



Innovative Manufacturing CRC (IMCRC) Annual Highlights 2019-2020

IMCRC | we champion
manufacturing
innovation



Australian Government
Department of Industry, Science,
Energy and Resources

Business
Cooperative Research
Centres Program

Cover image: Members of the Nutromics' research team at the Micro Nano Research Facility (MNRF) at RMIT University. Photo credit: RMIT

Australian manufacturing is transforming – no longer is it just about what we make but how we make it. To realise our vision of a thriving, relevant and globally integrated Australian manufacturing sector, we have established a framework for successful industry – research collaborations. Together, we invest in emerging technologies and explore new business models that spark innovation and help manufacturers compete, scale-up their operations, access global markets and move into higher value manufacturing.

Thank you for your support in 2019-20.

Copyright Statement

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Disclaimer

IMCRC has endeavoured to ensure that the information in this publication is correct. The Annual Highlights have been prepared to align with IMCRC's Commonwealth Agreement, referencing the progress, activities, participants and other matters as at 30 June 2020, unless it is otherwise specified in the document.

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HIGHLIGHTS 2019-20

Achievements in FY 2019-20



21 of 21

Commonwealth research
milestones met



9

new projects
commenced



3

projects
completed



13

new industry project
participants



7

new PhD and
Masters students



IMCRC activate:

shorter-term R&D funding
program launched



6

APR.Intern industry-research
PhD internships supported



200+

manufacturers completed
futuremap®

* as at 30 June 2020

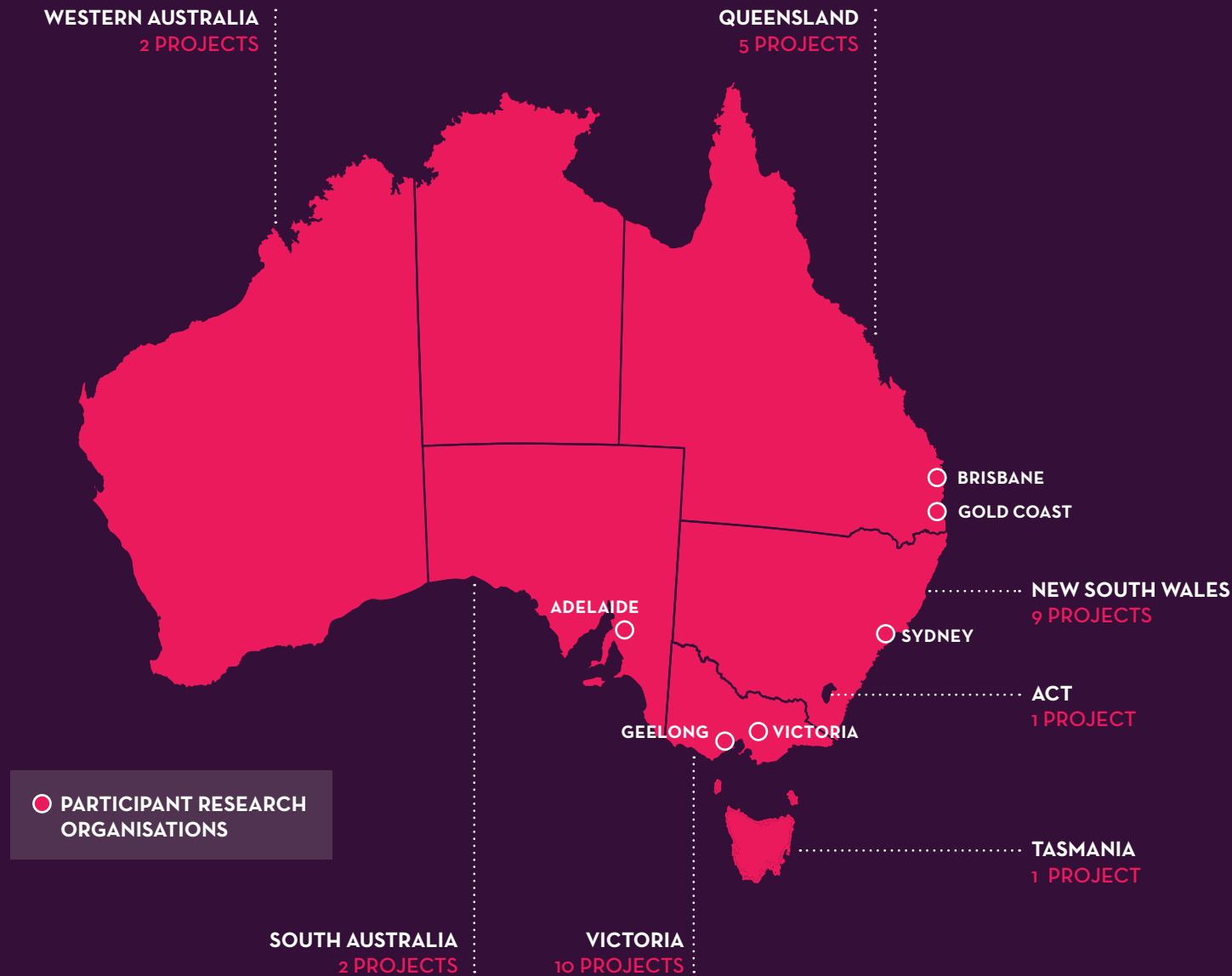
Progress to Date

Since its launch in 2016, IMCRC has purposefully invested **\$31 million of Commonwealth and other funding** to advance Australian manufacturing, catalysing over **\$200m investment** in collaborative research, manufacturing innovation and education across Australia.

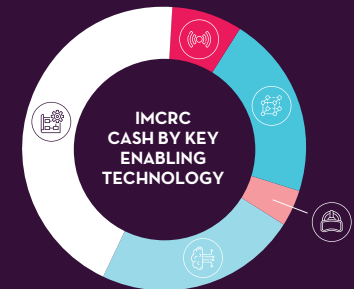


FOCUS	INDUSTRY FOCUS	RESEARCH COLLABORATION	MANUFACTURING INNOVATION	INDUSTRIAL TRANSFORMATION	ACROSS AUSTRALIA AND BEYOND
APPROACH	<ul style="list-style-type: none"> Being industry-led Driving real-world manufacturing and commercial outcomes Removing barriers to SME participation Taking proof of concepts through to pilot readiness and commercial investment (TRL/MRL 4-7) Taking no CRC share in project IP 	<ul style="list-style-type: none"> Accessing a network of 12 research organisations, plus CSIRO Agreed returns on investment for all collaborative parties In-kind contributions not matched with CRC cash Fostering talent through PhD stipends, Masters scholarships and industry internships 	<ul style="list-style-type: none"> Co-investing in emerging manufacturing technologies (Industry 4.0) and new business models to benefit the broader Australian manufacturing industry Independent Innovation Investment Committee reviewing project applications Manufacturing projects across multiple key industry growth sectors 	<ul style="list-style-type: none"> Delivering manufacturing industry SME customised education and awareness programs, centred around futuremap®, IMCRC's unique and proprietary diagnostic Collaborating with federal, state and local government, industry growth centres and industry associations to advance the adoption of Industry 4.0 	<ul style="list-style-type: none"> Engaging with industry and research organisations across Australia Stimulating SME growth and collaboration International partnerships such as with Germany's Fraunhofer Institutes and New Zealand's Callaghan Innovation
PROGRESS	<ul style="list-style-type: none"> 35 industry project participants ~70% cash co-invested with Australian SMEs 	<ul style="list-style-type: none"> 30 projects approved with 4 projects completed Average project investment is 5.5 multiple on CRC cash 26 PhD and Masters students 	<ul style="list-style-type: none"> Projects across 6 primary industry sectors Investment in all CSIRO defined key enabling manufacturing technologies 	<ul style="list-style-type: none"> futuremap® inspired 500+ manufacturers (90% SMEs) to future-proof their business and invest in Industry 4.0 Catalysed the ~\$20m ARM Hub establishment in QLD 	<ul style="list-style-type: none"> Industry-led investment across all states and the ACT >80% CRC cash co-invested with Australian owned businesses

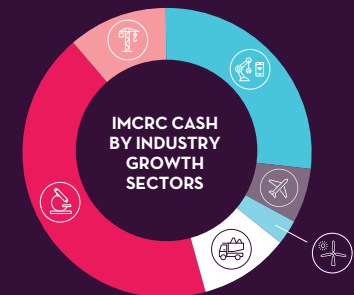
Industry-led Manufacturing Research across Australia



● 26 in progress
● 4 completed



● Additive manufacturing
● Automation and robotics
● Sensors and analytics
● Augmented and virtual reality
● Advanced materials



● Advanced manufacturing
● Oil, gas and energy resources
● Medical technology and pharmaceuticals
● Building and construction
● Mining equipment, technology and service
● Defence

* as at 30 June 2020

MESSAGE FROM THE CHAIR



It has been a year of growth and advancement for IMCRC. I am pleased to present this report for the 2019-20 financial year, during which the CRC realised significant opportunities and addressed major challenges in its work as a champion of Australian manufacturing and as a catalyst of change.

Although 2020 has been a demanding period for all, it has highlighted the resilience and dedication of IMCRC and all its participants. I am pleased to report that no projects were lost due to COVID-19 during the financial year, and over this period IMCRC met 100% of the agreed research program milestones.

The year concluded with the cumulative allocation of \$31 million of Commonwealth and other funding into research and development (R&D) projects to help catalyse the transformation of Australian manufacturing.

At the core of IMCRC's success, and central to its ability to weather the COVID-19 storm, is the organisation's business model – an industry-led, collaborative and outcomes focused approach – and the leadership team. Since its inception, IMCRC has worked together with universities and researchers, connecting them with innovative SMEs and global multi-nationals, while focusing on providing long-term value and real-world manufacturing impact.

In addition, the CRC's focused and data-driven methodology has meant the team has been able to stay close to projects, manage the COVID-19 associated risks and introduce new initiatives to help businesses through a challenging time.

It has never been more important than it is today for Australia to invest in homegrown R&D and to do this through effective collaboration. In times of crisis, this synergistic approach continues to propel innovation and technological advancement forward. IMCRC's role is critical in aiding manufacturers to prepare for a post-COVID world and I am delighted to be a part of an organisation doing such important work within the manufacturing sector.

On behalf of the Board, I would like to acknowledge the remarkable achievements of the entire team over the past year. Under the leadership of CEO and Managing Director David Chuter, IMCRC continues to be at the forefront of Australian manufacturing advancement with the team and project participants demonstrating real determination and perseverance throughout a challenging time.

Thank you.

A handwritten signature in black ink, appearing to read 'I. Macfarlane'.

The Hon Ian Macfarlane
Chair

MESSAGE FROM THE CEO AND MANAGING DIRECTOR



The 2019-20 financial year (FY) marked a year of action, transformation and growth for IMCRC and our partners as we continued to catalyse change through industry-led research and development (R&D) projects within Australia's manufacturing industry.

2020 itself has faced its share of disruption and uncertainty due to the COVID-19 pandemic, which continues to threaten businesses, research organisations, industry and the economy. Yet, out of every crisis opportunity emerges – including for increased collaborative investment, research impact and manufacturing innovation, as exemplified by IMCRC's business model and project portfolio.

Despite a challenging second half of the financial year adjusting to COVID-19, I am pleased to report significant and positive progress for the CRC. We set out to invest the remaining Commonwealth funds into transformative manufacturing research, and to help more industry participants create commercial outcomes through new projects. IMCRC met these objectives. With nine new collaborative research projects commencing, plus a further four projects being approved during the reporting period, we have cumulatively invested \$31 million of Commonwealth and other funding through 30 projects across many of Australia's primary industry sectors. Three research projects were successfully completed, taking the total number of completed projects to four. Together, these 30 projects, concurrently with other IMCRC initiatives, have catalysed what is now a \$200 million investment in research and innovation to help shape and drive the future of Australian manufacturing.

Strengthening industry through research collaborations

IMCRC's vision is for Australian manufacturing to be thriving, relevant and globally integrated. This year,

we welcomed 13 new industry project partners into the CRC, all embracing and investing in collaborative research partnerships. In addition to projects now with 35 industry participants – many of whom are small or medium (SME) Australian owned businesses – we continued to invest in the next generation of manufacturing leaders. Twenty-six PhD and Masters students from seven different universities are contributing to the research and development of cutting edge manufacturing solutions as part of our research programs. We advanced our partnership with APR.Intern, offering manufacturing SMEs the opportunity to explore emerging technologies and lift their industry capabilities with the help of highly qualified PhD students. We facilitated six short-term internships during the year, resulting in three PhD students securing full-time roles with those businesses – a win-win for all involved.

Accelerating manufacturing transformation

Collaboration and connecting continues to be crucial to our role as a catalyst in assisting manufacturing businesses embrace the fourth industrial revolution (Industry 4.0). This year, we encouraged even more manufacturers to assess their current business model and consider new approaches to manufacturing, technology and innovation. By deploying IMCRC's proprietary and unique futuremap® platform, we engaged with more than 200 manufacturing businesses through more than 30 face-to-face and (since March) virtual workshops across Australia. Partnering with the Commonwealth's Entrepreneurs' Programme and research organisation hubs, including Swinburne

University's Factory of the Future, has helped to accelerate these engagements.

IMCRC has further used initial aggregate futuremap® insights to engage with peers within industry and Government to prompt discussions around Industry 4.0 and the future of Australian manufacturing. As a member of Australia's Industry 4.0 Advanced Manufacturing Forum, IMCRC has led the combined Technology Applications and Digital Business Models workstream. At the inaugural conference of the Forum in August 2019, IMCRC facilitated an interactive workshop that asked a cohort of 50 manufacturers and industry experts what is needed to accelerate the uptake of the Industry 4.0 in Australia, further informing both the Forum and IMCRC initiatives.

The year also saw several commercial project outcomes being realised, in many cases well before the project completion. One exciting outcome catalysed by IMCRC's investment has been the establishment of the new Advanced Robotics for Manufacturing (ARM) Hub in Brisbane. Born out of UAP's IMCRC research collaboration with Queensland University of Technology (QUT) and RMIT University, the ARM Hub is also supported by funding from the Queensland State Government. This is a great example of how collaborative investment can create something much larger than the sum of its parts, and IMCRC is working on other similar and transformative investment opportunities with project partners.

Showing resilience

2020 has been a challenging year for many, including for our manufacturing industry, and I was pleased with our team's ability to adapt swiftly following the declaration of the pandemic in early March. As a business, IMCRC did not miss a beat, with our systems and processes enabling us to get as close as needed to every project to help ensure continuity and support through the most disruptive months. In response, and through the rapid design and recent launch of IMCRC's 'activate' project fund, we have created a new opportunity for Australian businesses (particularly manufacturing SMEs across all industry sectors) to invest in shorter term R&D projects with reduced barriers and financial commitment.

As a small organisation, the IMCRC itself has continued to evolve and mature, with the team continuing to be motivated, focused, effective and efficient. Our team should be proud of what has been achieved this year, and I am particularly pleased and impressed with how they have done this by remaining true to what we value.

I particularly and sincerely want to thank our research organisations and their researchers who have been disrupted by the pandemic, yet who remain firmly committed to the projects and to the CRC more generally. I also want to thank our industry partners and co-investors. All IMCRC projects are industry-led, and it has been a testament to these businesses and the transformational nature of the projects they are investing in, that IMCRC's project portfolio largely remained intact despite COVID-19.

Our team is of course thankful for the guidance of our Chair, the Hon Ian Macfarlane, and our Board of Directors, whose support and advice proved invaluable over the course of the year. The continued support of the Commonwealth must also be recognised – without the valuable funding it provides, IMCRC would not be able to advance innovation and the transformation of the Australian manufacturing sector, and we encourage the Commonwealth to continue to endorse and invest in Australian manufacturing.

We face a year ahead full of possibilities. Change is upon us as a society and as an industry following the outbreak of COVID-19. IMCRC's business model is to successfully drive effective collaboration, breakthrough innovation and purposeful research, including with SMEs – all of which provides a platform and significant opportunity for further investment into Australian manufacturing and national industry more broadly. Let's not see this opportunity wasted.



David Chuter
CEO and Managing Director

ABOUT IMCRC

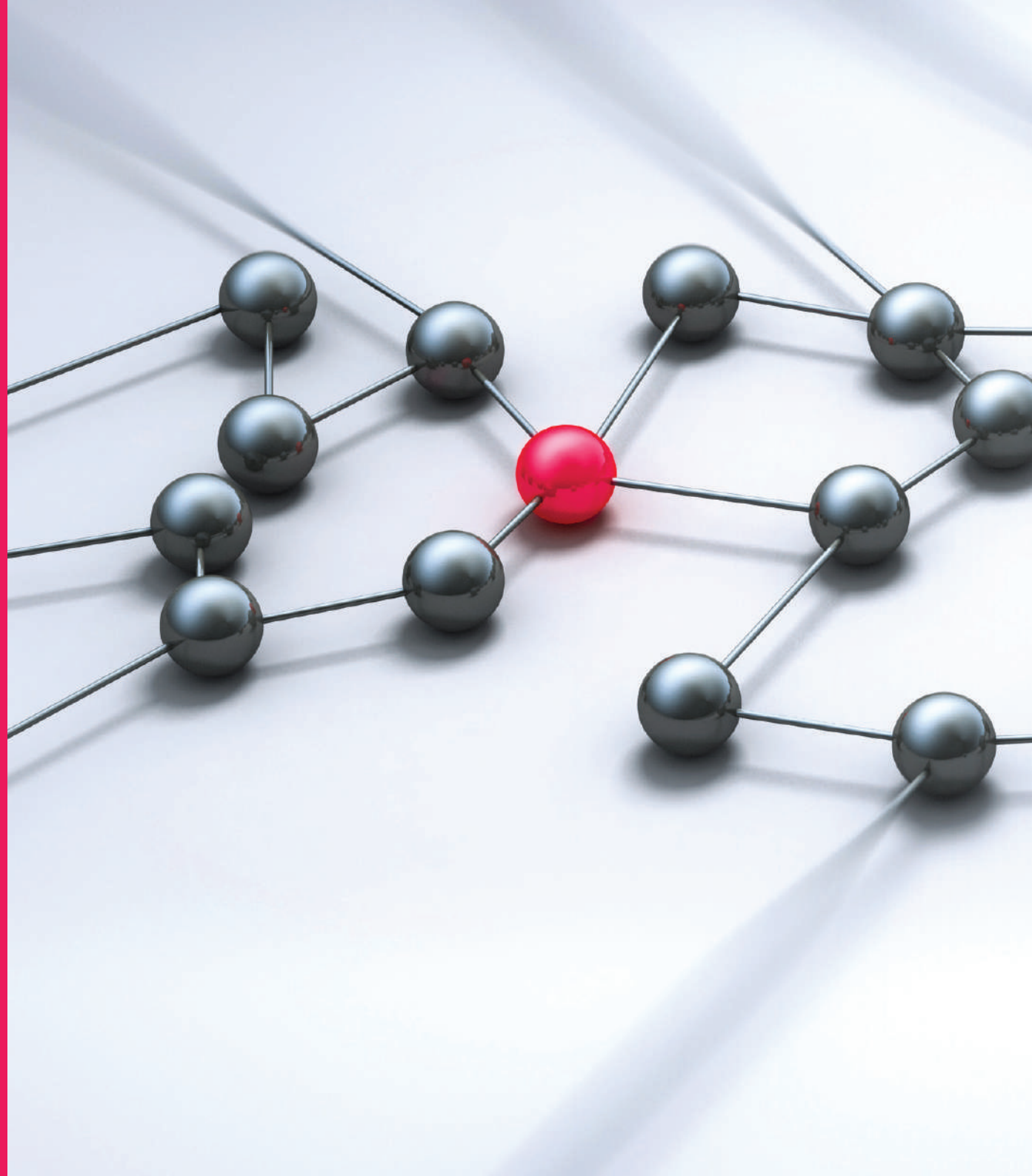
The Innovative Manufacturing CRC Limited (IMCRC) is an independent, not-for-profit Cooperative Research Centre that helps Australian businesses increase their global relevance through research-led innovation in manufacturing products, processes and services.

In collaboration with businesses, research organisations, industry associations, and government, we

- co-fund, on a dollar-for-dollar matched basis, broad, multidisciplinary and industry-led manufacturing research projects that deliver commercial outcomes
- advance the wider cause of manufacturing transformation through industry education and public advocacy.

Manufacturing has entered a fourth industrial revolution. This offers vast opportunities for Australian companies to create new products and services, expand into new supply chains and markets in Australia and around the world, and attract and develop a new generation of skilled employees.

We aim to encourage and help manufacturers invest in collaborative research to exploit innovative technologies. We want to see the public perception of a capital- and labour-intensive brand of manufacturing shift to one that embraces industrial transformation, in which companies leverage digital technologies, including Industry 4.0, to deliver innovative business models and sell new products, services and solutions to a global market.





Our Vision

is for Australian manufacturing to be thriving, relevant and globally integrated.



Our Mission

is to help catalyse the transformation of Australian manufacturing through collaborative investment, research impact and innovation.



Our Values

Collaboration

Improving engagement between industry, research institutions and the global community with open, respectful conversations that leverage effective feedback and 'collective genius' to find the best pathways to success.

Entrepreneurship

Thinking and acting creatively and adventurously and providing the insights and advice necessary to activate a spirit of enterprise and risk taking.

Leadership

Demonstrating the courage and boldness necessary to create and foster the skills and methods needed to bring about industrial transformation. Prepared to question the norm, find better solutions and drive outcomes.

Advocacy

Energising, engaging and inspiring individuals and the wider community to get behind the transformation of Australian manufacturing.

Advancement

Pursuing economic and social progress by continuously seeking opportunities for change, growth and evolution.

Our Partners

IMCRC believes in collaboration. By connecting companies and research organisations, and sharing knowledge and resources, we aim to make Australian manufacturing innovative, effective, resilient and relevant.

Industry



Research



Other



Our Board

IMCRC is governed by an independent Board of Directors that oversees the organisation's research and work in creating long-term impact for Australian manufacturing. The Board represents a broad range of industry, research and government expertise.



HON IAN MACFARLANE
Independent Director, Chair



MR INNES WILLOX, AM
Non-Independent Director (Industry Nominee)



PROFESSOR MARY O'KANE, AC
Independent Director



DR ALEXANDER GOSLING, AM
Independent Director



MR SIMON MARRIOTT
Independent Director



DR JENS GOENNEMANN
Independent Director (Growth Centre)



MR ROBERT COHEN
Non-Independent Director (Research Nominee)



PROFESSOR ROY GREEN
Non-Independent Director (Research Nominee)



MR DAVID CHUTER
CEO and Managing Director



DR JENNI LIGHTOWLERS
acts as IMCRC Company Secretary

Four advisory committees have been established to assist the Board in the execution of its duties.

Audit and Risk Committee (ARC)

offers guidance in terms of corporate and financial governance.

Nominations and Remuneration Committee (NRC)

provides advice on policies and best practices concerning recruitment, performance and remuneration of IMCRC Board and staff.

Innovation Investment Committee (IIC)

is an independent advisory committee that assesses IMCRC's manufacturing research projects and advises the Board on potential investments.

Transition Committee (TC)

provides advice and makes recommendations to the Board on strategic options available to IMCRC for transitioning operations in order to continue to create positive impact in Australian manufacturing industry.

Our Team

Through open and respectful conversations IMCRC's management team and staff facilitate the collaboration between industry, research organisations, government and the wider manufacturing community.



DAVID CHUTER
CEO and Managing Director



DR JASON COONAN
Chief Operating Officer



DR MATTHEW YOUNG
Manufacturing Innovation Manager



SIMON DAWSON
Director, Industrial Transformation



SAMEERA SILVA
Finance and IT Manager



DR MIN-YIN YAP
Project Research and Education Officer



DAVID CHANDLER
Project Research and Systems Officer



JANA KUTHE
Communications, Marketing and Events Manager

In FY 2019-20, IMCRC also engaged in full or part-time capacity:

Mr Lance Worrall – Industrial Transformation Program (up to December 2019)

Mr Rohann Chapman – Industrial Transformation Program

Mr Nathan Cooper – Marketing Events Coordinator (up to November 2019)



“

From my experience with taking innovation through the manufacturing process to commercialisation, the IMCRC industry-led model is not just distinct from a traditional CRC, but it is unique from a global perspective. This IMCRC has strong governance and organisational structures that focus on commercial outcomes with consideration of efficiency of decision making and industry engagement. This IMCRC is a true benchmark for engendering R&D collaboration between universities and manufacturers.

”

ROBERT COHEN
VICE PRESIDENT AND CHIEF TECHNOLOGY OFFICER,
GLOBAL RESEARCH & DEVELOPMENT OF STRYKER'S ORTHOPAEDIC
JOINT REPLACEMENT DIVISION
IMCRC DIRECTOR

CHAMPIONING MANUFACTURING INNOVATION

The COVID-19 pandemic has fast-tracked Australia's industrial transformation, with many manufacturing businesses looking to harness emerging technologies and digital business models to create new products and services, reset and expand their supply chains and markets, and attract and develop a new generation of skilled employees.

Since its launch in 2016, IMCRC has been co-funding industry-led research into innovative manufacturing technologies and processes. Across four research programs, IMCRC collaborates with manufacturing businesses, research organisations, industry associations and government, investing significantly in partnerships that support innovation and deliver commercial outcomes to ensure the Australian manufacturing sector can meet the challenges and opportunities of the global economy.

These multidisciplinary research programs comprise a series of projects, carefully crafted and executed to deliver significant benefits to IMCRC participants and create important insights to be shared with the wider manufacturing community.

IMCRC supports four research programs:

- 1. Additive manufacturing processes**
- 2. Automated and assistive technologies**
- 3. High-value product development**
- 4. Industrial transformation**

In FY 2019-20, IMCRC met all its agreed Commonwealth research program milestones. With nine new projects commencing, IMCRC managed a portfolio of 30 manufacturing projects of which three were successfully completed during the reporting period. Four additional projects were approved by 30 June 2020, due to start in the first quarter of FY 2020-21.

To date, there have been no significant technical or scientific impediments impacting on the projects' research progress. The details for each project are based on contractual agreements in place as at 30 June 2020 and do not include subsequent project variations. No changes to the directions of the four research programs are proposed.

In response to the significant challenges facing manufacturing businesses and research organisations due to the COVID-19 crisis, IMCRC designed and launched a new funding initiative, IMCRC activate. It is designed to create as well as maximise opportunities by enabling Australian manufacturers across all industry sectors to invest in shorter term R&D projects with reduced barriers and financial commitment.



**ADDITIVE
MANUFACTURING
PROCESSES**



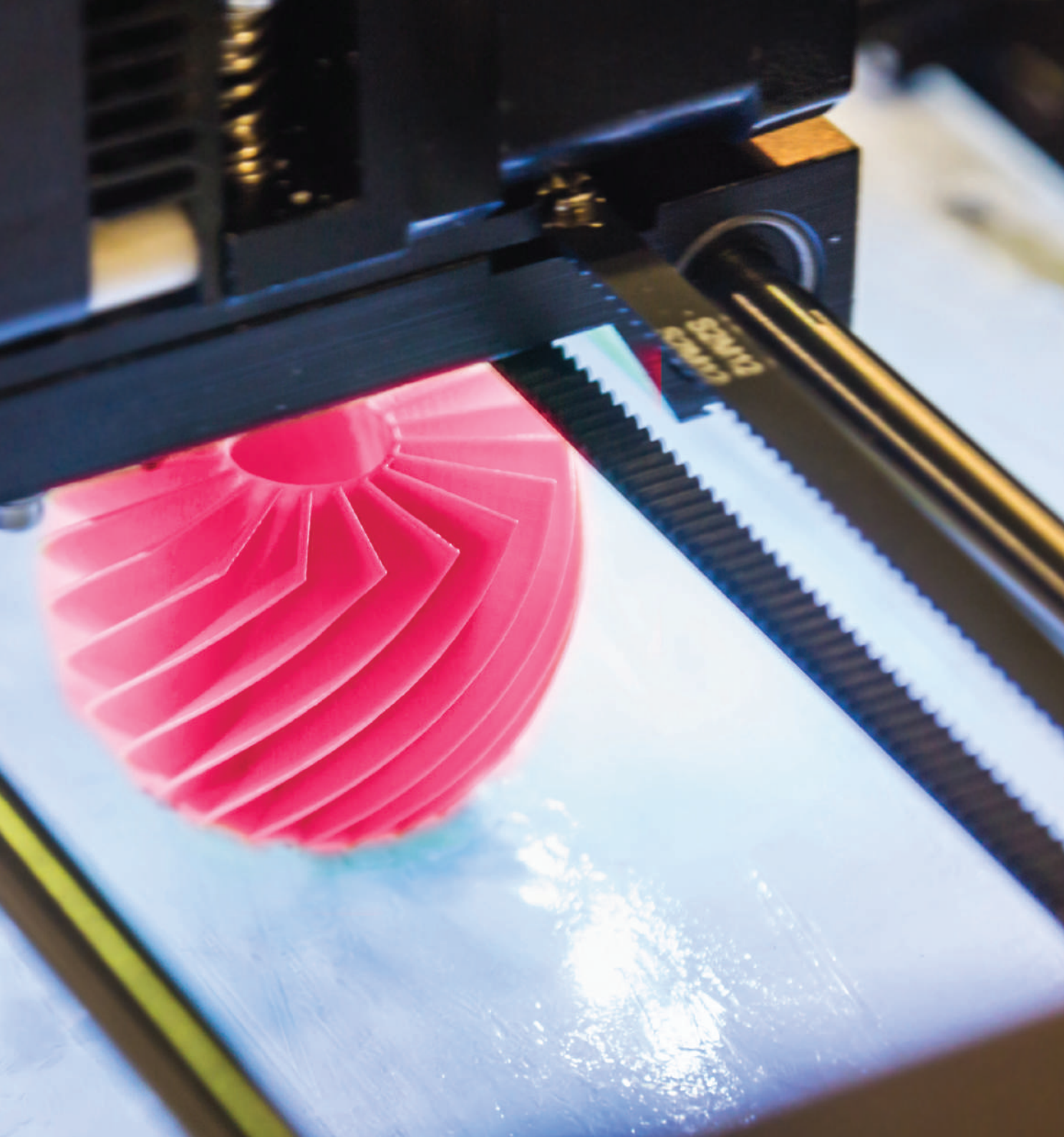
**AUTOMATED
AND ASSISTIVE
TECHNOLOGIES**



**HIGH-VALUE
PRODUCT
DEVELOPMENT**



**INDUSTRIAL
TRANSFORMATION**



Icon Reference


Primary Industry Sector

-  Advanced Manufacturing
-  Aerospace and Defence
-  Automotive
-  Building and Construction
-  Medical Technologies and Pharmaceuticals
-  Mining Equipment, Technology and Services

Key Enabling Technology

-  Additive Manufacturing
-  Advanced Materials
-  Augmented and Virtual Reality
-  Smart Robotics and Automation
-  Sensors and Data Analytics

Project Status

-  Start
-  In Progress
-  Completed
-  Media Link to Article

IMCRC activate: Get set for the future, now

IMCRC activate is a new funding initiative designed to help Australian manufacturers take action and gain a competitive edge in the post-COVID-19 world.

By offering businesses access to R&D expertise and matched cash funding of \$50,000 - \$150,000 for shorter-term research projects in advanced manufacturing and digital technologies, IMCRC aims to create pathways for manufacturers to recover and thrive in the future and also to stimulate and incentivise broader investment in Australian manufacturing research and development.

To be eligible for IMCRC activate funding, projects must

- be industry-led, deliver clear manufacturing outcomes and be completed within 6-15 months
- be undertaken by one of IMCRC's partner research organisations
- apply Industry 4.0 technologies and digital business models
- move the project through ideally two Manufacturing Readiness Levels (MRLs)
- involve, ideally, also other Australian manufacturing SMEs as collaborators
- address, where possible, other sustainability and/or national needs

For more information visit www.imcrc.org/activate





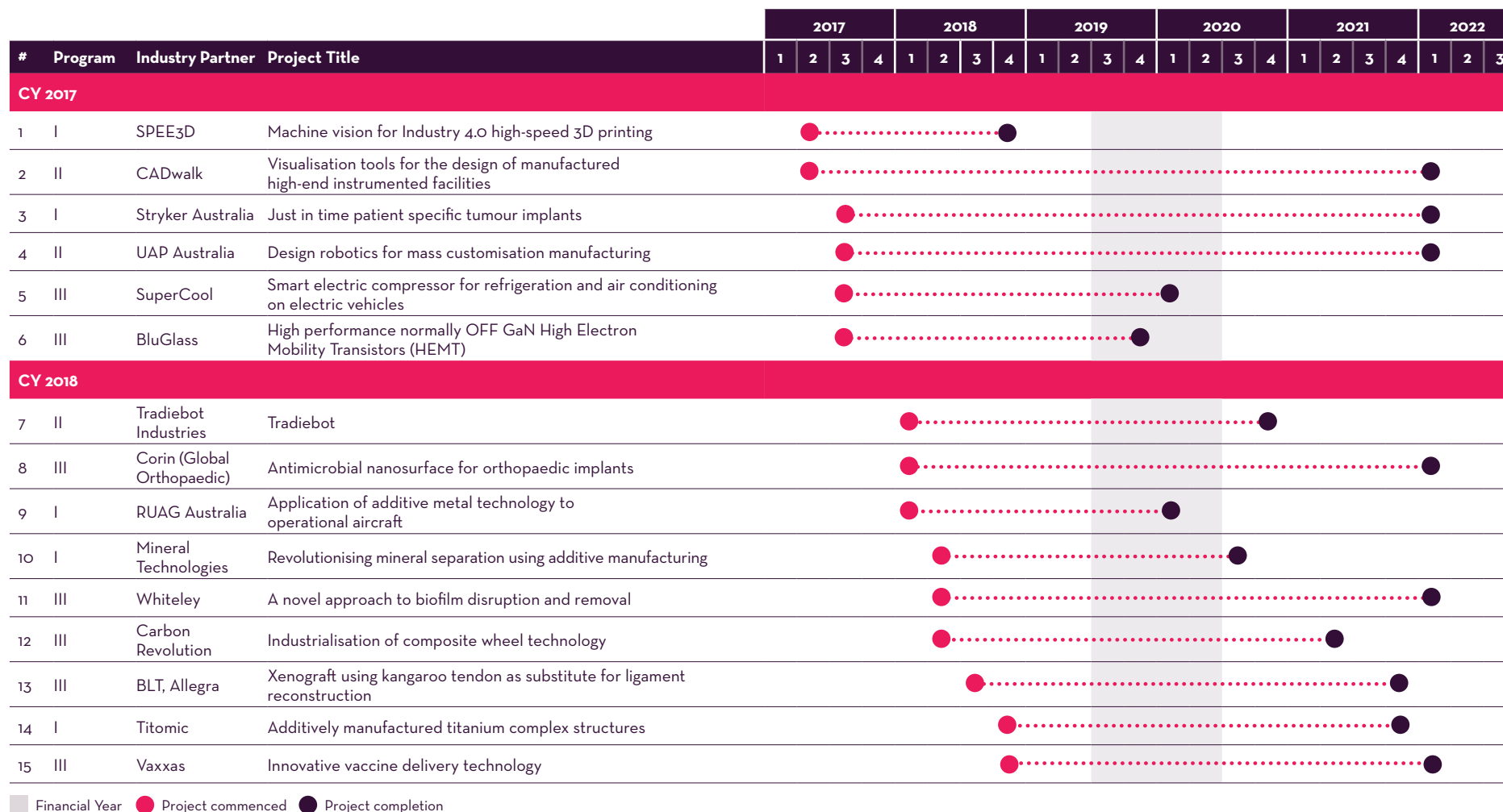
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A large contributor to the IMCRC's success to date has been its governance model. For example, from the beginning, IMCRC has been very much industry-led and we made a deliberate decision to set up an investment committee. While it added an extra layer to the traditional CRC application process, it also brought a significant amount of industry expertise and rigour at a critical juncture. I believe one of the reasons we have had such a low project attrition rate, even in such challenging times, is because applications that are approved have been thoroughly vetted which means we are able to maximise the return from every dollar we invest.

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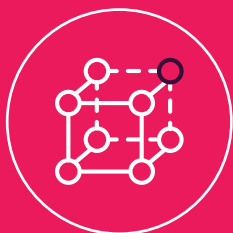
INNES WILLOX, AM
CHIEF EXECUTIVE, AI GROUP AND IMCRC DIRECTOR

Research projects in FY 2019-20



				2017				2018				2019				2020				2021				2022		
#	Program	Industry Partner	Project Title	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
CY 2019																										
16	IIII	Sleep Corp	A novel virtual manufacturing system approach																							
17	III	Speedpanel	Manufacture of the next generation Speedpanel																							
18	I	SPEE3D	Automated part repair using 3D scanning and supersonic 3D deposition																							
19	III	Codex	Engineering an advanced, high value bioreactor system for research and clinical applications																							
20	II	MThing	Automated monitoring and analytics for geotechnical and structural performance using the internet of GNSS things																							
21	III	Xefco	Atmospheric plasma coating system																							
22	III	ESN Cleer	Preventing heart attacks with nanotechnology-enabled biomarker sensors																							
23	II	Lava Blue	Value adding Australian minerals																							
24	II	Verton	Accelerated commercialisation of world's first and ground-breaking technology to manage suspended loads																							
25	III	Hazer Group	Developing and optimising advanced carbon materials																							
CY 2020																										
26	III	Telix	Centralised manufacture of Molecularly-Targeted Radiation (MTR) drugs for cancer treatment																							
27	IIII	Neometals	Value adding the Australian lithium mining sector																							
28	IIII	BAE Systems ASC Shipbuilding	Accelerating the uptake and diffusion of innovative manufacturing technologies in Australian shipbuilding and supply chain: the human factor																							
29	III	Nutronics	R2R printing for cost effective manufacturing of a smart patch for health monitoring																							
30	III	LPI	Smart coatings for the next generation of lightning strike protection devices																							
Financial Year																										

Financial Year ● Project commenced ● Project completion



Program 1: Additive Manufacturing Processes

Additive manufacturing, or 3D printing, has emerged as a viable manufacturing technology in its own right. More and more Australian manufacturers recognise the benefits that additive manufacturing can offer in terms of new product development, time to market, reduced waste and product cost.

Despite the technology continuing to mature into a production ready process, there is more research and development needed to take it to the next level. IMCRC's research program focuses on:

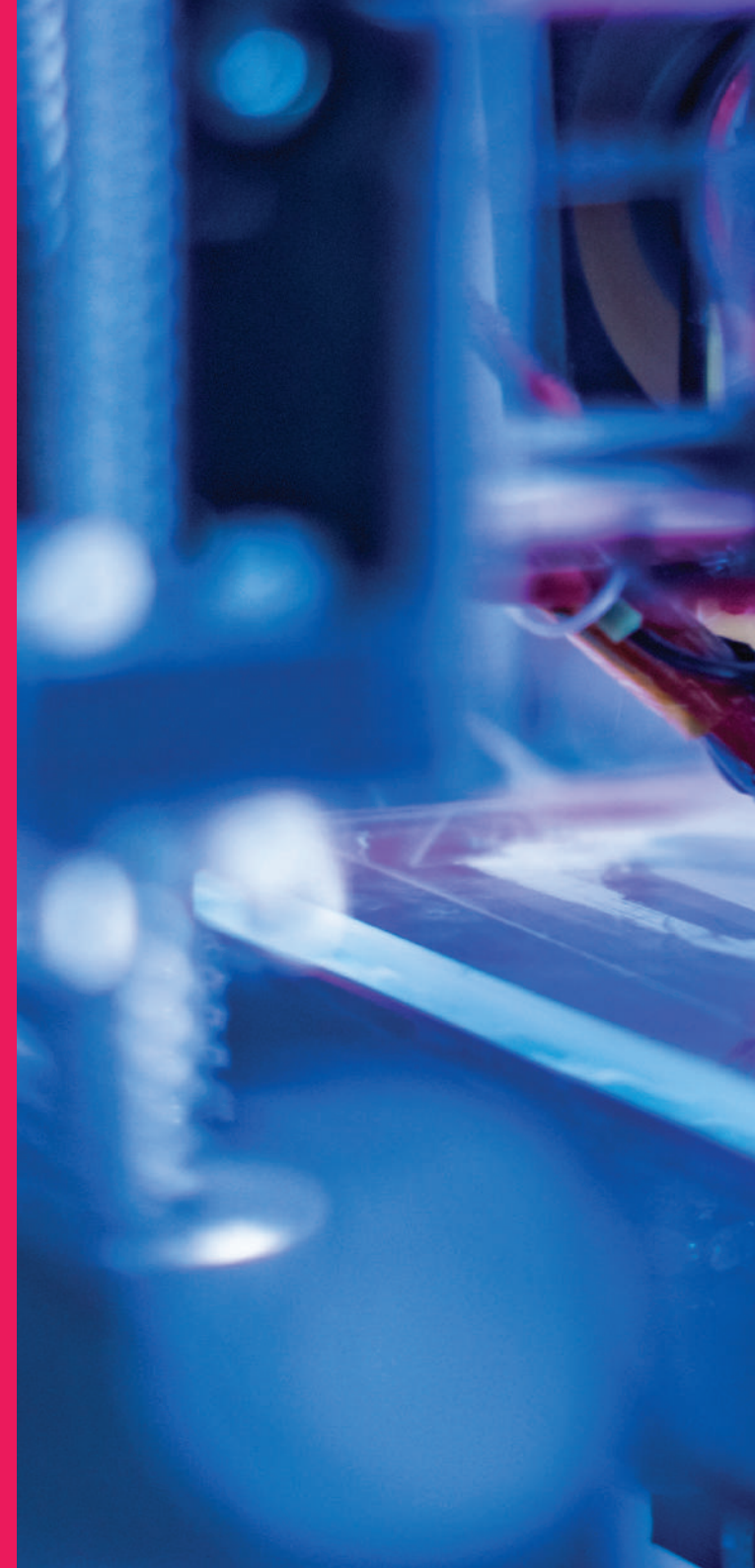
- developing and utilising existing and novel materials, process control, characterisation, and surface engineering
- advancing additive systems such as multi-material systems
- tailoring additive manufacturing designs, including shape and topography optimisation, integration of creative design and additive process engineering.

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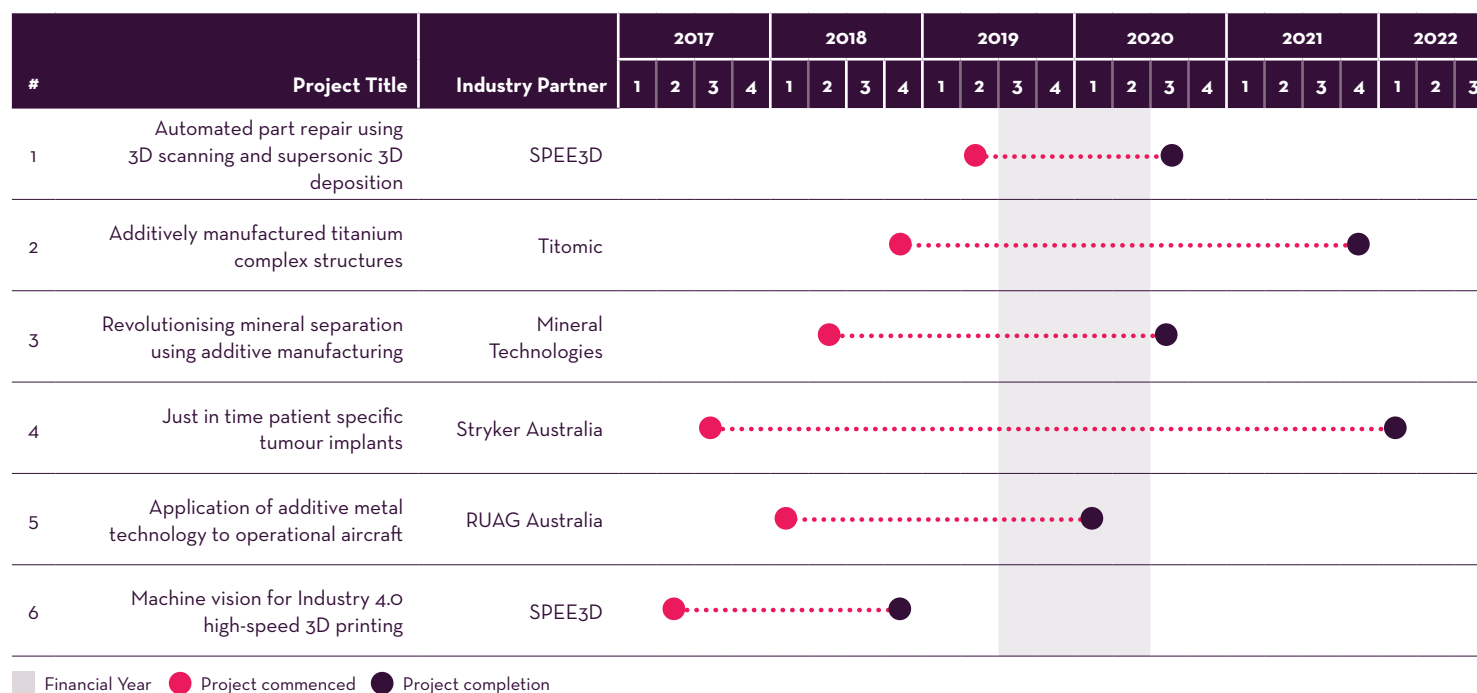
IMCRC's portfolio of additive manufacturing projects reflects the diversity and increased uptake of the technology in Australian industry. Our partners see 3D printing as an enabler for local innovation, bespoke manufacturing and new product or machine development. In general, most of IMCRC's co-funded projects embrace additive manufacturing to produce test apparatus and prototypes in both lab and field work to rapidly validate concepts and ideas.

”

DR MATTHEW YOUNG
MANUFACTURING INNOVATION MANAGER, IMCRC



IMCRC has invested in **six 'Additive Manufacturing Processes'** research projects to date, with two projects since being successfully completed.



In FY 2019-20, the following **four projects** continued their research journeys:

Automated part repair using 3D scanning and supersonic 3D deposition



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
SPEE3D	UTS	\$915,860	\$175,196	01/04/2019	1.5

Objectives

- to transform the current approach to maintenance by developing automated supersonic 3D deposition technology
- to upsize and integrate the scanning technology developed in the IMCRC project "Machine vision for Industry 4.0 high speed printing" in SPEE3D's next generation WarpSPEE3D machine
- to develop and demonstrate technologies required to automate and digitalise the repair process enabling and expanding the application of SPEE3D technology



Automated part repair using 3D scanning and supersonic 3D deposition

* photo credit: SPEE3D

To find out more about the project's progress click here:



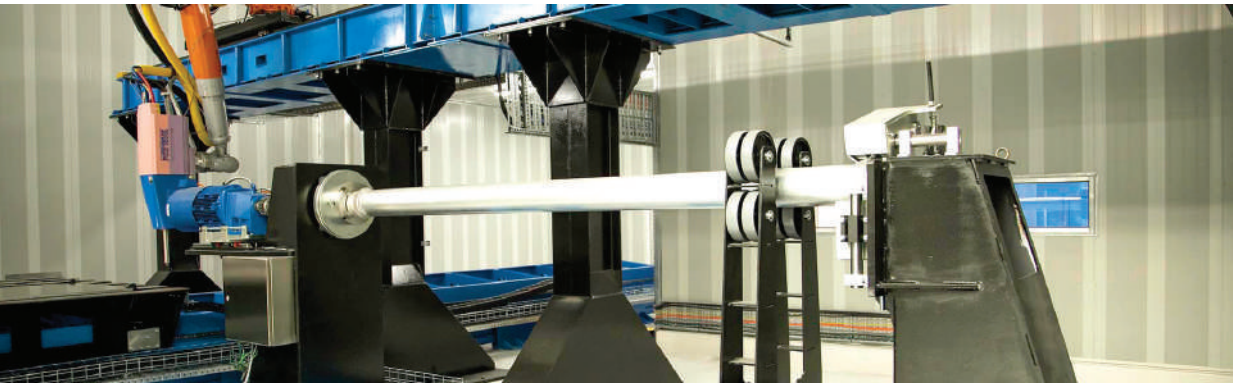
Additively manufactured titanium complex structures



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Titomic	CSIRO, RMIT	\$2,612,762	\$470,303	01/11/2018	2.0

Objectives

- to test ‘Additively Manufactured Titanium Monocoque Structures’ for use in commercial operations, and thus validate Titomic Kinetic Fusion™ as a competitive and novel advanced manufacturing solution
- to model, test and optimise Titomic Kinetic Fusion™ technology, titanium alloy powders, deposition paths, heat treatment and design for specific properties
- to incorporate post-manufacturing processes that apply Industry 4.0 principles to enhance manufacturing capability across multiple industry sectors



Additively manufactured titanium complex structures

* photo credit: Titomic

Revolutionising mineral separation using additive manufacturing



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Mineral Technologies	UTS	\$5,688,774	\$1,100,000	01/04/2018	2.5

Objectives

- to demonstrate how composite polymers can be used to manufacture precision-engineered mineral separation and mining equipment
- to redesign the helically shaped gravity concentrator using complex and efficient geometries in a way suited to an existing 3D printing technology. A product specific 3D printing machine will then be designed and prototyped to optimise the manufacturing process of the gravity concentrator
- to deliver additive manufactured products with embedded Internet of Things (IoT) connected sensors providing feedback about the product performance as well as insights into equivalent wear and structural characteristics for specific minerals and ore concentrations



To find out more about the project's progress click here:



Revolutionising mineral separation using additive manufacturing

* photo credit: IMCRC

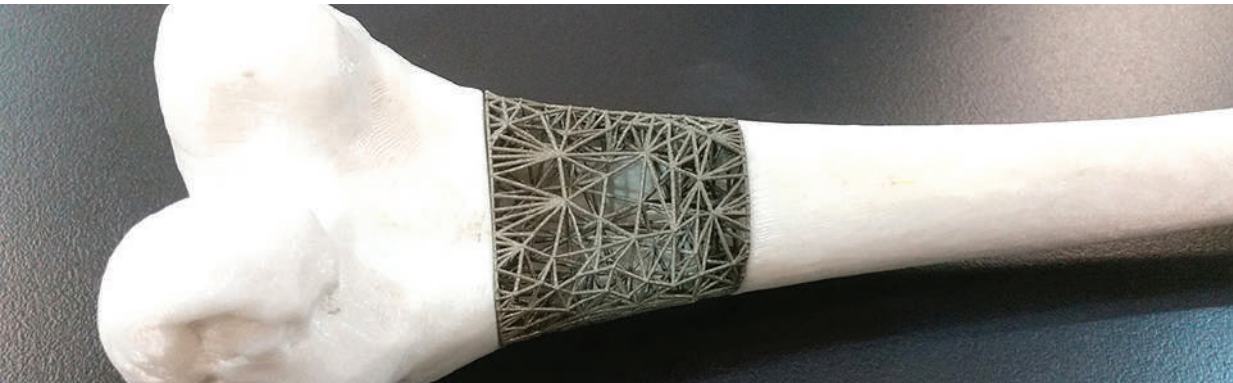
Just in time patient specific tumour implants



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Stryker Australia	RMIT, St Vincent's Hospital Melbourne, UTS, University of Sydney, University of Melbourne	\$16,556,918	\$3,000,000	01/07/2017	4.75

Objectives

- to transform the way musculoskeletal tumour implants are developed, manufactured and supplied, shifting the paradigm to a local, bespoke setting within the hospital
- to develop image analysis and implant design tools that allow a precise robotic resection of the tumour
- to combine the specialised imaging with additive manufacturing techniques for the construction of customised implants capable of achieving multi-density / property cross-sections and surfaces. Manufactured using just-in-time supply chain principles, these implants can then be inserted during the operation



Just in time patient specific tumour implants

* photo credit: RMIT

In FY 2019-20, the “Application of additive metal technology to operational aircraft” project was completed, bringing the total of completed **‘Additive Manufacturing Process’** research projects to two:

Application of additive metal technology to operational aircraft



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
RUAG Australia	RMIT	\$819,000	\$122,362	01/03/2018	2

Objectives

- developed an additive manufacturing process to address corrosion and stress-corrosion damage affecting the structural integrity of components in operational aircraft
- explored geometry restoration using laser deposition technology to solve problems associated with corrosion/ cracks in wing planks without the need for traditional major structural repair or component replacement
- to enable onsite repair and production of parts to improve aircraft maintenance processes including warehousing and transport



Application of additive metal technology to operational aircraft

* photo credit: RUAG Australia

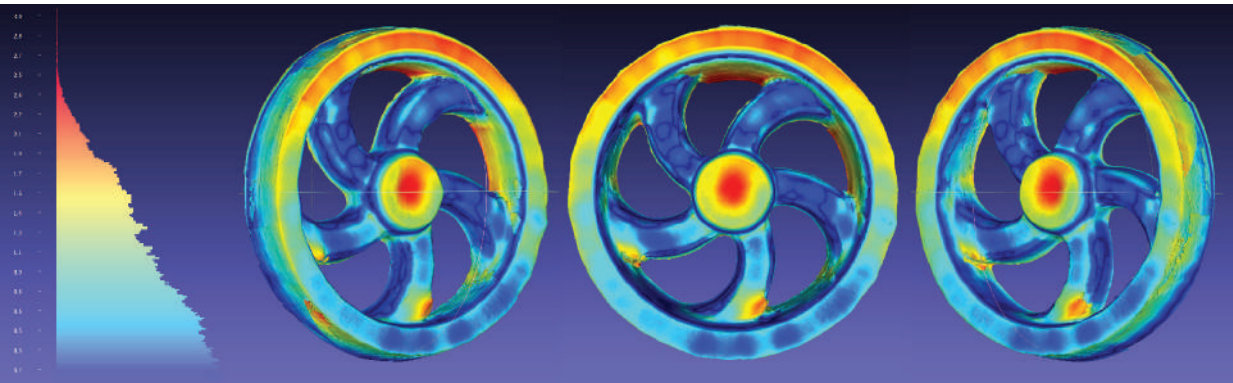
Machine vision for Industry 4.0 high-speed printing



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
SPEE3D	UTS	\$1,036,416	\$349,764	01/04/2017	1.4

Objectives

- automated process of 3D metal printing by developing 3D scanning technology, which, using image sensing, digitally acquires the shape printed by the machine and thus validate the printed part
- developed a 3D geometry processing software which can be used by CNC mill or suitable post processing equipment. Effectively, this “retrofit scanning solution” allows the part to be positioned for milling while being scanned at the same time. The imagery is then fed back to the part build software resulting in improved accuracy during manufacture



Machine vision for Industry 4.0 high-speed printing

* photo credit: UTS



Program 2: Automated and Assistive Technologies

Through the adoption of automated and assistive technologies, Australian manufacturers have the opportunity to reshape and streamline their business processes to gain competitive advantage.

The program investigates a suite of agile manufacturing technologies to improve the performance and operational effectiveness of short run and personalised production systems. The aim is to develop:

- assistive robotics and support systems (e.g. vision) that provide real-time, physical support to the workforce
- automated technologies with perception and situational awareness capabilities that interact safely with their environment including other assistive technologies and the workforce across the manufacturing process
- distributive heterogeneous collaboration technologies that enhance OH&S, skill augmentation and continuous quality control and assessment.

“

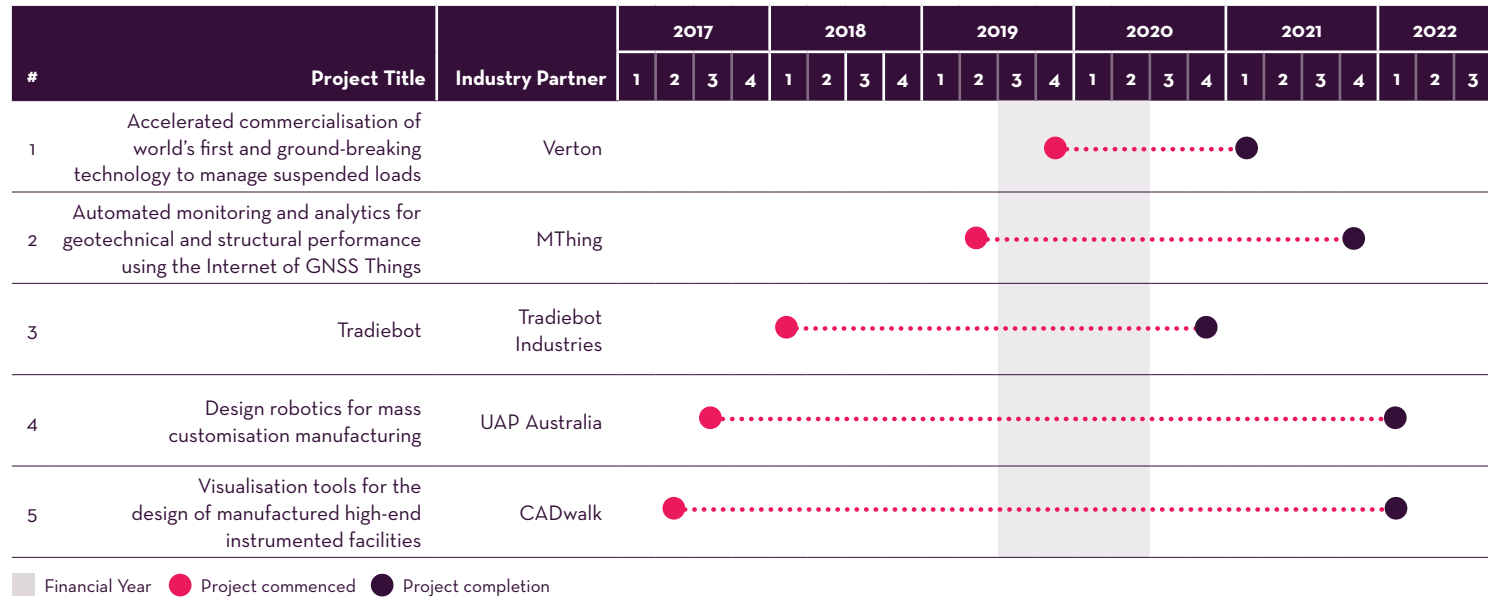
Artificial technology (AI), robotics and other forms of smart automation and assistive technology have the potential to create great economic benefits. Early outcomes of IMCRC's research projects already support Australian manufacturers not only with adopting approaches to collaborate with robotic technologies but also with improving efficiency through enhanced monitoring and control.

”

DR JASON COONAN
CHIEF OPERATING OFFICER, IMCRC



There are currently **five active research projects** under the 'Automated and Assistive Technologies' program.



In FY 2019-20, the following project commenced:

Accelerated commercialisation of world's first and ground-breaking technology to manage suspended loads



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Verton	QUT	\$4,407,634	\$587,993	1/10/2019	1.5

Objectives

- to advance its remote-controlled load-management system for suspended loads by improving the energy management and storage capabilities of the device
- to streamline production processes and reduce the overall manufacturing costs by integrating advanced manufacturing technologies such as robotics, sensing and data-analytics
- to optimise the performance of the equipment and overall operation of the crane using data generated from the sensors within the new technology



A remote-controlled load-management system for suspended loads

* photo credit: Verton

In FY 2019-20, the following **four research projects** continued:

Automated monitoring and analytics for geotechnical and structural performance using the internet of GNSS things



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
MThing	QUT	\$3,157,895	\$500,000	30/04/2019	2.70

Objectives

- to develop an effective IoT solution to automatically measure civil structures using low-medium-end Global Navigation Satellite System (GNSS) sensors
- to design the hardware and advance the manufacturing process to produce lower power GNSS IoT sensors
- to establish a four-level IoT reference framework (sensors, networks, service platform and applications) to simplify the development, deployment, service and upgrade of each GNSS IoT component
- to introduce a new business model that automates the monitoring of structures which reduces the risk and cost in the construction and maintenance of infrastructure assets



Automated monitoring and analytics for geotechnical and structural performance

* photo credit: MThing

Tradiebot



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Tradiebot Industries	Swinburne	\$1,333,495	\$400,347	18/01/2018	3

Objectives

- to enable a low-cost rapid repair service for automotive plastic trim and assembly components utilising 3D printing technologies and robotics along with complex materials
- to research novel polymer material solutions compatible with standard 3D printing processes
- to create a “Repair-bot” that integrates 3D printing, 3D scanning and robotics for in-situ automotive part repairs, allowing the replacement part being directly manufactured on the damaged component and thus reduces repair cost, time, waste and environmental impact



Tradiebot

* photo credit: Tradiebot

Design robotics for mass customisation manufacturing



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
UAP Australia	QUT, RMIT	\$7,978,005	\$1,500,000	01/07/2017	4.75

Objectives

- to develop robotic vision systems and software user-interfaces to support the custom design-to-manufacture cycle
- to test and integrate the systems with industrial robots that can manufacture high-value, complex products at reduced time and cost
- to set up a Design Robotics Open Innovation Network, enabling a peer-to-peer business knowledge transfer program as well as the establishment of a Living Laboratory Network



To find out more about the project's progress click here:



Design robotics for mass customisation manufacturing

* photo credit: UAP

Visualisation tools for the design of manufactured high-end instrumented facilities



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
CADwalk	UniSA	\$5,991,500	\$1,050,000	01/04/2017	5

Objectives

- to develop and productise a set of novel industry specific design tools that enable clients to experience and modify high-value spaces such as factories, distribution centres, submarines, hospitals in a life-size scale
- to demonstrate design concepts in real time using Spatial Augmented, Virtual and Mixed Reality which allow clients to walk around, physically touch and modify the proposed layout / interiors
- to demonstrate alternative manufacturing opportunities to existing local businesses and encourage the development of new strategies to offer specialised services to industry



Visualisation tools for the design of manufactured high-end instrumented facilities

* photo credit: CADwalk

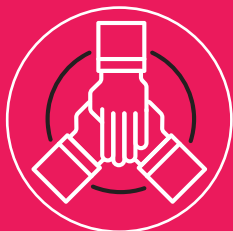


“

IMCRC has worked to build a new, more transformative model of R&D collaboration between industry and universities. Each project is fully focused on the delivery of its anticipated outcomes, ensuring mutual benefit for the participants and a positive impact for the wider economy. In these respects I believe the IMCRC goes above and beyond the traditional CRC model.

”

PROFESSOR ROY GREEN
CHAIR OF THE ADVANCED ROBOTICS FOR MANUFACTURING (ARM) HUB
SPECIAL ADVISOR AND CHAIR OF UTS INNOVATION COUNCIL
IMCRC DIRECTOR



Program 3: High Value Product Development

With new business models emerging and the broader manufacturing sector re-inventing itself, Australian manufacturers need to invest in and deploy new product innovations to future-proof their business.

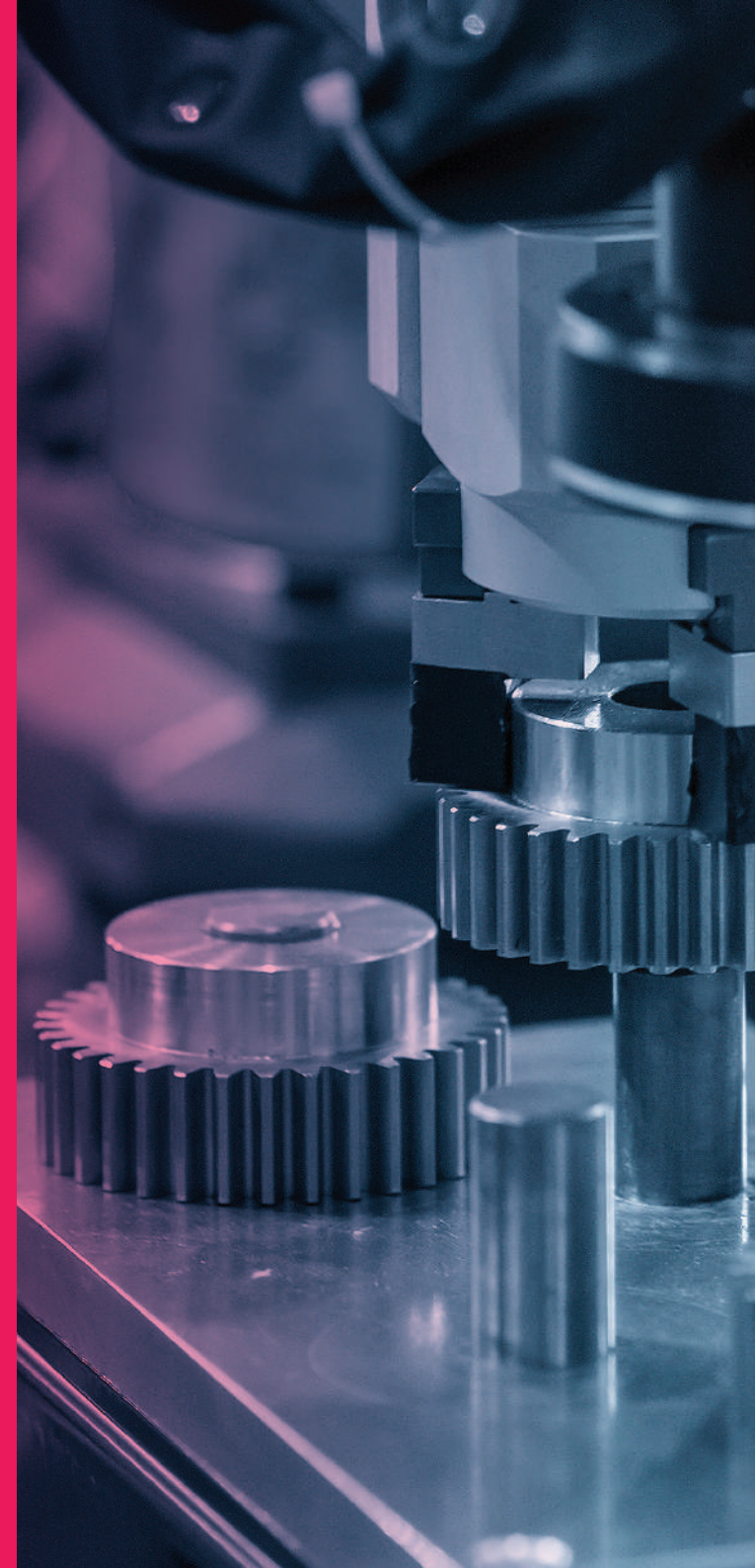
Program 3 - High Value Product Development - aims to develop for instance new electronic devices, diagnostic tools and implantable materials that utilise key enabling science and manufacturing technologies. These will enable Australian manufacturers to rapidly develop, produce, supply and support new products and technologies into international markets and supply chains.

“

IMCRC's industry partners seize these project opportunities to explore new ideas, invest in emerging technologies and digital business models to challenge the norm and create high value products and services to drive business success.

JANA KUTHE
COMMUNICATIONS, MARKETING AND EVENTS MANAGER

”



Seventeen 'High Value Product Development' research projects have been co-funded by IMCRC, with two projects being completed in FY 2019-20.

#	Project Title	Industry Partner	2017				2018				2019				2020				2021				2022		
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
1	Smart coatings for the next generation of lightning strike protection devices	LPI																							
2	Centralised manufacture of Molecularly-Targeted Radiation (MTR) drugs for cancer treatment	Telix																							
3	R2R printing for cost effective manufacturing of a smart patch for health monitoring	Nutromics																							
4	Value adding the Australian lithium mining sector	Neometals																							
5	Developing and optimising advanced carbon materials	Hazer Group																							
6	Value adding Australian minerals	Lava Blue																							
7	Preventing heart attacks with nano-technology-enabled biomarker sensors	ESN Cleer																							
8	Atmospheric plasma coating system	Xefco, Proficiency																							

Financial Year
 Project commenced
 Project completion

#	Program	Industry Partner	2017				2018				2019				2020				2021				2022		
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
9	Engineering an advanced, high value bioreactor system for research and clinical applications	Codex																							
10	Manufacture of the next generation Speedpanel	Speedpanel																							
11	Innovative vaccine delivery technology	Vaxxas																							
12	Xenograft using kangaroo tendon as substitute for ligament reconstruction	BLT, Allegra																							
13	Industrialisation of composite wheel technology	Carbon Revolution																							
14	A novel approach to biofilm disruption and removal	Whiteley																							
15	Antimicrobial nanosurface for orthopaedic implants	Corin (Global Orthopaedic)																							
16	High performance normally OFF GaN High Electron Mobility Transistors (HEMT)	BluGlass																							
17	Smart electric compressor for refrigeration and air conditioning on electric vehicles	SuperCool																							

Financial Year Project commenced Project completion

In FY 2019-1920, the following **seven research projects** commenced:

Smart coatings for the next generation of lightning strike protection devices



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
LPI	Swinburne	\$970,102	\$154,230	01/06/20	1.6

Objectives

- to develop novel materials that optimise the performance of corona-minimising technologies that can be additively deposited onto air terminals
- to integrate and assess the materials from industrial-level scale-up to manufacture
- to build and field test the performance of full-scale prototypes



LPI air terminal protecting a hospital in India

* photo credit: LPI

Centralised manufacture of Molecularly-Targeted Radiation (MTR) drugs for cancer treatment



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Telix Cyclotek Iphase Technologies Genisis Care	University of Melbourne	\$2,543,208	\$499,215	30/2/20	2.1

Objectives

- to advance Australian manufacturing capabilities for MTR drugs for prostate, kidney and neuroendocrine cancers
- to develop a more efficient, centralised manufacturing process that increases the shelf-life of MTR drugs using long-lived radioisotopes and supports early-phase clinical evaluation
- to transfer (once successfully tested) and consolidate the manufacturing process by applying internationally recognised Good Manufacturing Practice (cGMP) standards



Manufacture of Molecularly-Targeted Radiation (MTR) drugs

* photo credit: Telix

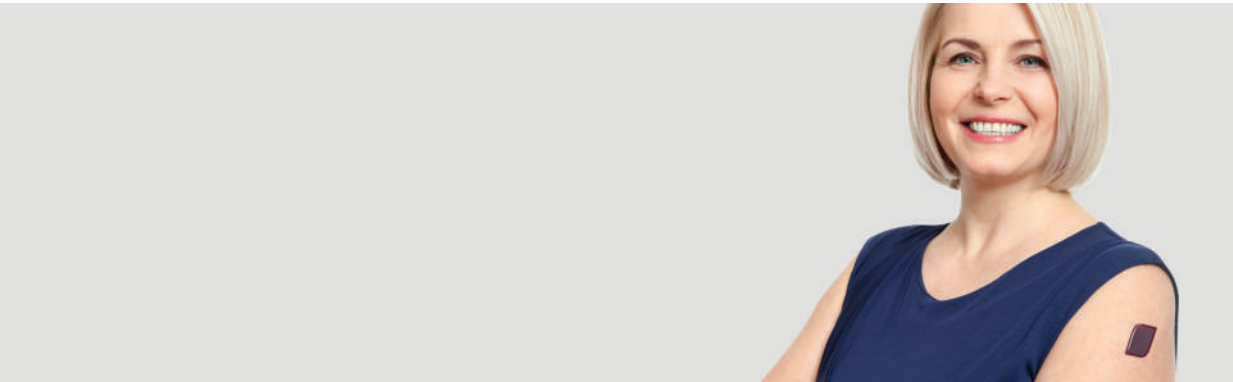
R2R printing for cost effective manufacturing of a smart patch for health monitoring



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Nutromics Romar Engineering	RMIT Griffith	\$6,919,282	\$1,285,720	01/02/20	2.0

Objectives

- to develop a cost-effective manufacturing process to produce a wearable smart patch designed to elicit positive lifestyle behaviour changes to reduce the risk of developing chronic disease like Type 2 diabetes
- to combine different technologies including microneedles, microfluidics and soft electronics to target specific biomarkers as well as monitor health progress which is referred back to a deep learning AI engine
- to demonstrate using roll-to-roll (R2R) printing the smart patch can be mass produced on a large substrate area at high speeds using automated systems with minimal human involvement



A proof-of-concept Nutromics smart patch

* photo credit: Nutromics

Value adding the Australian lithium mining sector: cutting-edge manufacturing process to convert aluminosilicate mining waste to zeolites



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Neometals	QUT	\$2,570,124	\$449,358	01/01/2020	1

Objectives

- to establish a cost-effective and sustainable manufacturing process that converts aluminosilicate residue – a waste material produced when extracting lithium from ore concentrates – into high-value synthetic zeolites
- to set up a digital pilot manufacturing plant that advances and semi-automates the zeolite production process using data analytics and inline monitoring technology to meet customer product requirements
- to explore innovative business models that add up-stream value to the lithium value chain as for example a circular economy approach to lithium production by reducing disposal of residue into landfill and creating a new, high-valued material



Australian lithium mine

* photo credit: Neometals

Developing and optimising advanced carbon materials



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Hazer Group	University of Sydney	\$4,354,253	\$811,712	1/11/2019	2.5

Objectives

- to optimise the synthesis and functionalisation of advanced carbon materials (ACM) for a) high purity graphite for Li-ion batteries, b) functionalised activated carbon for water purification and c) graphitic additives for lubrication
- to investigate innovative technologies and design manufacturing processes to optimise the properties and performance of the ACM at a small scale, and once optimised, initiate larger scale production at Hazer’s existing pilot plant (10 tonnes per annum)
- to test scaled application with specialty industry collaborators



Developing and optimising advanced carbon materials

* photo credit: Hazer

Value adding Australian minerals: advanced manufacturing of high purity alumina for batteries, sapphire glass and LEDs



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Lava Blue	QUT	\$4,449,390	\$645,804	23/09/2019	2.5

Objectives

- to develop a resilient, agile and highly competitive manufacturing process to transform kaolin, an aluminum-bearing clay, into high-purity alumina (HPA)
- to design and establish a pilot manufacturing plant that applies advanced manufacturing principles and incorporates inline monitoring technology to support and progress Lava Blue's HPA production
- to integrate feedback loops that will enable Lava Blue to tailor the process to potential customer requirements, upscale the pilot into a modular commercial plant with optimal financial returns and reduced risk



Advanced manufacturing of minerals

* photo credit: QUT

Preventing heart attacks with nanotechnology-enabled biomarker sensors



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
ESN Cleer	RMIT	\$3,511,119	\$510,849	15/09/2019	1.8

Objectives

- to design, develop and manufacture a biomarker sensor technology that will help users detect the early warning signs of cardiovascular diseases (CVD) from saliva
- to develop a manufacturing process to incorporate miniaturised biomarker sensors with optimised surface, maximum storage lifetime and ultra-small and battery-free communication modules
- to produce a user-experience driven modular design to integrate disposable sensor component with reusable electronic section



Biomarker sensor technology

* photo credit: RMIT

In FY 2019-20, the following **eight research projects** continued:

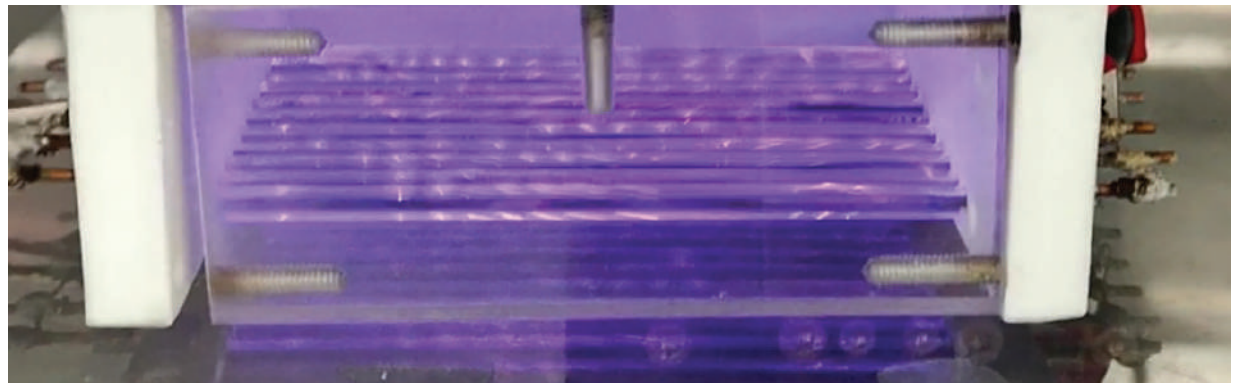
Atmospheric plasma coating system



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Xefco Proficiency Contracting	Deakin	\$3,502,211	\$534,358	01/06/2019	2.8

Objectives

- to advance conventional coating equipment and develop a commercially viable plasma deposition solution that improves current coating and treatment methods for textiles and substrates used in the garment, geotextiles, packaging and medical industry
- to address known functional and environmental issues, such as water contamination, pollution and use of harmful chemicals, within the textile manufacturing and processing industries
- to alter the way industry approaches treatment of commercial textiles and substrates by improving resource consumption and coating applications



Atmospheric plasma coating system

* photo credit: Xefco

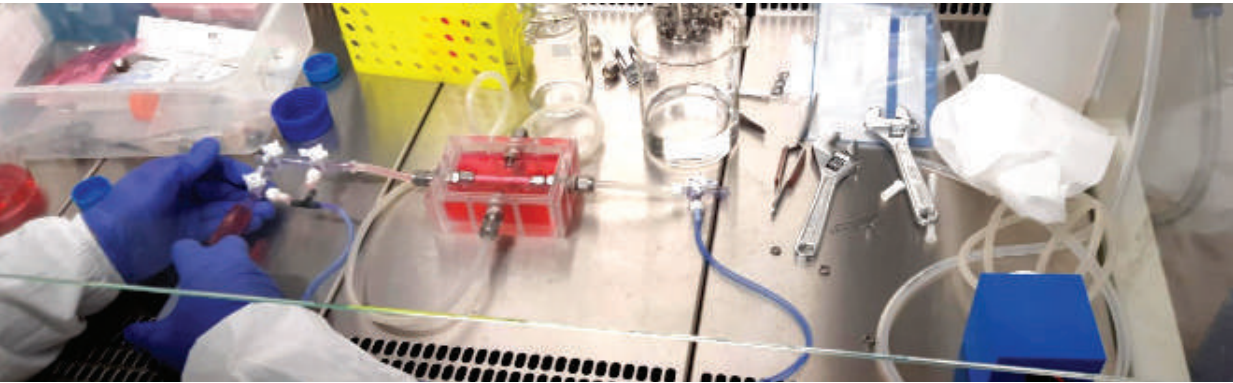
Engineering an advanced, high value bioreactor system for research and clinical applications



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Codex Research	University of Sydney	\$4,417,526	\$851,321	01/04/2019	3

Objectives

- to develop an advanced perfusion bioreactor technology that mimics biological environments in vitro to facilitate material research of vascular grafts
- to manufacture custom design components of the bioreactor technology by applying advanced manufacturing technologies such as 3D printing and robotics
- to integrate automated, flexible manufacturing strategies to facilitate the production of the bioreactor and used advance sensing technology to achieve real-time monitoring and control of its physical parameters



Engineering an advanced, high value bioreactor system

* photo credit: University of Sydney

Manufacture of the next generation Speedpanel



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Speedpanel	Swinburne	\$4,456,350	\$876,569	01/02/2019	3

Objectives

- to transform the manufacturing technology and process by replacing the cement core of the proven wall systems with another lightweight, environmentally friendly material
- to test the structural, acoustic and fire performance of the new material and apply it to existing production environments
- to evaluate new business models and distributed manufacturing for the fire and acoustic rated wall systems as a result of simplified logistics, better quality control and higher production capacity from a given manufacturing footprint



Manufacture of the next generation Speedpanel

* photo credit: Speedpanel

Innovative vaccine delivery technology (manufacture and multi-setting usability study, supply chain impact / disruption assessment and Phase 1 clinical study)



To find out more about the project's progress click here:



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Vaxxas	University of Sydney	\$1,595,390	\$248,695	1/11/2018	2.0

Objectives

- to assess the impact / disruption of supply chain logistics and highlight the cost-effectiveness of the vaccine delivery technology, the environmental sustainability and potential Industry 4.0 applications
- to conduct an end-user usability study to ensure that the vaccine delivery technology meets clinician and patient requirements
- to undertake an acceptability study as part of a Phase 1 clinical study to gather information how well this novel, needle-free vaccination technology is received by subjects



Innovative vaccine delivery technology

* photo credit: Vaxxas

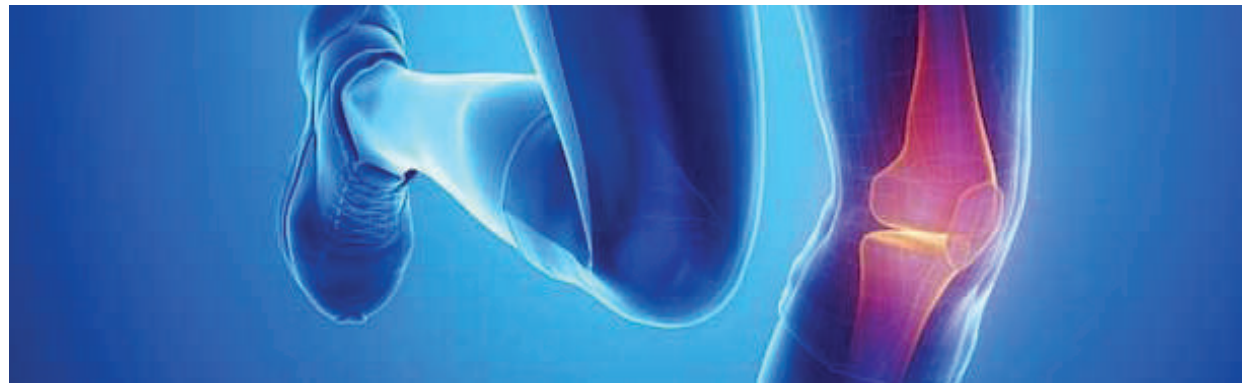
Xenograft using kangaroo tendon as substitute for ligament reconstruction



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Bone Ligament Tendon (BLT), Allegra Orthopaedics	University of Sydney	\$5,867,586	\$1,233,217	1/09/2018	3.1

Objectives

- to produce innovative xenograft material that will refine the future of ligament reconstruction and repair
- to manufacture kangaroo-derived ligament xenografts using novel decellularisation and sterilisation technique that will not impair mechanical performance and allow a range of surgical reconstruction applications
- to design and 3D print a screw using bioresorbable Sr-HT-Gahnite to fix the decellularised, sterile kangaroo tendon to the bone



Using kangaroo tendon as substitute for ligament reconstruction

* photo credit: IMCRC

To find out more about the project's progress click here:



Industrialisation of composite wheel technology



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Carbon Revolution	Deakin	\$15,452,126	\$2,997,233	01/07/2018	3

Objectives

- to increase manufacturing capacity and efficiency of its unique carbon fibre composite wheel technology
- to develop and commercialise new resin and fibre systems as well as optimise key enabling technologies such as binders, filler material and release agents that support high volume production
- to automate processes and support intelligent manufacturing through the development of data-driven statistical analysis techniques



Industrialisation of composite wheel technology

* photo credit: Carbon Revolution

A novel approach to biofilm disruption and removal



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Whiteley Corporation	University of Sydney	\$5,029,673	\$975,505	01/04/2018	4

Objectives

- to develop a new approach to resolving bacterial biofilm problems in humans and industrial settings through mimicking natural and synergistic multimodal strategies
- to develop several new therapeutic treatments for biofilm mediated infection that effectively disrupt the formation of biofilm and eradicate underlying bacteria found, for instance, in the lungs of cystic fibrosis patients, chronic urinary tract infections, burn wounds
- to develop and manufacture small / highly customisable high-value formulated products for different applications and carriers (e.g. gels, foams and coatings) using advance manufacturing design methods and processes



IMCRC meeting the Whiteley research team

* photo credit: Whiteley

To find out more about the project's progress click here:



Antimicrobial nanosurface for orthopaedic implants



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Corin (Global Orthopaedic)	UniSA, University of Adelaide	\$19,615,233	\$2,999,903	01/03/2018	4

Objectives

- to explore nano-modification technology based on the structure of the dragonfly wing to create antimicrobial surface for orthopaedic implants
- to confirm the safety of medical implants with the antimicrobial surface - “smart surface” - and test their bacteria-killing properties which will reduce the chance of infections after surgery
- to develop a manufacturing infrastructure that allows the antimicrobial nano-surface to be engineered onto existing medical devices



Antimicrobial nanosurface for orthopaedic implants

* photo credit: Corin

In FY 2019-20, the following **two research projects** were completed:

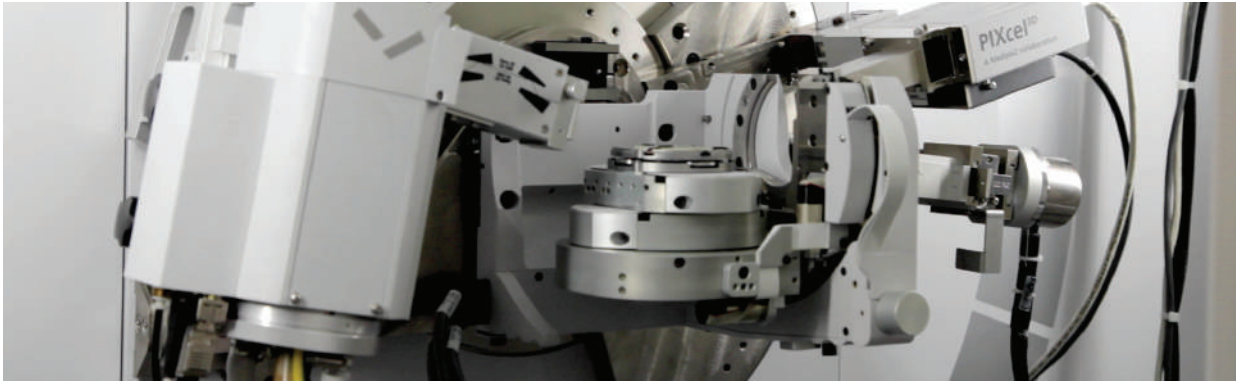
High performance normally OFF GaN High Electron Mobility Transistors (HEMT)



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
BluGlass	Griffith	\$1,580,702	\$330,000	01/09/2017	2.2

Objectives

- developed a commercially viable normally OFF fail-safe, lower cost and smaller Gallium nitride (GaN) based high electron mobility transistors (HEMT)
- combined two Australian enabling technologies - BluGlass' deposition technology called Remote Plasma Chemical Vapour Deposition (RPCVD), a revolutionary low temperature approach for the manufacture of semiconductor materials and Griffith University's Queensland Microtechnology Facility (QMF) Atomically Smooth SiC on large Si (SiC on Si) wafers
- delivered world leading enabling technology platform and processes (RPCVD) for the manufacture of GaN commercially viable SiC on Si substrate that addresses manufacturing cost, difficulty in engineering and the IP 'minefield' that is a barrier to wider manufacturing adoption



High performance normally OFF GaN High Electron Mobility Transistors (HEMT)

* photo credit: BluGlass

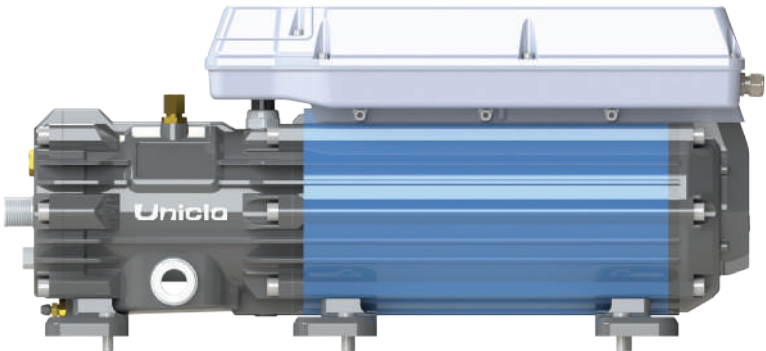
Smart electric compressor for refrigeration and air conditioning on electric vehicles



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
SuperCool	Griffith	\$1,867,871	\$296,325	01/09/2017	2.5

Objectives

- developed an intelligent semi-hermetically sealed electric swash plate compressor for use in mobile air-conditioning and refrigeration applications for passenger and commercial vehicles and equipment
- built an Internet of Things (IoT) enabled smart compressor with onboard diagnostic systems, which provides valuable information for quality control, maintenance and development, leading to a shorter product improvement cycle and providing service provision to end-users
- designed a compact, robust unit suitable for harsh Australian environments, and with technology offering transformative services to electric air-conditioned and refrigerated vehicle and equipment operators worldwide



Smart electric compressor for refrigeration and air conditioning on electric vehicles

* photo credit: SuperCool



Program 4: Industrial Transformation

Industry 4.0, while creating new opportunities for Australian manufacturers through connected, more efficient production and new business models, impacts the market dynamics across the entire sector, affecting, in particular SME manufacturers along the value chain.

IMCRC's Industrial Transformation Program seeks to advance the wider cause of manufacturing transformation in Australia through industry education and public advocacy. It creates and provides resources that particularly help SME manufacturers assess and adopt emerging digital technologies and new business models.

In FY 2019-20, the Industrial Transformation Program has successfully:

- appointed Simon Dawson as Director, Industrial Transformation to engage and work with the manufacturing SME community to help accelerate and enable Australia's industrial transformation through advocating for the uptake of Industry 4.0.
- continued to build lasting and meaningful relationships with key decision makers, opinion leaders and industry associations involved in Industry 4.0. These have included Australia's Industry 4.0 Advanced Manufacturing Forum (I4AMF) and the Australian Industry Group (Ai Group), the Entrepreneurs' Programme (EP), CSIRO, Austrade and selected universities as well as Germany's Fraunhofer Institutes and Callaghan Innovation, New Zealand's Innovation Agency.
- engaged with 211 manufacturing businesses through futuremap® workshops, encouraging them to take the first step towards digital transformation. Since the launch of futuremap® in March 2018, a total of 531 manufacturers have completed the diagnostic tool to deepen their understanding of their business capabilities and what is needed to advance and effectively transform their manufacturing operation.
- accelerated the delivery of futuremap® across Australia by successfully onboarding two new deployment partners: Swinburne University of Technology in Victoria and the ARM Hub in Queensland. A total of 33 futuremap® workshops were hosted in collaboration with state and local governments, Ai Group, EP and other industry partners across Australia. Since COVID-19 brought physical events to a stop in March 2020, futuremap® workshops have been condensed and transferred into a virtual environment, incorporating guest speakers to elevate the industry engagement.
- harnessed PowerBI, a cloud-based data visualisation tool, as a platform to evaluate and disseminate the aggregated futuremap® data, allowing selected partners to interrogate the complete data set. The IMCRC team analysed the futuremap® findings (data) and developed key messages that summarise the current adoption of Industry 4.0 across Australia. These findings were shared, amongst others, with the I4AMF and EP.

- built a virtual, Smartsheet-based environment to support the delivery of the Fraunhofer Industry 4.0 assessment and offer participating SME manufacturers easy access to their evaluation results and supporting material. Sleep Corp and the Australian Red Cross Lifeblood were amongst the first two Australian manufacturers to benefit and use the enhanced Fraunhofer assessment to establish practical pathways to adopt and integrate Industry 4.0 within their production facilities.
- supported the inception of the ARM Hub, Australia's first robotics manufacturing hub to provide practical production and manufacturing advice in a real-life factory environment.
- expanded the national network of connected Industry 4.0 test labs with the ARM Hub joining in the quest of providing Industry 4.0 expertise, technologies and resources for manufacturing SMEs in their respective states.

“

We are amidst the fourth industrial revolution (Industry 4.0), and technology is evolving faster than ever. Australian businesses, particularly manufacturing SMEs, need to keep up with some of the major tech trends or they run the risk of being left behind. Participating in futuremap® and hearing how others have responded to this challenge will allow them to better prepare and grasp the opportunities ahead.

”

SIMON DAWSON
DIRECTOR, INDUSTRIAL TRANSFORMATION, IMCRC

In FY 2019-20, IMCRC invested in **two research projects** as part of the **'Industrial Transformation Program'**.

#	Project Title	Industry Partner	2017				2018				2019				2020				2021				2022		
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
1	Accelerating the uptake and diffusion of innovative manufacturing technologies in Australian shipbuilding and supply chain: the human factor	BAE Systems ASC Shipbuilding																							
2	A novel virtual manufacturing system approach for integrated flexible low-cost manufacturing to enhance cost competitiveness, value differentiation and market focus	Sleep Corp																							

Financial Year
Project commenced
Project completion

In FY 2019-20, the following industry project commenced in the reporting period:

Accelerating the uptake and diffusion of innovative manufacturing technologies in Australian shipbuilding and supply chain: the human factor



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
BAE Systems ASC Shipbuilding	Flinders	8,989,472	\$1,458,985	17/02/2020	2.1

Objectives

- to develop and pilot Industry 4.0 technologies to support the progress and delivery of the Hunter Class Frigate Program
- to capture and address the challenges associated with the implementation of the Industry 4.0 technologies throughout the project
- to work with local manufacturing SMEs to drive digital transformation through advanced robotics, assistive manufacturing, and readiness utilisation – both inside the shipyard and more widely in the Australian supply chain



Hunter Class Frigate Program

* photo credit: ASC Shipbuilding, BAE Systems Australia

In FY 2019-20, the following project continued:

A novel virtual manufacturing system approach for integrated flexible low-cost manufacturing to enhance cost competitiveness, value differentiation and market focus



Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Sleep Corp	Swinburne	\$2,201,870	\$260,305	01/01/2019	2

Objectives

- to set up a novel Virtual Manufacturing System (VMS) that connects robotics-based machinery to a digital twin for a faster and more flexible manufacturing approach
- to integrate all manufacturing operations ranging from tailoring, cutting, sewing to packaging into the VMS application which then will be linked to Sleep Corp's Enterprise Resource Planning (ERP) and Data Analysis/ Analytics for enhanced visibility across the manufacturing value chain
- to deliver a model system for an adaptable Industry 4.0 enabled production line that accommodates mass customisation to deliver the right product at the right time to the right quality the customer expects



A novel virtual manufacturing system approach

* photo credit: Sleep Corp



Towards an Industry 4.0 future

Since the launch of futuremap® - IMCRC's proprietary and unique business diagnostic tool – at National Manufacturing Week in 2018, more than 500 manufacturing businesses across Australia have used the tool, either in a facilitated workshop or a one-on-one discussion, to assess their business capabilities and map their future ambition in areas such as leadership, innovation and Industry 4.0 awareness and utilisation.

Through conversations with business leaders and having analysed the initial aggregated futuremap® insights, it has become apparent that Australian manufacturing SMEs:

- 1 Industry 4.0 awareness**
understand the true potential of Industry 4.0 for their business
- 2 Industry 4.0 utilisation**
seek opportunities to embed Industry 4.0 into their business operations
- 3 Leadership**
must develop their leadership capabilities to take full advantage of Industry 4.0 and drive digital transformation

For more information visit futuremap.org.au

CATALYSING INDUSTRY TRANSFORMATION

Collaboration

Collaboration is at the heart of IMCRC's business model and operation. By connecting industry, research organisations, government and the wider manufacturing community, sharing different ideas, experiences and ways of thinking, IMCRC aims to fuel innovation and create new business and research opportunities that benefit Australian manufacturing.

Research

- IMCRC maintained and strengthened its unique ecosystem of manufacturing research expertise and infrastructure, consisting of CSIRO and 12 research organisations in Victoria, New South Wales, Queensland and South Australia, that offers manufacturers diverse perspectives and inclusive environments to unlock innovation and business potential.
- IMCRC helped grow the network of Industry 4.0 test labs across Australia - the ARM Hub, Swinburne's Factory of the Future, TMI Hub - to offer manufacturing SMEs access to technical capabilities, equipment and resources to take innovative ideas from concept to reality.

Industry

- IMCRC worked with small, medium, large and multinational companies across a range of industry

sectors including advanced manufacturing, medical technology, mining, building, construction and defence. IMCRC has approved a total of 34 industry-led research collaborations that focus on advancing technical capabilities and delivering real benefits for Australian manufacturing.

- In FY 2019-20, futuremap® enabled IMCRC to engage directly with 211 manufacturing businesses across Australia, encouraging them to access the roots of their business and re-think their current business processes. As a next step, futuremap® recommended further information as well as offered access to a wider support ecosystem.
- IMCRC continued working with its member industry associations, such as the Ai Group and prefabAUS, in promoting and educating Australian businesses about the potential of advanced manufacturing technologies, especially around Industry 4.0. The collaboration strengthened particularly with the Ai Group through the joint delivery of futuremap® workshops in Queensland and New South Wales.

Government

- IMCRC deepened its collaboration with federal, state and local governments, government agencies (Austrade) and industry growth centres (AMGC,

MTP Connect) to help catalyse industry-research collaboration and manufacturing growth.

- IMCRC further grew its partnership with APR.Intern, with nine manufacturers accessing the program to utilise the specialist expertise of PhD students to drive advanced manufacturing and optimisation solutions within their business.
- futuremap® exemplifies the effective collaboration of multiple government organisations. In collaboration with the Entrepreneurs' Programme and other partners, IMCRC delivered 33 interactive futuremap® workshops across Australia.
- IMCRC shared examples of emerging medical technology, outlining their potential for Australia's health sector, in a workshop with the Therapeutic Goods Association (TGA).
- IMCRC supported MTP Connect's successful \$32million 'Researcher Exchange and Development within Industry' (REDI) application and now contributes to the program as a member of the Steering Committee.
- As a member of Australia's Industry 4.0 Advanced Manufacturing Forum, IMCRC has led the combined Technology Applications and Digital Business Models workflow.



Transforming industry through advanced manufacturing and robotics

The Advanced Robotics for Manufacturing (ARM) Hub is a not-for-profit technology centre with a mission to reinvigorate 'Australian Made' and amplify Australia's reputation for high value manufacturing through robotics and assistive technologies. Based in Brisbane, the ARM Hub offers manufacturers access to a unique network of research institutions, facilities and smart commercial companies. Drawing on the expertise of scientists, technical specialists, engineers, and designers to develop commercial solutions, especially for small and medium organisations, the ARM Hub aims to lower the technical, operational and economic barriers to advanced manufacturing and Industry 4.0 adoption.

The ARM Hub was born out of an \$8 million Design Robotics research project between Urban Arts Projects (UAP), Queensland University of Technology (QUT) and RMIT University, co-funded by IMCRC, with the aim to develop vision-enabled, agile and adaptable robots that SMEs can use easily to make high-value products that open export opportunities and create more jobs in Australia. As part of the five-year project, UAP agreed to open their manufacturing facility and involve other businesses in the research and share its outcomes. As industry interest grew, they conducted a feasibility study into the concept and business model for a Living Laboratory and Open Innovation Network, which led to the design and formation of the Design Robotics Open Innovation Network - which has now become the ARM Hub.

IMCRC and UAP have continued collaborating on the Design Robotics project, further developing new ways to implement robotics and vision systems for design-led manufacturing. Commercially viable solutions from this project have been applied within UAP and

shared with a wide range of SMEs through the project's Open Innovation Network. The development of semi-automated manufacturing for Vertron's R-Series crane load-management system is another collaborative venture involving IMCRC, the ARM Hub and QUT.

To help more Australian SMEs to explore and achieve their advanced manufacturing potential, the ARM Hub and IMCRC have extended their collaboration. Together, they have established an SME engagement program based on IMCRC's futuremap® platform and created pathways to access R&D matched funding. Across the Hub's wider program of delivery, this could lead to new partnerships across different industry sectors such as Mining, Food, Energy and Space - and help businesses repurpose their manufacturing facilities, increase efficiency through the adoption of new technology, undertake high-value research and development, innovate existing supply chains, and expand business collaborations to access new markets.



Education and Training

IMCRC's Education and Training activities focus on catalysing the transformation of the Australian manufacturing sector. A large component of this involves engaging directly with manufacturing SMEs via the Industrial Transformation Program, as well as helping skill the manufacturing workforce of the future through PhD stipends, Masters scholarships and industry internships.

In FY 2019-20, IMCRC continued to build on the foundations it established in the previous years and focused on

Student Engagement and Development

- IMCRC grew its student community to 22 PhD and four Masters students from seven universities, with five additional PhD and two Masters students commencing their candidature in FY 2019-20. Two students gained first-hand industry experience through Industry 4.0 internships.
- IMCRC underscores the value of getting involved and provides various opportunities for its PhD and Masters students to present their research. In FY 2019-20, IMCRC for the first time encouraged its PhD students to participate in the CRC Association's "Early Career Researcher Showcase". Two PhD students submitted a 30 second video outlining the work.

- With the goal to match 23 skilled PhD students with manufacturing SMEs and larger companies to drive manufacturing transformation, IMCRC entered a funding partnership with the Australian Mathematical Sciences Institute's APR.Intern program. As of 30 June 2020, six PhD students have successfully completed an internship position. Three students were offered full-time employment at the end of the internship.
- To elevate Australia's emerging manufacturing talent, IMCRC has dedicated a section of its website to PhD students who contribute to an IMCRC co-funded research project or have completed an internship through the APR.Intern program. The section features a growing number of student profiles as well as interviews about their research.

Industry Training

- Together with its deployment partners IMCRC hosted 33 futuremap® workshops throughout the reporting period, of which 15 were delivered in an online setting due to the COVID-19 pandemic. 211 manufacturing businesses from across Australia attended the workshops to learn about leadership, innovation and Industry 4.0 technologies and digital business models. Since the launch of futuremap® in March 2018, a total of 531 manufacturers used the business diagnostic

tool to assess their business capabilities and map out the best path for adopting advanced manufacturing in their operations.

- After successfully adjusting and piloting Fraunhofer's Industry 4.0 assessment in FY 2018-19, IMCRC assessed in collaboration with Swinburne's Factory of the Future the digital manufacturing capabilities of Sleep Corp and the Australian Red Cross Lifeblood, identifying Industry 4.0 innovations for both organisations.
- At the inaugural conference of the Industry 4.0 Advanced Manufacturing Forum (I4AMF) in August 2019, IMCRC shared initial futuremap® findings that highlighted that most Australian manufacturing SMEs were aware of Industry 4.0 yet not in a position to define their digital strategy. IMCRC collaborated with industry at the conference to outline primary barriers and what should be done to accelerate the uptake of Industry 4.0 in Australia.
- The past year saw IMCRC expand its commitment to helping widen a national a national network of Industry 4.0 test labs. True to its mission to help catalyse the transformation of Australian manufacturing, IMCRC supported the inception of the ARM Hub and has since been involved in establishing programs of activity applying Industry 4.0 technologies and processes.

SME Engagement

Australian manufacturing SMEs are critical to Australia's economy. However, disruptive technologies, new business models and global competition are changing the business landscape, putting increased pressure on businesses to develop new ideas, new products and services to maintain their competitive advantage. For SMEs this presents further challenges as they are often limited by access to the funding, facilities and expertise that is needed to assist their business in adapting for growth.

IMCRC engages with manufacturing SMEs across Australia, offering them different pathways to explore, adopt and implement emerging digital technologies and business models to support their business and improve their productivity.

In FY 2019-20, IMCRC:

- co-funded eight new industry-led manufacturing research projects involving small and medium businesses from a diverse cross section of industries, sizes and location, all adhering to IMCRC's SME collaboration requirement.
- launched IMCRC activate, a new funding initiative that offers SME manufacturers access to R&D expertise and matched cash funding between \$50,000 – \$150,000 for shorter-term, industry-led research projects in advanced manufacturing and digital technologies.
- raised awareness and shared 'digital manufacturing' insights impacting SME manufacturers at industry conferences, webinars and workshops. Through a partnership with Manufacturers' Monthly, IMCRC has published thought leadership articles designed to drive industry and research collaboration and industrial transformation more generally.
- delivered 33 futuremap® workshops of which 15 were conducted in an online environment due to COVID-19 restrictions. In collaboration with its deployment partners and supported by state and local governments, industry associations and industry experts, IMCRC guided 193 SME manufacturers through futuremap® – a business diagnostic tool that helps them assess and map the current state of their business across 13 key areas of industrial and manufacturing maturity.
- invested in the expansion of Industry 4.0 test labs across Australia, bringing onboard the ARM Hub. Involving all test labs – Tonsley's Manufacturing Innovation Hub (TMII), Additive Manufacturing Applied Research Network (AMARN), Swinburne's Factory of the Future and the ARM Hub – IMCRC advanced its SME engagement model to accelerate the uptake and diffusion of digital and advanced manufacturing technologies.



"Applied technologies and digital business models" workshop at the I4AMF Conference



futuremap® workshop

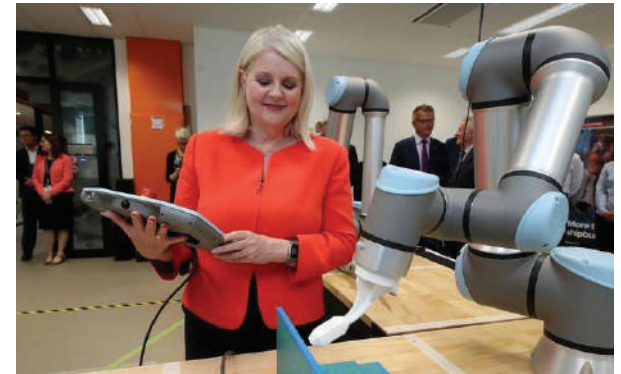
Communications

In an industry undergoing significant change, effective and engaging stakeholder engagement and communications are essential. To realise IMCRC's vision for a thriving, relevant and globally integrated Australian manufacturing industry, IMCRC's strategic communications intent to:

- create awareness, understanding of and commitment to IMCRC, and the contributions made by the CRC, its industry and research participants and partners to specific manufacturing research innovations, and the Australian manufacturing industry at large
- engage and collaborate with manufacturing businesses, research organisations, industry associations and government, building strong relationships that drive innovation and thus help transform Australia's manufacturing industry
- inform, educate and support Australian manufacturers, in particularly small and medium businesses, to enhance their product portfolio, re-think their business models and invest in new technologies, and at the same time advocate for the wider manufacturing community to get behind the digital transformation of the industry.

As a voice for innovation and a catalyst for industrial transformation in Australia, IMCRC continued to shape the conversation about opportunities in advanced and digital manufacturing in FY 2019-20. This was achieved by:

- strengthening IMCRC's brand identity to amplify the importance of collaborative investment, research impact and innovation for Australian manufacturing
- launching IMCRC activate, a new funding initiative that offers SME manufacturers access to R&D expertise and matched cash funding between \$50,000 – \$150,000 for shorter-term, industry-led research projects in advanced and digital manufacturing
- collaborating with publications such as Manufacturers' Monthly offering thought and action leadership as well as practical advice for those looking to explore key enabling technologies and new business models
- announcing nine new manufacturing research partnerships and reporting on the progress and milestone achievements of five IMCRC projects, secured news coverage in ~300 publications – nationally and internationally. The Hon Karen Andrews, Minister for Industry, Science and Technology, joined the press conference announcing the BAE Systems ASC Shipbuilding research project in February 2020.

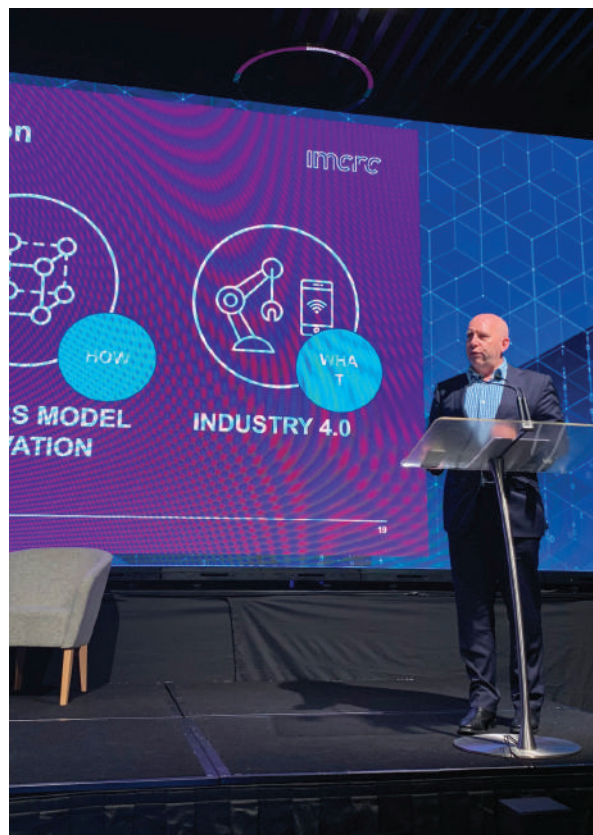


The Hon Karen Andrews, Minister for Industry, Science and Technology



Press conference announcing BAE Systems ASC Shipbuilding research project

- offering regular updates about IMCRC's research initiatives, organisational and industry news through Innovate - IMCRC's e-newsletter - reaching an audience of 400+ subscribers.
- doubling IMCRC's online and social media presence with, for instance, an active and engaged network of 1,635 LinkedIn followers at 30 June 2020.
- establishing a strong presence at industry conferences, seminars and workshops. One highlight - before COVID-19 disrupted IMCRC's 2020 events calendar - was the inaugural I4AMF conference in August 2019 where IMCRC facilitated an interactive workshop with 50 business leaders about the uptake of Industry 4.0 in Australia.
- delivering 33 futuremap® workshops across Australia, encouraging 211 manufacturers and SMEs to think differently about the opportunities that emerging digital technologies and new business models pose for their business.



Siemen's Digitalize 2019



RMIT Global Business Innovation Conversations



BioMelbourne Network

Glossary

IMCRC	Innovative Manufacturing Cooperative Research Centre
ACNC	Australian Charities and Not-for-profits Commission
AGM	Annual General Meeting
Ai Group	The Australian Industry Group
AMGC	Advanced Manufacturing Growth Centre Limited
APR.Intern	Australian Postgraduate Research Intern
ARC	Audit and Risk Committee
ASIC	Australian Securities and Investments Commission
BDO	BDO Australia - Certified Public Account
Board	Company Board of Directors
CEO	Chief Executive Officer
CRC	Cooperative Research Centre
CY	Calendar Year
CSIRO	The Commonwealth Scientific and Industrial Research Organisation
Deakin	Deakin University
FY	Fiscal (financial) Year
Griffin	Griffith University
IIC	Innovation Investment Committee
IP	Intellectual Property
ITP	Industrial Transformation Program
MD	Managing Director
MTP Connect	Medtech and Pharma Growth Centre
MOU	Memorandum of Understanding

NRC	Nominations and Remuneration Committee
SME	Small and medium enterprises
SUT	Swinburne University of Technology
TC	Transition Committee
TMI	Tonsley Manufacturing Innovation Hub (TMI)
UniSA	University of South Australia
UTS	University of Technology of Sydney
UTSA	University of Tasmania
QUT	Queensland University of Technology



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