



Capability Statement

Advanced, clean manufacturing

The University of Wollongong (UOW) is at the centre of a manufacturing innovation ecosystem that extends across our communities within the Illawarra and NSW more broadly.

We are working to identify sustainable solutions that embrace new technologies, particularly in clean energy and circular economy principles, to aid the revival of manufacturing in NSW and achieve sustainability goals. This includes tapping into the skills of the existing workforce, creating new supply chains, and harnessing our knowledge base and relationships with industry to help regional transformation through advanced manufacturing.

Research in next-generation manufacturing at UOW spans clean energy technology, 3D printing, high-strength alloys, better battery materials, biomedical microdevices, bionic implants and nanomaterials, along with innovative building materials. UOW is a world leader in smart materials research, intelligent systems, autonomous vehicles, and robotics in remote and challenging environments. Our researchers are also developing innovative machinery including 3D printers, high productivity welding systems, metal forming systems, and autonomous robots.

These world-class capabilities provide a deep base of research and commercialisation capacity that greatly magnifies the potential for small and medium-sized enterprises (SMEs) to grow and compete.

UOW is not only working to revitalise the Illawarra – which has deeply held roots in mining and manufacturing – but to distribute opportunities across NSW for businesses to be exposed to a range of frontier manufacturing materials and technologies. In particular, we are advancing industry capability through our work in clean energy, biomaterials research, smart materials research, biomedical devices, and defence-related research.

UOW's work in advanced, clean manufacturing is:

- Increasing collaboration between government, industry, research organisations, universities and VET providers to build industry capability and increase research.
- Upskilling employees, encouraging lifelong learning, and producing graduates with the competencies required for the manufacturing jobs of the future.
- Encouraging start-ups and entrepreneurship and increasing participation in STEM.
- Increasing the adoption of advanced “smart factory” production techniques.
- Supporting the creation of customised, high-value goods and increased commercialisation.
- Positioning the Illawarra and NSW to be at the forefront of advanced manufacturing.
- Creating an environment attractive for multinational corporations to develop an R&D presence and for locally-based companies to grow into world-class advanced manufacturers.
- Fostering and training undergraduate and postgraduate students, particularly HDR students and early career researchers.
- Scoping alternative models to the linear flow of products from factory to landfill through a circular economy.



We are focused on the broad set of connected technologies in advanced manufacturing, including:

- **Sensors and data analytics (including the Internet of Things):** these include predictive maintenance, logistical tracking for operational efficiencies, and quality control.
- **Advanced materials:** advanced materials can be integrated to offer attributes such as biocompatibility, biodegradability, energy efficiency, self-sensing, self-actuation, and self-repair.
- **Smart robotics (artificial intelligence) and automation:** affordable and adaptive robotic systems uniquely tailored to Australian manufacturing, delivering mass customisation solutions.
- **Additive manufacturing (3D printing):** the fastest-growing sector of manufacturing globally.
- **Augmented and virtual reality:** used to overlay product designs with end-use environments, facilitate remote collaboration and train or guide workers through complex or dangerous tasks.

UOW works closely with industry, research partners, governments, universities and VET providers to provide solutions to support existing and emerging businesses as they look to adopt advanced manufacturing technologies and innovative systems.

Our international and national collaborations range from a partnership with Andhra Pradesh Medtech Zonev (AMTZ) in India to produce 3D-printed ears, to teaming with Liverpool-based multinational manufacturing company Daikin for research opportunities, product development, and internships.

UOW has an excellent reputation for defence-related research to support the defence industry with materials and manufacturing solutions. We are a founding member of the DMTC (formerly known as the Defence Materials Technology Centre). Within the DMTC, UOW draws on its traditional strength in materials engineering (particularly steel research), welding and joining.

NEW MATERIALS AND NEW APPLICATIONS

Australian Institute for Innovative Materials (AIIM): The cutting-edge work at UOW's AIIM, which includes materials science and next-generation fabrication technology, is helping to set a new direction for manufacturing. For example, artificial muscles in miniature devices are being developed that could be applied to medicine and robotics.

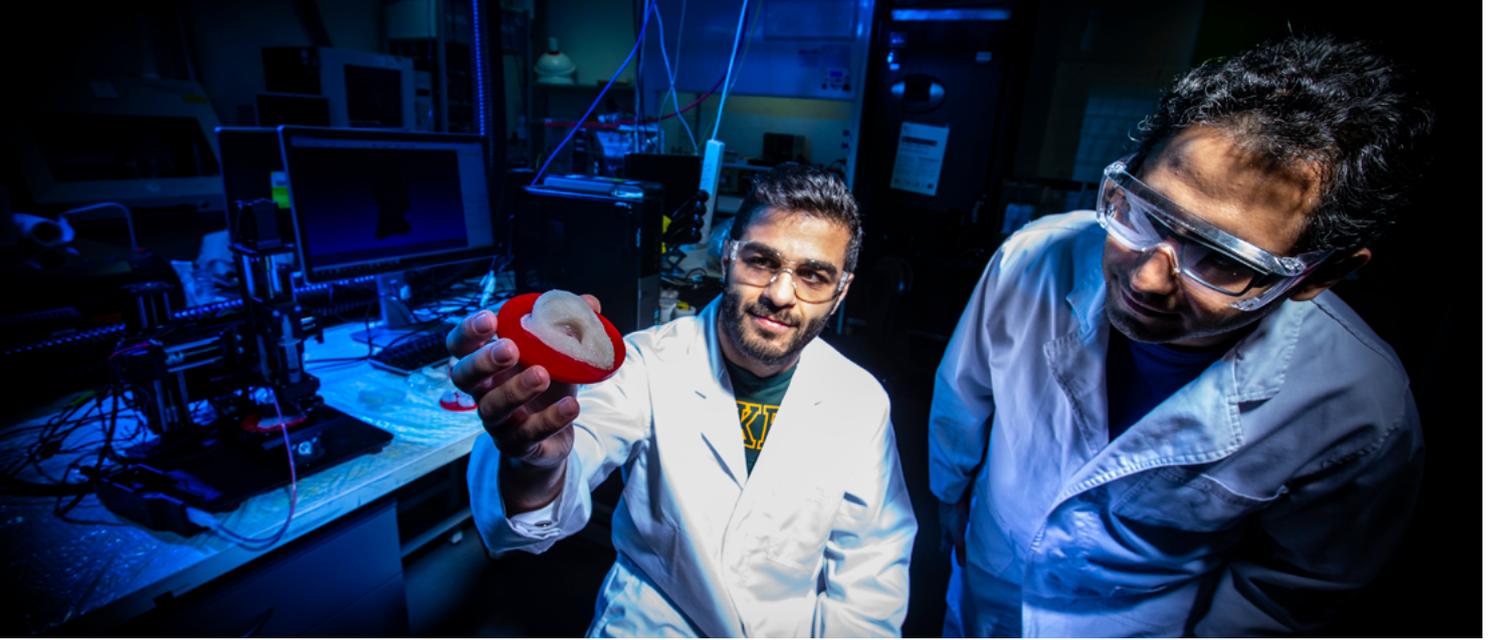
AIIM houses two of UOW's flagship research groups – the Institute for Superconducting and Electronic Materials (ISEM) and the Intelligent Polymer Research Institute (IPRI), which is also the lead node of the ARC Centre of Excellence for Electromaterials Science (ACES) and the Australian Fabrication Facility (ANFF) Materials Node. IPRI is leading the nation's research into the development of new industries and manufacturing opportunities in next-generation materials such as biomedical implants, batteries and hydrogen generation.

The Process and Devices Facility at AIIM allows researchers to take their new materials from fundamental research, through the proof-of-concept stage and into real world applications through novel fabrication, processing and manufacturing methods.

AIIM helps deliver UOW's Graduate Certificate in Biofabrication - a unique offering for students interested in new additive biofabrication methods for medical applications such as 3D printing body parts and regenerative medicine.

The Intelligent Polymer Research Institute (IPRI): The institute is recognised internationally as a world leader in the development of "intelligent" materials and nanotechnology. Its researchers work with nanomaterials in areas such as renewable energy (plastic solar cells, lightweight batteries and electronic textiles), medical science (nerve and muscle regeneration and cell communications), sustainable industries, and 3D printing.

Researchers are collaborating on projects from developing 3D-printed body parts to building robotic systems that have the high dexterity found in humans (soft robotics). Ink-jet printing, 3D extrusion printing and wet-spinning methods are being adapted to produce biomaterials. Latest advances at



IPRI include customised 3D bioprinters such as the 3D Genii, which can print implantable, flexible, customised prosthetic ears. This innovation has helped UOW expand our biomedical ties with India, signing a strategic collaboration in 2019 with Andhra Pradesh Medtech Zone (AMTZ) to bring our expertise in 3D bioprinting to India's first integrated medical devices manufacturing zone.

We are advancing industry capability through our work in clean energy, biomaterials research, biomedical devices, Industry 4.0 technologies, and defence-related research.

TRICEP initiative: The Translational Research Initiative for Cellular Engineering & Printing (TRICEP), supported by UOW and the Australian National Fabrication Facility (ANFF) Materials Node, connects research and industry to fast-track bioprinting solutions. TRICEP houses world-leading research infrastructure to develop innovative technologies in 3D bioprinting, including printer manufacturing, biomaterials, and bioinks. The team is also involved in growing research and industry activity in marine bioresources. As part of this, TRICEP is working to accelerate commercialisation opportunities in 3D bioprinting of seaweed molecules. TRICEP's partnership through the Marine Bioproducts Cooperative Research Centre (MB-CRC) is helping researchers to develop, refine and validate marine bioproducts in an environmentally and economically sustainable way.

Institute for Superconducting and Electronic Materials (ISEM): ISEM is a world-leading research institute that works to advance technologies including batteries for electric vehicles and energy storage; applied superconductivity for electrical and medical devices; energy conversion

and transmission; spintronic and electronic materials for applications; terahertz science; and nanostructured materials.

The institute's research program focuses on developing new technologies and materials for applications in hybrid vehicles, medical equipment, telecommunications technologies, biomedical applications, and turning waste heat into an energy source.

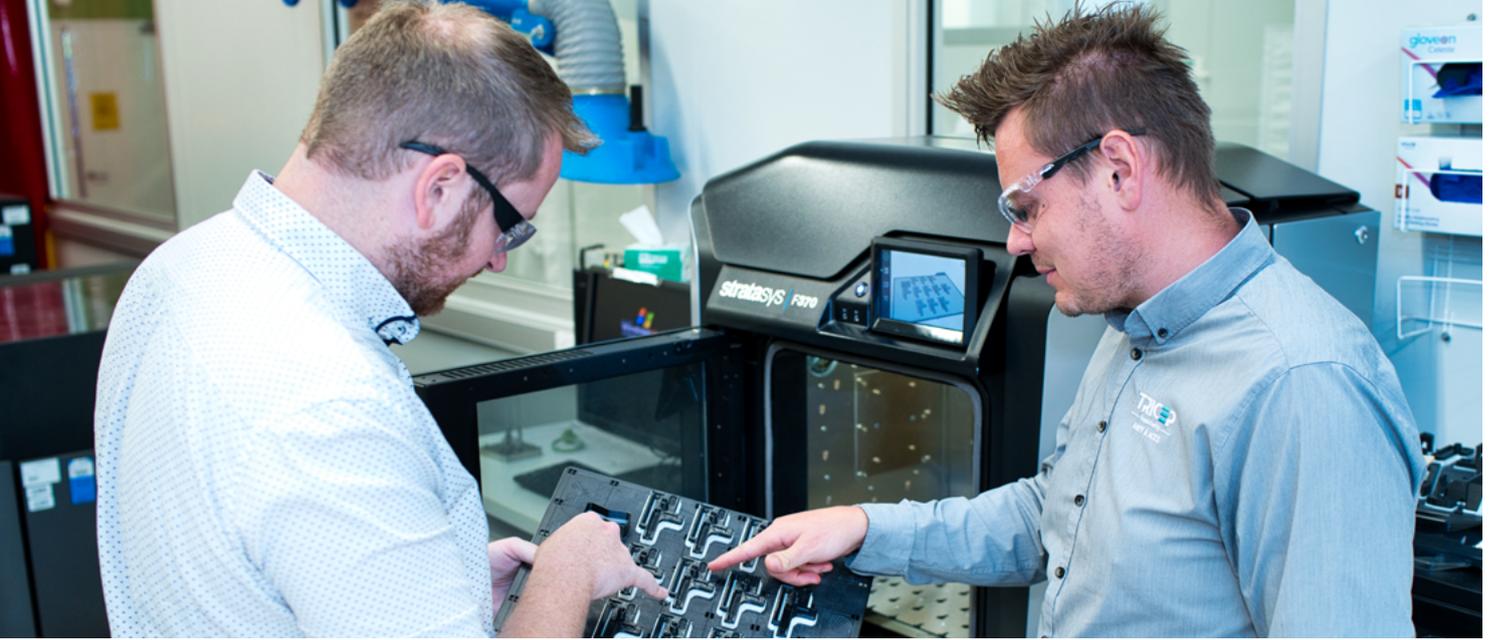
ISEM develops novel electronic/magnetic materials and electroactive materials (particular polymers) that can be used in a vast range of applications.

The Institute has educated 240 PhDs to completion, of whom more than 100 have won national-level talent plans (including 80 ARC fellowships).

Steel Research Hub (SRH): UOW headquarters the new ARC Research Hub for Australian Steel Innovation (SRH), which is a research hub designed to support the transition of Australia's steel manufacturing industry to a more sustainable, competitive and resilient position, based on the creation of new, higher value-added products and more advanced manufacturing processes.

In 2020, the Federal Government announced funding for the SRH through to 2025. The funding is part of the ARC's Industrial Transformation Research Program. Currently, The SRH's industry partners include BlueScope Steel, Liberty Primary Steel, Infrabuild, ArcelorMittal, Bisalloy, Australian Steel Institute, Weld Australia, and Australian Industry Group. University partners include RMIT University, Australian National University, Swinburne University of Technology, University of Newcastle, Deakin University, University of Sydney, University of New South Wales and Monash University.

Within its first five years, the SRH delivered many successful research projects across its three research programs – Market-Focused Product Innovation, Innovative Coating Technologies and Sustainable Steel Manufacturing. Product innovations included a self-cleaning, antimicrobial organic coating for painted steel to prevent the build-up of mould, algae and other bacteria on steel surfaces.



A joint research team comprising members from UOW, BlueScope and the University of Queensland is investigating the challenge of producing smooth, uniform, thin metallic alloy coatings on high-quality coated steel products.

UOW is working to identify sustainable solutions that embrace new technologies to aid the revival of manufacturing in NSW.

TECHNOLOGY ADOPTION

Facility for Intelligent Fabrication (FIF): The FIF is a collaboration between UOW, TAFE NSW and Weld Australia to assist SMEs to identify and implement welding and manufacturing automation-related technology, backed with technical education, training and certification support.

The facility assists SMEs to skill up, using UOW's expertise in advanced manufacturing which has been developed over more than 20 years of supporting work in both the fabrication and defence sectors. It is an extension of existing UOW research, consulting and education expertise, combined with TAFE NSW's complementary training and facilities, and Weld Australia's network of companies in the welding and fabrication space and internationally-accredited certification.

The facility provides a nationally unique set of capabilities in welding, automation and rapid metal fabrication and its members work closely with the Advanced Manufacturing Growth Centre. In addition to providing training programs, both general and tailored to company needs, the FIF provides demonstrations of technology and proof-of-concept, including prototype development.

UOW Industry 4.0 Hub: The hub enables industry and entrepreneurs to benefit from cutting-edge Industry 4.0 technology and research. Located on the grounds of the UOW Shoalhaven Campus, the hub is a five-minute drive

from HMAS Albatross, the Albatross Aviation Park and the Flinders Industrial Estate.

The goals of the UOW Industry 4.0 Hub include:

- Supporting local and regional industry (SMEs in manufacturing, agribusiness, defence industry) with the awareness and adoption of Industry 4.0 technologies;
- Engaging with schools and community to educate around Industry 4.0 and generally promote interest in STEM (Science, Technology, Engineering and Mathematics); and
- Strengthening connections between UOW researchers and local industry.

Modelled on the FIF in Wollongong, the hub is aimed at benefitting agribusiness, defence and manufacturing industries, which are key drivers of the Shoalhaven economy. Facilities include cobots, welding equipment, virtual and augmented reality training, 3D printing, and a makerspace.

Sustainable Buildings Research Centre (SBRC): The Sustainable Buildings Research Centre (SBRC) at UOW is a multidisciplinary facility that collaborates with industry to meet the challenges of improving the energy efficiency of new and existing buildings.

The SBRC is working with steel producer BlueScope on the development and testing of next-generation steel building products including photovoltaic (PV) thermal roofing, cool roof products and other innovative building envelope systems. It is also working with other key industry partners on innovative control systems for building services, including air-conditioning systems and automated natural ventilation systems.

Australian Centre for Culture, Environment, Society and Space (ACCESS): Researchers at UOW have conducted nationally significant research on creative industries-related manufacturing and technology adoption, including sustainable materials, artificial intelligence and maker innovations. ACCESS teams are also focusing on creative manufacturing work impacted by the COVID-19 pandemic and technology adoption in remote or hybrid work practices.

SMART MANUFACTURING AND AI

SMART Infrastructure Facility: The Digital Living Lab facilitates the SMART IoT Hub, a dedicated space for the development of sensor and IoT technologies. It is an open and collaborative space for researchers, students and the community to design and prototype smart sensors.

Intelligent systems and AI: Researchers at the Centre for Artificial Intelligence (CAI) are recognised nationally and internationally in machine learning, computer vision and multimedia. CAI has established strong and sustained collaboration with industries and other leading research organisations, including DATA61, Sydney University and Microsoft, in developing innovative AI solutions for the emerging market and services.

Decision Systems Lab: The Decision Systems Lab solves problems in the areas of business process management (specifically process analytics), software analytics, software testing, requirements engineering, service-oriented computing, service science, industrial optimisation, database systems, formal knowledge representation and reasoning and agent technology.

Areas of focus at the DSL include applied artificial intelligence, software analytics, oncology informatics, business process analytics, business process automation, and resilient system design. This work significantly supports UOW's collaboration with the University of South Australia (UniSA) in boosting defence industry research.

NEW TECHNOLOGIES AND INDUSTRY

Sustainable mining equipment: UOW is the headquarters of the new Australian Research Council Training Centre for Innovative Composites for the Future of Sustainable Mining Equipment. The centre is training and producing engineering graduates to be highly qualified professionals who are empowered to take on future challenges. The centre aims to:

- Develop new-generation innovative composites for mining equipment that can be applied in practical harsh working environments in deep mining;
- Develop advanced manufacturing technology of innovative mining equipment and smart mining technology;
- Train industry-focused researchers in advanced manufacturing and mining with graduates equipped to solve complex problems in the development of novel steel composites, innovative mining equipment, and sustainable mining processes; and
- Improve Australia's international standing for developing innovative mining equipment materials and manufacturing processes.

Innovation and commercial research: UOW's Innovation and Commercial Research team (ICR) works with investors and industry to create impact from the University's intellectual property portfolio. Recent spin-out companies such as hydrogen electrolyser manufacturer Hysata and battery anode manufacturer Sicon are examples of cutting-edge research being translated into real-world solutions.

ICR also works to support major new UOW collaboration initiatives aimed at the uptake of disruptive technologies, such as the Facility for Intelligent Fabrication.

The ICRU is coordinating UOW's participation in the NSW Defence Innovation Network (DIN), which is an association of seven universities in NSW.

EDUCATION AND BUILDING PARTNERSHIPS

UOW is working to eliminate barriers to collaboration, particularly as the majority of manufacturing firms are SMEs that have had limited prior engagement with research providers.

UOW has partnered with the Innovative Manufacturing CRC (IMCRC) to deliver the Futuremap workshop to manufacturers in the Illawarra and Shoalhaven. UOW is working with DMTC to pilot the Smart Enough Factory program at the UOW Industry 4.0 Hub in Nowra, and has jointly hosted UOW lab tours and industry engagement events with a wide array of industry groups including AusIndustry, the Advanced Manufacturing Growth Centre (AMGC), Southern Strength Agile Manufacturing Network, Illawarra Innovative Industry Network (I3 Net), the Shoalhaven Defence Industry Group, the Defence Innovation Network, and the Tasmanian Minerals Manufacturing and Energy Council (TMEC).

Advantage SME: UOW's Advantage SME program supports the formation of new industry partnerships with businesses across Australia, fostering industry connections to UOW's world-class research and helping to identify opportunities for collaboration. Within Advantage SME, UOW has undertaken collaborative research with a wide array of manufacturing businesses across NSW including HE Silos (Forbes), Clearlight Sauna (Ocean Shores), Romar Engineering (Sefton), Daikin Air Conditioning (Chipping Norton), Silver Services Club (Taren Point), Antec Refractory (Blacktown), Planet Protector Packaging (Silverwater), Bluey Merino (Mittagong) and Sungent Packaging (Fairfield).

Generator Labs: Generator Labs is an initiative of UOW's Innovation and Commercial Research Unit that allows UOW researchers to contribute to complex, multi-stakeholder challenges. These often centre on a major industry or government partner, and bring together academics, government stakeholders, industry networks and an array of SMEs who contribute to the regional supply chain.

Makerspaces at UOW: UOW has created makerspaces, where students, entrepreneurs and businesses can experiment and create. Located at UOW's Science Space and at the Industry 4.0 Hub at the Shoalhaven Campus, makerspace facilities are continually expanding to support SMEs, inventors and entrepreneurs with product design, manufacturing diversification and business development.

The makerspace provide 3D printers and scanners, laser cutters, advanced fabrication tools and design software. A series of New South Wales Education Standards Authority (NESA) accredited professional development programs are also provided to equip school teachers with the knowledge, skills and teaching practices they need to create interest in STEM in schools.



BUILDING A CIRCULAR ECONOMY

Turning waste into souvenirs: Teams within UOW’s Australian Centre for Culture, Environment, Society and Space (ACCESS) are working with the Australian Research Council and CSIRO-funded postgraduate and postdoctoral researchers on critical social science on circular economy principles. ACCESS HDR student Makrita Solitei is studying the circular economy in Kenya, Africa. Her research is uncovering legacies of engagement with craft, repair and recycling, known locally as “jua kali”. These latent skills are being reapplied by grassroots entrepreneurs to new flows of waste, such as thongs and plastic bottles collected from beaches. Using the latest digital platforms these “digital jua kalis” are repurposing waste into souvenirs for online customers from Africa, Europe, the United States and Australia.

New Bega centre: A new multi-purpose tourism, community and research hub, the National Circularity Centre (NCC), will be built in Bega to develop market-leading research and demonstrate replicable models for the circular economy. UOW, through our memberships of the Regional Circularity Cooperative (RCC), will be a driving partner to establish the centre, bringing research expertise in energy, materials innovation and sustainable building practises. The Bega Valley is the perfect location to prove the concept of the circular economy because it is a natural water catchment and has relevant industries thriving in the district – tourism, agriculture, aquaculture and Australian food producer, Bega Cheese. The NCC will be a test case for scalable solutions with potential for world-wide application. UOW is part of an international cross disciplinary team, recently funded by CSIRO and the National Science Foundation USA, that is focused on finding a solution to the scourge of plastic and further integrating the material into the circular economy, to be reused for other value-added purposes.

INTRODUCING ROBOTICS INTO BUSINESS

Temora business owner John Smith contacted the UOW Industry 4.0 Hub to explore the use of cobots to reduce manual load.

Smith’s BBQs has had to ramp up production to keep up with the demand, but the manufacturing process of the outer stainless-steel skin of barbecues is a laborious process.

Before purchasing a solution, John wanted to make sure that the cobot technology would help automate some of the processes in the design and manufacture of portable barbecues.

The Industry 4.0 Hub invited John and his colleague to its full-day cobot workshop to introduce them to the robotic arm and explore how this technology could be incorporated into the business. Topics covered during the day included basic programming, safety, installation and integration.

As a result of the workshop, John gained confidence to purchase a cobot from a distributor and looks to integrate the robot arm into his workflow and automate some business processes. This has allowed him to ramp up production, scale up to international markets and expand his workforce.

“UOW’s Industry 4.0 Hub in Nowra has been a vital source of information, training and help with the introduction of robotics into my business,” John says.

UOW WELCOMES THE OPPORTUNITY TO WORK WITH GOVERNMENT AND INDUSTRY PARTNERS TO DELIVER EXCEPTIONAL OUTCOMES

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