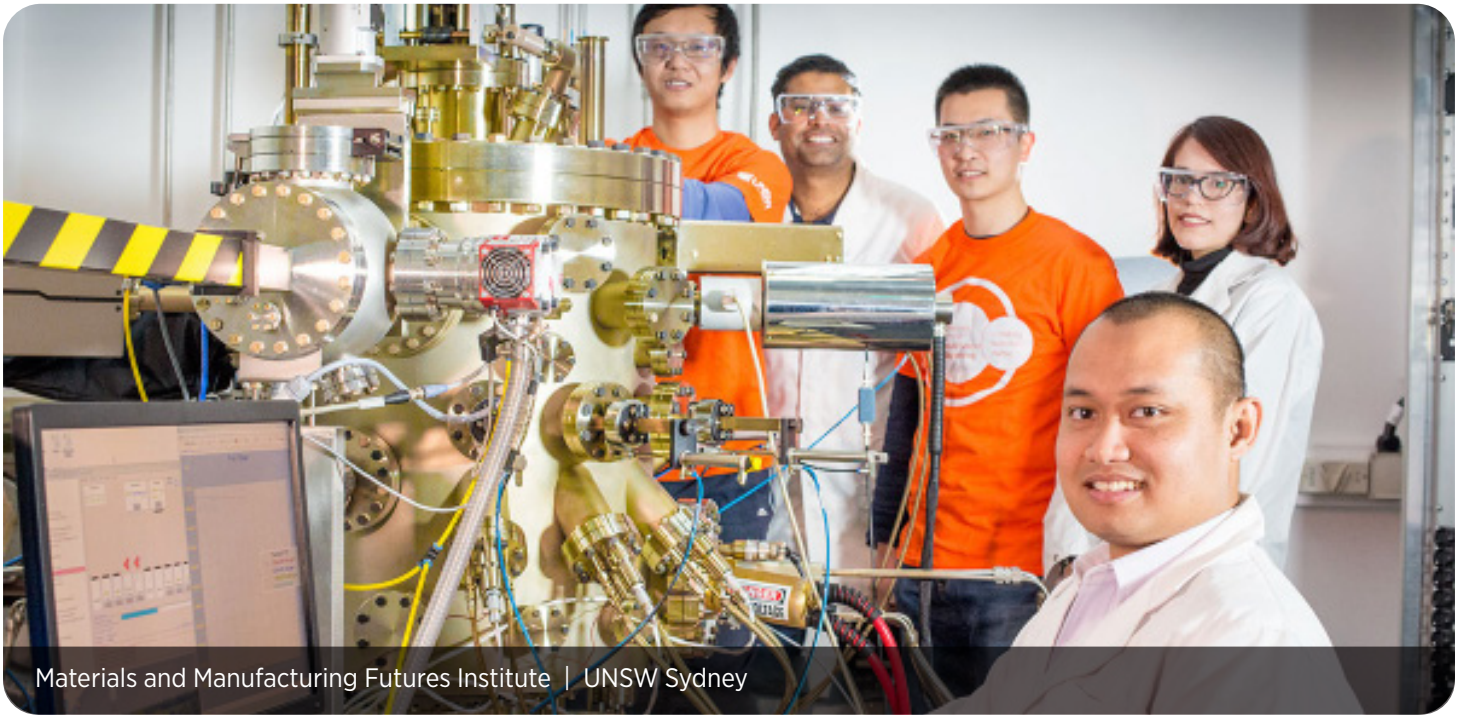
Nanofabrication will also advance into unconventional research areas such as catalysis, personalised wearable sensors, personalised medicine, and development of other personal gadgets and devices.

The future of nanofabrication will also entail large scale and low cost approaches taking it out of the clean room for revolutionising industrial fabrication processes.

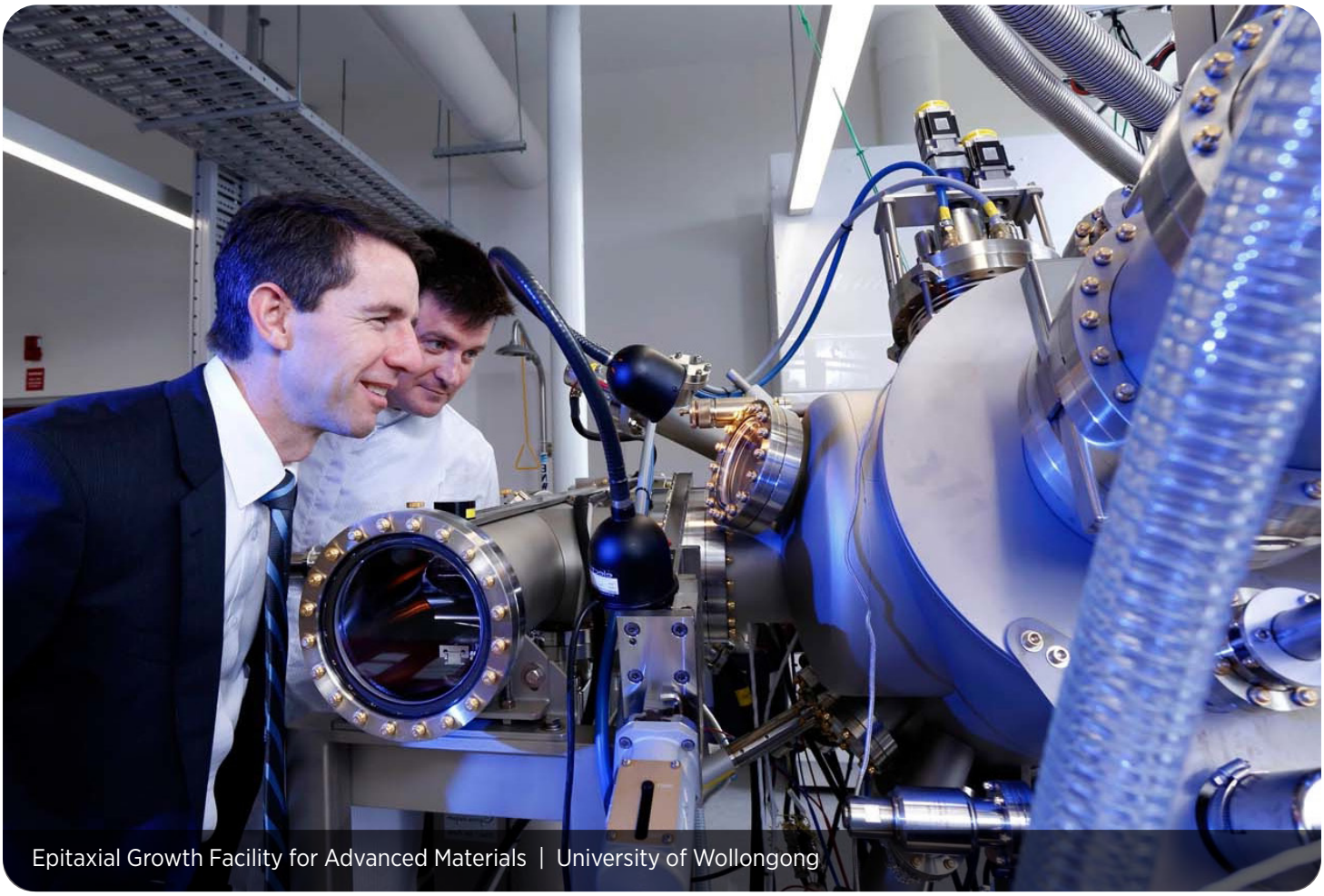
INNOVATORS IN MATERIALS AND SCIENCE.

At the forefront of developing state-of-the-art and cost-effective technologies, the Global Centre for Advanced Nanomaterials (GICAN) is developing advanced nanostructures for various applications across the extensive energy, environment and health sectors using both chemical and physical routes of nanoscale manipulation.

GICAN is specialized in fabrication of 0D, 1D, 2D and 3D nanostructures with and without ordered porosity along with tunable electronic, catalytic, sensing, magnetic and textural properties. It is engaged in development of thin film devices for gas and liquid sensing, fabrication of solar cells, energy storage devices (supercapacitor, battery) and photocatalytic and catalytic applications (hydrogen generation) using physical and chemical vapour deposition, spin and dip coating, self-assembled and electrochemical deposition, as well as electrospinning based techniques.



Materials and Manufacturing Futures Institute | UNSW Sydney



Epitaxial Growth Facility for Advanced Materials | University of Wollongong

NEUROMORPHIC ENGINEERING.

At the AMRF, the NUW+UTS consortium will demonstrate the gains possible using neuromorphic sensors to capture data more efficiently, and neuromorphic algorithms to pre-process this data at the sensor (or 'Edge'), reducing the amount of data that needs to go to cloud servers, and producing faster decisions.

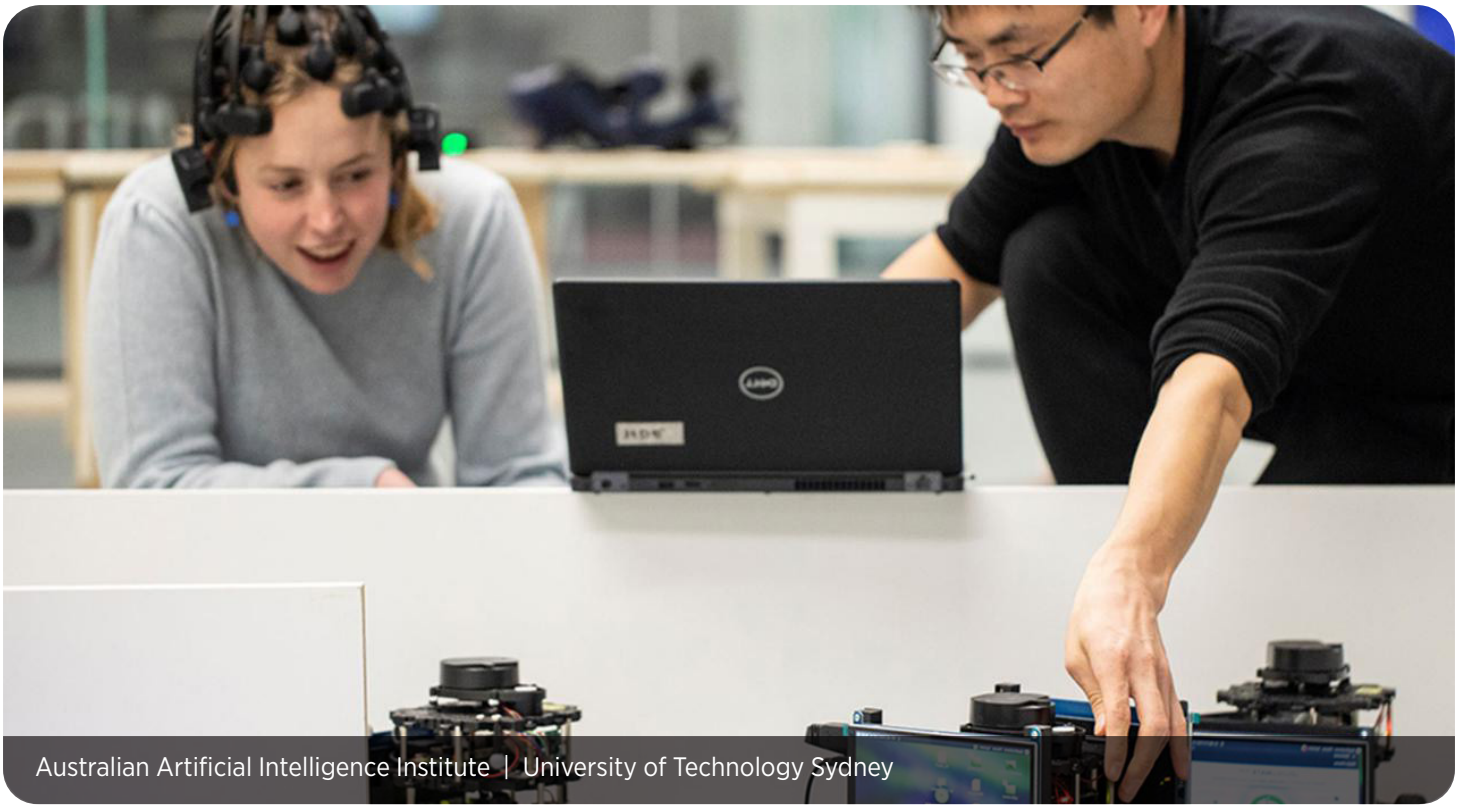
As artificial intelligence has grown increasingly sophisticated, it has become a crucial element of modern manufacturing. Today's AI systems can interpret spoken commands, recognise objects and gestures, navigate, plan, and make decisions.

Smart, autonomous, industrial environments interact naturally with users, and adapt to changing conditions seamlessly. Keeping up with these increasing expectations requires new thinking about how AI systems are designed.

THE INSPIRATIONAL BRAIN.

Neuromorphic engineering turns to the brain for inspiration. The human brain consumes a fraction of the energy required by the processors that power today's AI systems, and needs only a few examples to learn new patterns. It has evolved to quickly identify and avoid lunging predators. It has many properties we need in the next wave of efficient, responsive, and adaptive 'smart systems'.

Neuromorphic computing is a powerful approach to hardware-accelerated AI. Inspired by the properties of biological brains, neuromorphic architectures are radically different from those used in traditional processors. Instead, they emulate neural systems.



Australian Artificial Intelligence Institute | University of Technology Sydney

DATA AT THE EDGE.

The Advanced Manufacturing Research Facility provides the opportunity to showcase the benefit and application of the full stack of neuromorphic engineering in operation across the whole industry value chain, to continue the productivity gains enabled by the adoption of digital technologies and systems.

INTUITIVE APPLICATIONS.

Neuromorphic sensors and Edge processing can be applied to many areas inspired by biology, such as, vision, audio, chemical and tactile, but also to other types of sensing, such as quantum, radar and lidar.

These sensors would not only be used in the manufacturing chain, such as for high-speed counting of objects, or fast manipulation of components, but also for monitoring plant performance via vibration monitoring and anomalous audio detection, sensing human presence in dangerous environments, or monitoring operator fatigue. In addition, edge processing can monitor equipment for anomalous behaviour as part of a cybersecurity approach.

A LIVE ENVIRONMENT.

To enable the full range of neuromorphic capabilities, the AMRF will make available an operating environment that can demonstrate novel sensors, hardware platforms, and algorithms all working together. This environment will also provide a live environment for testing new modes of operation, it will be available for the training and development of the skills required, upskilling the regional workforce in the critical capabilities required for Industry 4.0.

Neuromorphic Engineering | Western Sydney University

AV-VR + HUMAN MACHINE INTERACTION.

The NUW+UTS consortium's neuroscientific approach to Human-Autonomous Teaming and Human-Machine interface design offers Advanced Manufacturing previously untapped opportunities for greater efficiency and productivity through its capacities to assist decision-making, human-assisted product design and modelling, real-time monitoring of human-autonomous team behaviour and on-site training. The possibilities are unlimited.

As Advanced Manufacturing industries become ever more reliant on digital and automated systems, the potential for human-machine collaboration broadens. Human-Autonomous Teaming (or HAT) exemplifies the possibilities.

HAT employs algorithms or machines – sometimes in large numbers, for example, drones – to interact with human-team members in real time, to make decisions and to accomplish complex objectives.

AUTONOMOUS AGENT TRANSPARENCY.

Using a combination of artificial intelligence, brain imaging and cognitive science, NUW+UTS researchers focus on bi-directional communication between humans and machines in HAT. Analysis of brain states, autonomous agent transparency or decisional 'explainability', can help predict HAT performance, in turn, enabling the appropriate calibration of trust in autonomous systems.

To effectively interact and collaborate with digital systems human users must be capable of meaningfully and efficiently interpreting the information provided to them. Increasingly, this information is received in the form of digitally generated visual data, presented to the user via screens, immersive or augmented reality devices.

CHANGING COGNITIVE STATES.

To ensure digital information is presented in a way that optimises productivity and performance, researchers employ a combination of brain imaging, artificial intelligence and neuroscientific principles to design digital human-machine interfaces that are visually digestible, task optimal and which dynamically adapt to users' changing cognitive state.

Augmented Reality (AR) systems use visual projection to superimpose computer-generated images onto the user's visual field, producing a composite of normal 'natural' visual input with computer-generated content. A major advantage of AR over screen-based and fully immersive virtual reality (VR) systems is that they enable the user to continue to view and interact with the real world whilst receiving and interacting with digital information in real-time. AR has been adopted to assist in a range of industrial and military contexts as a means of facilitating procedural training, enabling multi-sensory communication of large data sets and improving situational awareness.

Virtual Reality Midwifery | University of Newcastle

Virtual Exhibition | UNSW Sydney

ROBOTICS + AUTOMATION.

The main industry opportunities in robotics are to address challenges driven by consumer demand towards process innovation, integrated service offerings, customisation, and bespoke products that have resulted in complex and demand-driven manufacturing processes which do not lend themselves to full automation but require some element of human-robot collaboration to be efficient, safe, cost-effective and of high quality. These are challenges the NUW+UTS consortium is well placed to explore and overcome with industry partners at the AMRF.

Robotics and automation technology, in general, is one of the key components of the Industry 4.0 approach to advanced manufacturing.

Although automation has played a main role in manufacturing for many decades, it is traditionally characterised by highly structured environments, repetitive actions, and a low level of uncertainty. Robotics in the advanced manufacturing context plays a much more agile role with a far greater degree of autonomy.

Collaborative robotics (often abbreviated as co-bots) is an area that draws on the research strengths of many Australian universities. The development of collaborative robotics applications, combining the strengths of humans and robots, will underpin global competitiveness in advanced manufacturing.

Tech Lab | University of Technology Sydney

HUMAN-ROBOT COLLABORATION.

Human-robot collaboration increases adaptability and flexibility, reduces ergonomic stress, possesses high availability and ability-based distribution of tasks, and is economical. This shift toward co-bots will support Australian manufacturers in shifting toward higher-potential markets and competing globally.

Important challenges the NUW+UTS consortium will partner with industry to address at the AMRF include: the optimisation of collaborative robots to mimic humans; improving co-working outcomes; understanding human and workplace dynamics; and, the implications associated with the use of collaborative robots to increase effectiveness and efficiencies.

THE ROBOTICS ROADMAP.

Co-bots are particularly relevant to SMEs, which represent the majority of current Australian manufacturing businesses. The Robotics Roadmap for Australia released in 2018 describes a vision for "robots as a tool to unlock human potential, modernise the economy, and build national health, well-being and sustainability."

The Roadmap notes that, "Australia has a specific need for robotics to act as a force multiplier, augmenting and extending world-class, skilled human capability while reducing human exposure to dirty, dull, and dangerous processes. Safety is a key priority for the sector, which is dominated by SMEs who need skilled workers to take advantage of Industry 4.0."

Applied Mechatronics | University of Wollongong

CYBERSECURITY.

The cybersecurity research the NUW+UTS consortium will apply at the Advanced Manufacturing Research Facility aims to protect us from these future vulnerabilities by working on opportunities and challenges now, to develop post-5G, post-quantum and post-COVID cybersecurity solutions.

This capacity will be critical in ensuring the integrity and effectiveness of the AMRF's 'space' and 'defence' specialisations. It will also provide new opportunities for industry and the wider community in an increasingly complex and competitive field.

If you've ever had your credit card phished, or your computer infected with malware, you will know the importance of cybersecurity. We are all well-versed in personal cybersecurity measures; choosing strong passwords, changing them frequently, being wary of email attachments, and backing up data.

The purpose of cybersecurity is to make the world a safer place. Cyber attacks are on the rise globally and becoming ever more sophisticated. Every sector faces the daily threat of cyber security incidents.

CRITICAL INFRASTRUCTURE.

Our society relies on critical infrastructure like water and power, hospitals, and banks to operate effectively. These same infrastructures all have online data, information, networks, and systems that are potential targets for cyber attack from bad actors.

Cybersecurity defends us against cyber threats such as malware, ransomware, phishing, cyber-espionage, botnet armies, cryptomining etc. Cybersecurity protects people, systems, utilities, and organisations. It keeps us safe from cybercriminals.

Institute for Cyber Security | UNSW Sydney

What of the future? Over the next 10 years, our world will become even more connected than it is now.

We will have access to high speed 5G networks, and there will be an explosion in the number of IoT connected devices, smart cars, smart city apps, e-health devices, virtual reality (VR), augmented reality (AR), Big Data, e-payment, blockchain, and cloud computing. The list goes on. How will we safeguard such interconnected devices, data and systems? How will we defend privacy in a cloud-everything world?

QUANTUM COMPUTING.

Meanwhile, the promise of quantum computing – with its anticipated revolution in computing speed and power – will bring new opportunities for security and privacy, and new vulnerabilities that can be exploited by cybercriminals who make use of quantum computing.

The COVID19 pandemic has identified a new cybersecurity issue: working from home. The rapid adoption of remote working that occurred in 2020 and 2021 is likely to continue into the future. How will we protect home computers and networks from attack beyond the protection of organisational firewalls?

Data Arena | University of Technology Sydney

WHAT'S NEXT?

The pandemic has been a learning curve, globally, in so many ways. The lessons are telling, hard and unrelenting.

The way we work, how we move through cities, how we interact socially, culturally, and internationally are in flux. A return to normal is no longer possible, nor will it even be recognisable to children growing up in this period.

Not so long ago, the 'future of work' was something referred to in abstract terms. It was something we were told is coming, something we should prepare for, something we might even be able to 'future proof'. All of that sounds outdated now.

What we have now is a situation very few of us could have imagined. But now is when our imaginations matter the most.

We must ask, what future can we imagine? It is a compulsion hardwired in us all, to ask, what will tomorrow look like? Especially when we're surrounded by uncertainty.

The fundamental human action in recovery is to rebuild, to construct to make. That is what we must draw on now.

But we need to remake the way we make. This is the opportunity we have under the umbrella of advanced manufacturing.

The research vision the NUW+UTS consortium has mapped in this document is only the beginning. It is simply a platform on which to contemplate what's possible. But that is how all great possibilities start.

What's required now is a commitment.

The researchers whose combined insights constitute this vision are committed to working together. The universities that support, enable, and unleash that vision are committed partners.

If industry, government, and most importantly, the community, will join us in that vision, then there is nothing stopping us from realising it, together.

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Virtual Reality at Catalyst West | Western Sydney University

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