



Curtin University

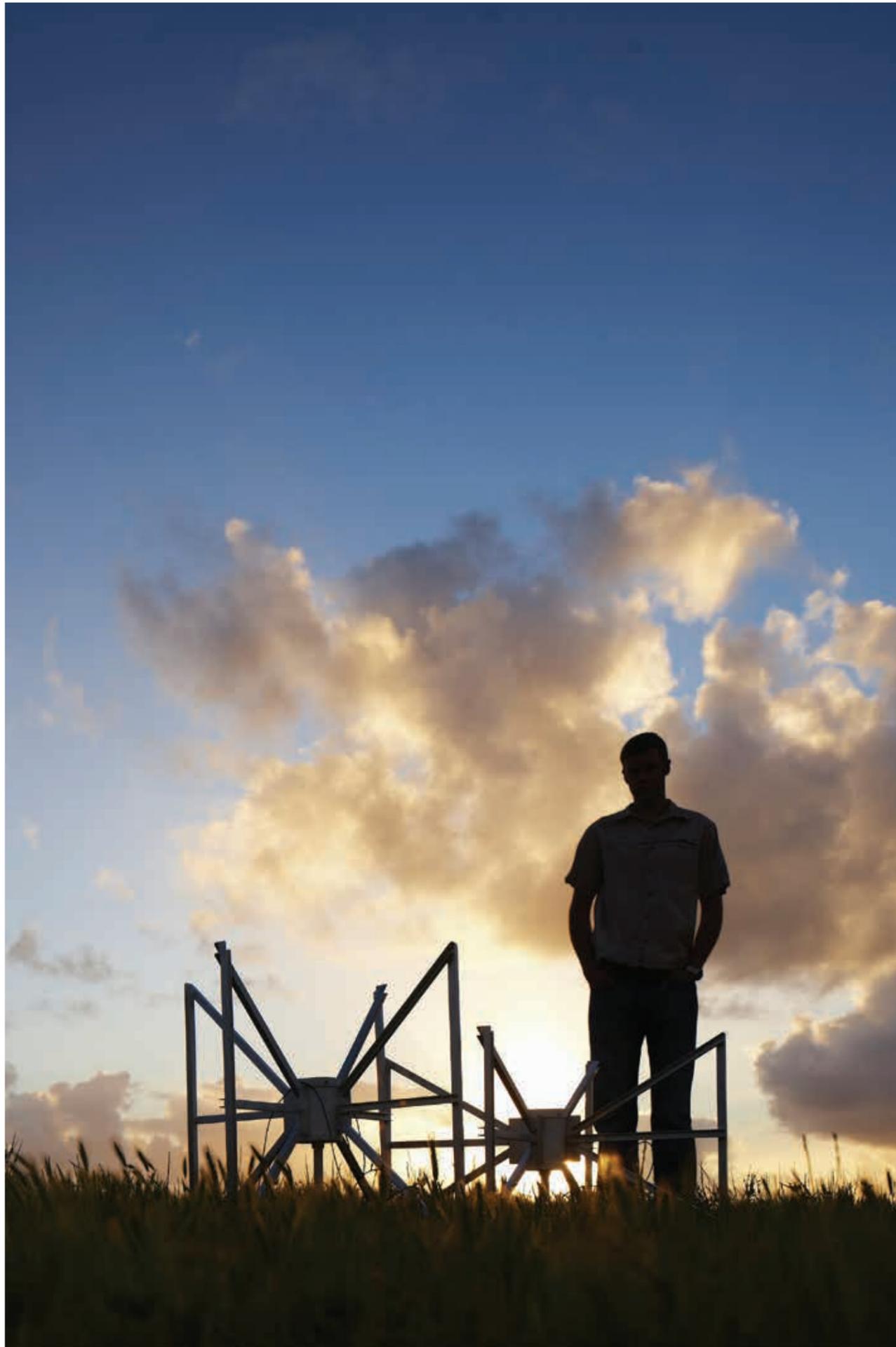


CONNECTING THE DATA

INDUSTRY 4.0 CAPABILITY STATEMENT

Make tomorrow better.

curtin.edu/industry4-0



ABOUT CURTIN UNIVERSITY

Curtin has become a leading institution for progressive research and collaboration.

As we look to build on this momentum, we aim to strike a balance between demand-driven research, which solves defined problems for industry and society, and researcher-driven research, which is characterised by a desire to push the limits of understanding.

At the heart of both endeavours are strong academic and industry partnerships. We believe it is only through collaboration and research excellence that we can achieve impact and be ranked among the best in the world.

We are placed in the top one per cent of tertiary institutions worldwide, according to the 2019 Academic Ranking of World Universities, and the latest Excellence in Research Australia analysis ranked more than 95 per cent of our assessed research as world standard or above.

Partner with us on your next challenge, and leverage our experience, networks, facilities and research expertise as we work together to find innovative solutions and explore new possibilities.



CURTIN AND INDUSTRY 4.0

Digital connectivity is impacting all economic sectors and industries. Industry 4.0 (I4.0) is about innovating our workplaces and social environments with smart systems powered by intuitive data and connectivity.

During the past decade, Curtin University has been building research capabilities that support the evolution of I4.0 – characterised by the internet of things connectivity, artificial intelligence, data science, virtual reality robotics and more – and exploring their benefits to industry.

Our research programs range in focus from digital technologies for the agrifood industry, to datasets that generate immersive visualisation tools for training in the mining sector. Importantly, Curtin is dedicated to building collaborative research ecosystems that both anticipate and respond to industry needs.



OUR RESEARCH IS ON THE RISE

Within the industry 4.0 context, Curtin research aims to improve productivity and engagement across workplaces and learning environments.

ROBOTICS AND AUTOMATION

Curtin has a track record of innovation with automation and robotics, providing solutions in construction, healthcare and transport. For example, Curtin and engineering company **TENSA Equipment** have partnered to develop a control algorithm for crane load-rotation devices. The solution allows cranes to operate safely in varied weather conditions, creating a more reliable and productive apparatus.

At Curtin's **Biorobotics Research Lab**, we've pioneered robotics that support people with disabilities and hasten injury recovery and rehabilitation. Researchers have developed a hand orthosis that helps people with weak fingers manage everyday tasks, such as turning a door knob, and have created a motorised exoskeleton to enable people with spinal cord injuries to walk, with applications in health care for the aged and remotely operated mine sites.

With automated vehicles and innovative navigation technologies set to transform transportation, Curtin is the first Australian university to trial a commercial driverless bus. The vehicle's technology, which combines remote sensors, stereo cameras and GPS systems, will inform development of next-generation autonomous vehicles.



MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE

AI is transforming our technology environments, and at two research hubs – the **Optus-Curtin Centre of Excellence** and **Innovation Central Perth** – Curtin researchers are exploring how AI and machine learning can improve business and industry efficiency.

For example, Curtin researchers have developed a neural network that can identify mechanical faults by sound, for near-real-time fault classification and notification. In collaboration with the **Public Transport Authority**, the team has applied the novel technology, to detect escalator faults before damage occurs – a non-invasive intervention that avoids costly repairs. The system is easily deployed and is adaptable for machines across various industries.

In the area of health, our researchers have developed a smartphone app that aids in the care of people with dementia. Acquired by **PainChek Ltd** in 2016, the app uses AI to detect and quantify pain, based on a patient's facial expressions – offering carers and family members a reliable means to assess pain and improve care. The technology is being assessed for non-verbal patients, including infants.

Space science is another realm of Curtin's digital innovation. **The Desert Fireball Network**, a major initiative of the **Space Science and Technology Centre**, uses a network of 50 optical cameras across Australia to detect possible meteorites. The researchers used machine learning, involving thousands of images, to train the system to detect faint meteor streaks and improve efficiency. The technology can now detect objects ranging from meteors and supernovae to space junk, with potential defence applications.



IMMERSIVE MEDIA

Curtin's expertise in virtual reality (VR), augmented reality (AR) and large-scale displays can help businesses exploit new commercial opportunities.

Curtin HIVE – the Hub for Immersive Visualisation and eResearch – provides systems for advanced presentation, communication and interpretation of data, to find solutions to real-world challenges. With visualisation systems such as the Tiled Display, Cylinder, Wedge, Dome, Hologram Table and VR/AR headsets, the HIVE is an important centre of training and interdisciplinary research collaborations at Curtin.

An example of the HIVE's value is the recently developed VR cooking simulation that can be used by quadriplegic patients to improve upper-limb function. Being immersive and imaginative, VR is ideal for providing a motivating and low-risk rehabilitation environment.

AR has exciting future applications in medicine. Our researchers have investigated how the real-time display of patient information through headsets can be used during surgery or consultations.

Curtin researchers are also investigating how VR could enable 'travel' to remote and inhospitable environments. A potential benefit is the monitoring of large, hard-to-access structures, such as mining and exploration assets, and the surveying of remote environments for training and investigative purposes. For example, topographic data from the **HiRISE Mars** satellite has been used to recreate the Mars environment so that it can be explored with VR. And photogrammetry technology and high-performance computing is being used to 'reconstruct' the **HMAS Sydney II** shipwreck from underwater images.

The **Consumer Research Lab**, in Curtin's Faculty of Business and Law, uses immersive media to place 'consumers' in various retail environments. By analysing biometric data on facial expression and skin conductance, the team's research is providing fascinating new insights into consumer behaviour. The lab is also exploring the value of VR and augmented reality to tourism and economic development.

INTERNET OF THINGS AND SENSOR TECHNOLOGY

The internet of things, or IoT, is revolutionising how we interact with our work and home environments, with sensor data fuelling more efficient and intuitive technologies.

At Innovation Central Perth, a Curtin team is working with **National Energy Resource Australia** to develop and deploy sensor technology in the energy and resources supply chain. Focus areas include maintenance schedules, management of aging infrastructure and the **Wireless Industrial Sensor Environment (WISE)** program – which is helping organisations develop best practices for data capture, transport, visualisation and analysis.

Our researchers also have the benefit of Curtin's Perth campus as a living laboratory. Smart buildings and IoT technology enable real-world research into sensor systems and insights into building use and structural integrity. Our experience with these complex systems, including use of data related to building occupancy, air-conditioning, structural monitoring and wi-fi access, offers a real-world competitive advantage.



DATA SCIENCE

I4.0 is underpinned by the ability to exploit data. The **Curtin Institute for Computation** boasts 150 researchers who use simulation, modelling, optimisation, data analytics and visualisation. Their research is supported by 12 data scientists helping to optimise research codes and data flows.

To help boost Australia's grain production, which is typically lower than our international competitors, Curtin researchers captured the characteristics and activities of a harvest season and created a rigorous mathematical model. More than 60 inputs can be set to match a farm's operations, and growers can use this tool to run what-if scenarios and plan their harvest logistics.

At the **ARC Training Centre for Transforming Maintenance through Data Science**, researchers from Curtin, **The University of Western Australia** and **CSIRO** are working with **Alcoa**, **BHP** and **Roy Hill** to develop new maintenance practices, with support from **CORE Innovation Hub** and the **Minerals Research Institute of Western Australia**. This work lays a foundation for future automation by embedding data-science practices in everyday maintenance and pioneering maintenance optimisation.

Cost-effective solutions to supply chain and logistics challenges is integral to many industries. In WA's northwest, Woodside's round-the-clock operations require efficient ways of resupplying remote facilities, such as offshore rigs. A solution was developed at the **Curtin Institute for Computation**, with new mathematical models to generate ideal vessel routes in any operating scenario. The company was able to optimise fuel consumption while ensuring cargo delivery and offtake requirements were met.

High-performance computing can be integral to research that requires complex modelling and computation. The **Pawsey Supercomputing Centre** at Technology Park, adjacent to Curtin Perth, supports the future of space research and data science in Australia. The centre hosts the world's only real-time supercomputing service dedicated to telescopes used in astronomy research, including the **Murchison Widefield Array**, which involves colossal data generation and processing.



THE FUTURE OF WORK

With digital technology rapidly transforming our work environments and processes, it is essential that organisations understand how to harness technology, while at the same time ensuring that people can thrive at work.

The **Future of Work Institute (FoWI)** at Curtin is a place of cross-disciplinary research in organisational psychology and management. FoWI researchers investigate how emerging work processes can impact industry productivity and provide consultancy in workplace technology development, organisational culture and health.

For example, the team has developed a framework for meaningful and motivating work. Based on decades of research, the SMART work design model has five themes for positive outcomes across jobs and industries: Stimulating, Mastery, Agency, Relational and Tolerable Demands.

ADDITIVE MANUFACTURING

Curtin has established a dedicated **Microfactory for Additive Manufacturing** that supports researchers across all disciplines, including metal printing, biomedicine and chemical and structural engineering. The microfactory is adjacent to the **John de Laeter Research Centre**, where researchers undertake material characterisation. The two facilities enable efficient metallurgical testing and chemical mapping of manufactured parts.

TEACHING AND LEARNING

Curtin is leading the 'uberisation' of higher education, employing data analytics to cater to the individual needs and goals of students and enhance their learning experience.

Through **CurtinX**, we also offer massive open online courses (MOOCs) that cover I4.0 topics such as the internet of things, data analytics and cybersecurity.

At the **WA Data Science Innovation Hub**, SMEs are supported through the coordination of training and development of course content development, including upskilling and executive programs at Curtin's premises in St Georges Terrace in Perth city.

Curtin is also committed to providing high-quality online learning programs. Our Business of Mining course, for example, won the Interactive Media Awards' Best in Class (university category) for its design, content, feature functionality, usability, standards compliance and cross-browser compatibility.

CYBER SECURITY

Through **Optus**, Curtin has established a partnership with leading international cybersecurity company **Trustwave**. The partnership focuses on managed cyber security services for Curtin – including vulnerability management, automated detection, threat hunting, cloud monitoring and incident response services – and enables further capabilities for digital innovation. The collaboration will support the expansion of I4.0 research and learning partnerships.

VIEW OUR STRATEGIC PARTNERSHIPS

The most efficient method of learning, developing and deploying industry 4.0 technologies is through collaboration. Our strategic partnerships are journeys of digital transformation.

BLOCKCHAIN RESEARCH AND DEVELOPMENT LABORATORY

Partners: Curtin University, Natsoft Corporation.

Activities: A centre for research, development and implementation of blockchain solutions. Researchers at the lab help industry capitalise on this new economy by developing blockchain technology strategies and roadmaps, and delivering blockchain products and services. The Laboratory also provides consultancy, education and training services.

More information: Visit curtin.edu/blockchain-lab.

CISCO-CURTIN CENTRE FOR NETWORKS

Partners: Cisco, Curtin University

Activities: This data-driven centre is co-located at Curtin Perth campus and Innovation Central Perth. Together with IoT sensor technology, intent-based networks can help accelerate digital transformation in industries such as manufacturing, mining and utilities. Centre experts help organisations use intent-based networks to automate routine tasks, generate analytics and improve security.

More information: Visit icentralau.com.au/Perth/.

DIGITAL HEALTH COOPERATIVE RESEARCH CENTRE

Partners: Government-funded consortium of more than 16 universities (including Curtin), various health funds and health and technology providers.

Activities: This centre responds to the demand for health data scientists, health technologists and technology-literate clinical staff associated with the digitisation of health services. The centre's R&D focus combines individual and collective expertise with data, information and telecommunication technologies – and represents a multidisciplinary taskforce of research, clinical, industry, government and educational organisations.

More information: Visit digitalhealthcrc.com.

AUSTRALIAN RESEARCH COUNCIL TRAINING CENTRE FOR TRANSFORMING MAINTENANCE THROUGH DATA SCIENCE

Partners: Curtin leads this national Industrial Transformation Training Centre. Research partners include The University of Western Australia, CSIRO, University of Adelaide, CORE Innovation Hub and the Minerals Research Institute of Western Australia. Industry partners include Alcoa, BHP and Roy Hill.

Activities: This centre is preparing the next generation of data scientists for Australia's resources sector. The centre focuses on digital technologies to ensure efficient, sustainable and safe productivity for the resources industry.

More information: Visit maintenance.org.au.

FOOD AGILITY COOPERATIVE RESEARCH CENTRE

Partners: Eight universities (including Curtin), 25 business and industry organisations and five state governments.

Activities: Data analytics, economics and supply chain management. The centre is facilitating the digital revolution in food production and supply in Australia and helping the national agrifood sector to be more globally competitive and sustainable. Researchers collect, analyse and share data relevant to the application of digital technology across the agrifood industry.

More information: Visit foodagility.com.

INNOVATION CENTRAL PERTH

Partners: Curtin-based and led by Cisco, with Woodside and CSIRO's Data61.

Activities: A centre of industry experts, start-ups, developers and 80+ researchers in a collaborative environment. The centre helps organisations exploit digital transformation. Our Wireless Industrial Sensor Environment (WISE) program helps industry, technology providers and research organisations to understand, develop and deploy sensor technology, using a test environment at Curtin Perth. The centre also offers:

- a 'design sprint' process, proof-of-concept development, and a technological sandpit to test novel ideas
- workshops on the topics of innovation, design thinking and ideation
- co-innovation project development and rapid prototyping.

More information: Visit icentralau.com.au/Perth.

OPTUS-CURTIN CENTRE OF EXCELLENCE IN ARTIFICIAL INTELLIGENCE

Partners: Curtin University, Optus Business.

Activities: A research alliance exploring the impact and benefits of AI on regional telecommunications, higher education and the urban environment. It includes a research group in Curtin's School of Electrical Engineering, Computing and Mathematical Sciences, with links to the Curtin Institute for Computation. Researchers are now focusing on applying AI to 5G networks, drone technology and regional telecommunications.

More information: Visit curtin.edu/optusai.

PAWSEY SUPERCOMPUTING CENTRE

Partners: A joint venture of Western Australia's public universities and CSIRO.

Activities: The centre hosts supercomputers (the most powerful of which can perform a quadrillion calculations per second), cloud computing, visualisation and data storage. The centre provides vital support for data-intensive research areas such as radio astronomy, and computational modelling tasks required by materials scientists, for example.

More information: Visit pawsey.org.au.

SmartSat CRC

Partners: A national Cooperative Research Centre with 18 core partners comprising universities and other research organisations.

Activities: Australia's largest space industry R&D collaboration, this centre focuses on advanced telecommunications and IoT connectivity, intelligent satellite systems and Earth observation next-generation data services. It exploits Curtin's longstanding strengths in global navigation satellite systems (GNSS) to develop new methods and algorithms for GNSS attitude determination. Applications range from navigation of space platforms and unmanned vehicle guidance, to vessel docking and precision farming.

More information: Visit smartsatcrc.com.

WA DATA SCIENCE INNOVATION HUB

Partners: Led by Curtin University with foundation partners Bankwest, Mets Ignited and National Energy Resources Australia, and supported by the Western Australian Government's New Industries Fund.

Activities: The hub is driving digital innovation across WA's agriculture, mining and oil and gas sectors. It promotes the uptake, education, training and awareness of data science in WA. Training is a key part of the hub's activities, including upskilling managers to better manage data science projects.

More information: Visit wadsih.org.au.

ACCESS OUR EXPERTISE

Curtin University welcomes opportunities to collaborate with organisations that are interested in Industry 4.0 technologies.

Our partner agreements range from contractual tasks to short- or long-term partnerships – all of which are underpinned by an understanding of core values. When you partner with us on your organisational challenges, we work together to develop innovative solutions.

Curtin also offers executive education, professional development and postgraduate courses that encourage lifelong learning and help organisations build expertise within their workforce.

Contact us today to discuss your business challenge or opportunity.

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Available in alternative format on request.

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