Australian Government
Department of Industry, Science, Energy and Resources

AusIndustry
Cooperative Research Centres Program

Innovative Manufacturing CRC (IMCRC)

HIGHLIGHTS REPORT 2020-2021

imcrc | we champion manufacturing innovation

Cover image: IMCRC

The Innovative Manufacturing CRC (IMCRC) is an independent and for-impact cooperative research centre that helps catalyse the transformation of Australian manufacturing.

By investing in research-led innovation in manufacturing products, processes and services, we bring together forward-thinking businesses and some of Australia's best universities and the CSIRO to collaborate, address pressing industry challenges and develop solutions that lead to commercial outcomes – helping those involved to scale up, transform their business operation and become more competitive and resilient, and be exemplars for others in the industry to follow.

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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 2021, unless it is otherwise specified in the document.

CONTENTS

HIGHLIGHTS

* photo credit: UAP

Achievements in FY 2020-21

49
ACTIVE RESEARCH PROJECTS, OF WHICH 19 COMMENCED IN THE REPORTING PERIOD

8
SUCCESSFULLY COMPLETED PROJECTS

14
MANUFACTURERS JOINED THE IMCRC'S ACTIVATE INITIATIVE WITH AN ADDITIONAL 9 PROJECTS IN THE PIPELINE

WON
CRC ASSOCIATION'S 2020 AWARD FOR EXCELLENCE IN INNOVATION

19
NEW INDUSTRY PARTICIPANTS ENGAGED

22
RESEARCH PUBLICATIONS PUBLISHED

3
"MASTERS BY COURSEWORK" SCHOLARSHIP SUPPORTED

23 PhD
AND 6 MASTERS STUDENTS ENROLLED IN IMCRC'S RESEARCH COHORT, PLUS 12 NEW MANUFACTURING INTERNSHIPS BACKED BY APR.INTERN

$220
MILLION CUMULATIVELY INVESTED INTO COLLABORATIVE MANUFACTURING RESEARCH AND INNOVATION

115
MANUFACTURING BUSINESSES COMPLETED FUTUREMAP©

Progress to Date

Since its launch in 2016, IMCRC has purposefully invested **$33 million of Commonwealth and other funding** to advance Australian manufacturing catalysing over **$220 million investment** in collaborative research, manufacturing innovation and education across Australia.

$33m+
CRC cash co-invested in projects

60+
industry-led projects

60+
new industry project partners

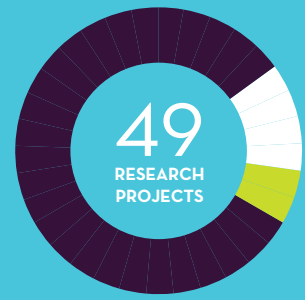
5.5x
multiplier on Commonwealth project funding

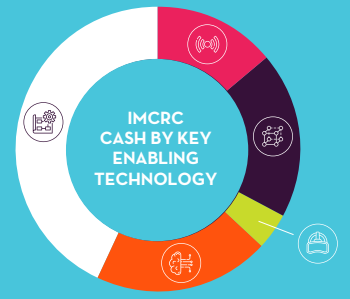
$220m+
total manufacturing R&D investment

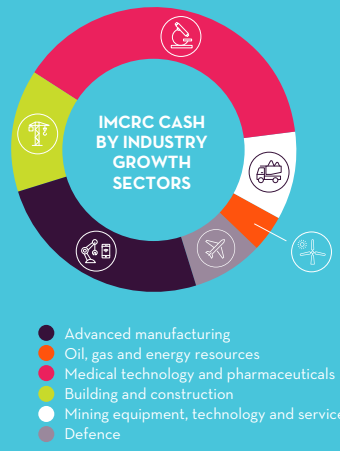
FOCUS	INDUSTRY FOCUS	RESEARCH COLLABORATION	MANUFACTURING INNOVATION	INDUSTRIAL TRANSFORMATION	ACROSS AUSTRALIA AND BEYOND
APPROACH	• Being industry-led • Driving real-world manufacturing and commercial outcomes • Removing barriers to SME participation • Taking proof of concepts through to pilot readiness and commercial investment (TRL/MRL 4-7) • Taking no CRC share in project IP	• Accessing a network of 11 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	• 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	• 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	• 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	• **60+ industry project participants** • **67% cash co-invested with Australian SMEs**	• **49 projects approved with 8 projects completed** • **Average project investment is 5.5 multiple on CRC cash** • **29 PhD and Masters students**	• **Projects across the six National Manufacturing Priority areas** • **Investment in all CSIRO defined key enabling manufacturing technologies**	• **futuremap® inspired 600+ manufacturers (90% SMEs) to future-proof their business and invest in Industry 4.0** • **Catalysed the ~$20m ARM Hub establishment in QLD**	• **Industry-led investment across all states and the ACT** • **>80% CRC cash co-invested with Australian owned businesses**

Industry-led Manufacturing Research across Australia

* as at 30 June 2021







Australia's Modern Manufacturing Strategy

The Modern Manufacturing Strategy is the Australian Government's action plan for Australia to be recognised as a reliable, high-quality and sustainable manufacturing nation.

Positioned as a strategy for industry, by industry, with government and industry coming together to make bold changes to create strong, resilient, thriving and internationally competitive manufacturing businesses, the Modern Manufacturing Strategy aims to:

2 years create the business environment to support manufacturing jobs and encourage new investment

5 years support a more industry-focused science and technology system which helps boost productivity, scale and competitiveness

10 years lock in productive and competitive firms with high impact sectoral growth.

Recognising that Australia can not be 'all things to all people', the Government has started to align resources across government, industry and the research and education sector to build scale and secure investment in high-value areas of manufacturing where Australia either has established competitive strengths or emerging opportunities.

The Government has identified six National Manufacturing Priority areas:

- Resources technology and critical minerals processing
- Food and beverage
- Medical products
- Recycling and clean energy
- Defence
- Space

To incentive manufacturing businesses to scale up, collaborate and commercialise in these areas, the Government has launched three key initiatives with the $1.3 billion Modern Manufacturing Initiative (MMI) being the centrepiece. Across three targeted streams – Collaboration, Translation and Integration – the MMI will provide funding for manufacturing projects and collaborations that help businesses translate their ideas into commercial products or services that integrate into local and international value chains.

By strategically investing and boosting the role of science and technology in industry – a key pillar of the strategy - the Government hopes to establish new partnerships that both solve industry-specific problems and deliver innovations that open up new opportunities for Australia.

IMCRC's industry-led research portfolio aligns with the six National Manufacturing Priorities as follows:

Message from the Chair

I am pleased to present this report for the 2020/21 financial year and want to acknowledge that this year's results have been the culmination of five years' effort and dedication from IMCRC – its staff, Board, and industry and research partners – to advance Australian manufacturing and innovation.

In what has been an extraordinary 12 months, IMCRC has proactively supported manufacturing businesses in response to the COVID-19 pandemic, helping them invest in research, emerging technologies and new business models to accelerate new opportunities, become more competitive and resilient. A thriving portfolio of 49 manufacturing research projects, of which several reached completion and delivered first commercial outcomes, is testament to IMCRC's convening power and the team's ability to rally business and research organisations together and develop collaborative solutions at pace.

When we launched IMCRC in 2016, we committed to helping catalyse the transformation of Australian manufacturing though collaborative investment, research impact and innovation. We also pledged to operate the CRC according to strong commercial principles: being fair, transparent and outcome focused, prioritising collaboration, removing barriers to entry, setting clear milestones, and putting in place intuitive processes and flexibility to ensure the success of projects, whether for SMEs or multinationals. Importantly, we determined that IMCRC would not own any of the intellectual property created through its projects, instead encouraging industry and research participants to set mutually beneficial arrangements that would allow them to effectively commercialise.

Since that launch, IMCRC has successfully implemented an industry-led, collaborative business model that enabled the purposeful investment of more than $30 million of Commonwealth and other funding into industry and research collaborations. This has catalysed close to a 6x multiplier on project investments from a taxpayer perspective, with indications already that outcomes are leading to thousands of high worth jobs and substantial net economic value added to the sector and nation. It has set the standard for project governance and continuity and proven to be one of the key success stories of Australia's CRC program.

The pandemic has highlighted a critical need for a stronger design and manufacturing base in Australia, including the ability for local industry to contribute to global supply chains and commercialise the wealth of research talent and ideas available to us. I am delighted to be able to say that IMCRC has demonstrated its ability to catalyse these outcomes, especially in sectors recognised by the Commonwealth as National Manufacturing Priorities.

While IMCRC plans to wind up operations in 2022 on completion of all supported projects, the opportunity now exists to scale up this successful business model to contribute more broadly to Australia's innovation ecosystem, and to help further the Commonwealth's Modern Manufacturing Strategy.

This would not have been possible without the efforts of the IMCRC team who, despite the challenges of the pandemic, have maintained a fantastic output and exemplary professionalism and should be proud of all that has been achieved.

On behalf of the Board, I would like to congratulate CEO and Managing Director David Chuter and his team, as well as our industry and research partners, for their performance over this financial year and for their unwavering commitment over the last five years.

The Hon Ian Macfarlane
Chair

Message from the CEO and Managing Director

The past 12 months have marked a year of further impact and outcomes for IMCRC, as we continued to provide backing for our industry and research partners' investment in research and development (R&D) and innovation.

The COVID-19 pandemic brought the Australian manufacturing industry into sharp focus, which has been prioritised through the Australian Government's Modern Manufacturing Strategy. As an organisation that, since 2016, has passionately championed innovative manufacturing, collaborative investment and research impact, we were determined not to see that opportunity wasted.

Our $220 million investment portfolio of 49 active research projects, which includes 19 new projects that commenced in the fiscal year, is a testament to the willingness and ambition of our industry and research partners, who not only embraced the opportunities we sought to provide but are already realising real world and commercial outcomes as a result.

As an industry-led CRC, our business model is designed to catalyse projects of strategic importance to our industry and research partners. It centres around safeguarding government and industry funding by requiring partners to set clear strategic and commercial objectives from the outset and by putting in place processes to overcome barriers to collaborative success. I am particularly pleased to report that the IMCRC portfolio has remained both resilient and largely intact through the pandemic.

As a result, we now have 8 completed projects, of which 5 were completed in the financial year.

A key and timely project to reach completion was the collaboration between Perth-based Alcolizer and the University of Technology Sydney, which saw the development of a cost-effective, point-of-care COVID-19 test. The project was the first to commence under IMCRC's new activate program, designed by our team to stimulate collaborative investment during the pandemic and provide opportunities for Australian manufacturing SMEs to invest in shorter-term R&D projects with reduced barriers and financial commitment. This year, 14 small and medium enterprises (SMEs) joined the IMCRC activate initiative with additional 9 projects to date in the pipeline.

With many in-person events cancelled or unable to be planned due to continued lockdowns during the fiscal year, we took the opportunity to develop an enhanced platform for our manufacturing SME diagnostic tool, futuremap®, and deepen deployment partnerships with research and industry hubs such as Queensland's Advanced Robotics for Manufacturing (ARM Hub). With South Australia's Flinders University and New South Wales' University of Technology Sydney (UTS), further partners have come on board to help us engage with local manufacturing SMEs to accelerate the adoption of Industry 4.0 principles and technologies. Our goal has been to ensure that futuremap can be scaled up and deployed locally via state-based partners, offering manufacturers across Australia access to industry insights, expertise and facilities that allow them to develop new business models and create innovation platforms. With the support of our partners, we informed manufacturers about emerging trends, shared Industry 4.0 exemplars and helped them navigate and access Australia's innovation ecosystem. Together we hosted 23 futuremap workshops (of which 19 were customised and delivered virtually) that saw 115 manufacturing businesses complete the course. As lockdowns come to end, the opportunity exists to once again scale deployment and impact.

I particularly want to thank our partner universities, the CSIRO and all the researchers who have been disrupted by the pandemic – yet are still keenly supporting IMCRC's industry-led projects. Australia has a wealth of world-class universities and scientific research organisations, and it has been rewarding to witness first-hand their ability to work hand in glove with industry partners on IMCRC projects and help deliver commercial and other manufacturing outcomes. This fiscal year saw 23 PhD and 6 Masters students thrive as part as of IMCRC's research cohort. With the launch of the webinar series "Unlocking potential in manufacturing', we offered them the opportunity to talk about their research, knowledge and passions. The first 3 webinars hosted in the year delved into the latest trends in robotics, advanced materials and medical products, attracting the interest of the wider manufacturing community. To encourage more Australian students to explore manufacturing as a career path, we created a "Masters by Coursework" Scholarship that supported 3 Masters students.

Supporting Australia's next generation of innovators out in industry is also an important part of what we do at IMCRC. This year we continued to contribute to the innovation and manufacturing landscape through our collaboration with APR.Intern. Our team supported and co-funded 12 new manufacturing PhD internships with SMEs over the past 12 months.

We also had the opportunity to contribute a submission to the Department of Education, Skills and Employment's consultation into the development of a model for university research commercialisation and possible mechanisms to incentivise and increase partnerships between businesses and universities. Our submission considered the areas of mission-driven research, stage-gated design, incentives for participation, industry-university collaboration and governance. It also offered recommendations for a national, industry-led model based on IMCRC's experience, success, learnings and business model. The issue of research commercialisation is of critical importance to Australia's manufacturing future and the Government should be commended on its prioritisation of the consultation.

The challenges of the last 12 months have had a remarkable impact on the way we live and work. I have been extremely proud of the outcomes our team has delivered, particularly during this past year. It has been a pleasure to work with a close group of experts so invested in every project and engagement, and I am sure I am joined by our industry and research partners in thanking them for their efforts.

Of course, these achievements would not have been possible without the continued support of the Commonwealth along with the guidance of our Chair, the Hon Ian Macfarlane, and our Board of Directors, whose advice proved invaluable throughout 2020/21.

As IMCRC draws to its conclusion at the end of 2022, I am excited for what the future holds for our partners and broader industry. This fiscal year has been about putting strategy and principles into action and, as more IMCRC projects reach completion, I am optimistic about what could be achieved using the IMCRC business model at scale to drive further Australian manufacturing innovation and transformation, particularly with SMEs.

It has been a privilege to safeguard the government and industry funding for the benefit of Australian manufacturing over the last five years, and to have played our role in catalysing substantial research, development and innovation investment that is delivering both impact and outcomes.

David Chuter
CEO and Managing Director

* photo credit: IMCRC

CASE STUDIES

* photo credit: IMCRC

Urban Art Projects (UAP)

Design robotics for mass customisation manufacturing

* photo credit: UAP

The IMCRC has been a catalyst for fundamental change in our business. Without investment in these types of research partnerships, Australian industry will lose all ability to transform and the impact on our global competitiveness will be devastating.

MATTHEW TOBIN
FOUNDER AND MANAGING DIRECTOR, URBAN ART PROJECTS

Brisbane-based Urban Art Projects (UAP) is a design and manufacturing company with design studios around the world that specialises in delivering public art and large creative projects.

With funding from the IMCRC, in 2017 UAP embarked on a design robotics research project in partnership with Queensland University of Technology (QUT) and RMIT University. The aim of the project is to not only reduce the cost of artworks, but also for SMEs to more easily make high-value products and help create export opportunities.

According to Urban Art Projects' Founder and Managing Director, Matt Tobin, the IMCRC-facilitated research project was proof positive that the digital transformation of manufacturing is reinvigorating the sector.

"Industry 4.0 technologies such as the robotics we are integrating into our processes are changing manufacturing, and in turn it changes the profile of people who are attracted to manufacturing," he said.

"The new paradigm is breaking down the traditional barriers that existed between the previously siloed teams and precipitating a shift in what skills are perceived as valuable in manufacturing."

"Our design teams are now fully integrated with our workshop staff - you can't tell the difference between them; we are one team and all invested in the one vision."

For Tobin and the UAP team, the experience with the IMCRC has been a positive one.

"This is our first CRC engagement, and it has been a marked success," he said.

"IMCRC has been incredibly supportive and knowledgeable. We felt we were in safe hands every step of the way with an organisation that truly understands industry."

But what Tobin didn't anticipate was the project's profound impact on UAP's culture that went far beyond the project's technological advancements.

"We knew that bringing such a disruptive technology into what was a very traditional workshop environment would require some adjustment," he said.

"Our strategy to build trust in the project and encourage collaboration within, and across, teams was to empower some of our younger team members with greater input opportunities and decision making responsibilities."

"Through sharing and demonstrating their enthusiasm and passion, the impact was immediate and sparked a new energy for innovation across the whole team as we supported each other on our technological learning curve," said Tobin.

* photo credit: UAP

Stryker

Just in time patient specific tumour implants

* photo credit: RMIT

Our experience working with the IMCRC has changed how we approach innovation globally and was a key consideration in our decision to open a dedicated R&D facility in Australia.

ROB WOOD
SENIOR DIRECTOR OF R&D FOR STRYKER'S DIGITAL, ROBOTICS, AND ENABLING TECHNOLOGIES ORGANISATION

Leading global medical technology company, Stryker, is partnering with RMIT University (RMIT), the University of Technology Sydney (UTS), University of Sydney, University of Melbourne and St Vincent's Hospital in the development of a revolutionary treatment for bone cancers and tumours.

With a total value of more than $18 million in collaborative research effort catalysed by IMCRC, Stryker and its university research partners are combining 3D printing and robotic surgery to create tailored bone implants that deliver better patient outcomes.

Beyond its many technological advancements, the project includes consideration for how the treatment pathway translates effectively into a healthcare system in terms of its integration with patients, clinicians and funding models.

According to Senior Director of R&D, Digital, Robotics, and Enabling Technologies at Stryker, the IMCRC industry collaboration model has had a significant impact on their approach to R&D globally.

"Traditionally, our innovation relationships with universities have been on a contract research basis. Our engagements with Australian universities via the IMCRC have been a game changer."

Aside from the state-of-the-art technologies we are developing here together, probably the largest revelation has been the collaborative spirit, with all parties working together as a close-knit, cohesive team towards our common goal."

Robert Cohen*, President of Stryker's Digital, Robotics, and Enabling Technologies organisation added "not only has this accelerated the innovation process beyond our expectations for the project, but it has made us re-think how we resource, conduct and manage innovation globally."

IMCRC's stewardship role has been invaluable to the project's success.IMCRC is so much more than a research funding mechanism. They bring so much knowledge and experience to the table and, most importantly, they understand the inherent challenges of bringing industry and research collaborations together, and how to overcome them."

Wood confirmed Stryker has made a significant investment to ensure that the IMCRC project's legacy has even more broad and far-reaching consequences.

"Over the last five years we have come to an understanding of how fruitful Australia is for collaboration of this nature," he said.

"A legacy of our experience with the IMCRC and our project partners will be the establishment of a dedicated Stryker R&D lab here in partnership with the Queensland government.

* Robert Cohen is an IMCRC Board Director

* photo credit: RMIT

SuperCool

Smart electric compressor for refrigeration and air conditioning on electric vehicles

* photo credit: SuperCool

It is so important to work with people who understand the challenges and opportunities facing the automotive industry. The IMCRC team understood our project and were engaged with it. This really helped us achieve a successful outcome.

MARK MITCHELL
MANAGING DIRECTOR OF SUPERCOOL

The production of electric vehicles and equipment is advancing globally, but the development of suitable mobile air-conditioning solutions for commercial transport and heavy vehicles has lagged.

To overcome this challenge, SuperCool has used advanced manufacturing techniques to create a smart electric compressor that will meet the technical requirements for future electric vehicles in this sector. In collaboration with Griffith University and IMCRC, SuperCool has developed an intelligent semi-hermetically sealed electric swash plate compressor suitable for the Australian climate and Internet of Things enabled.

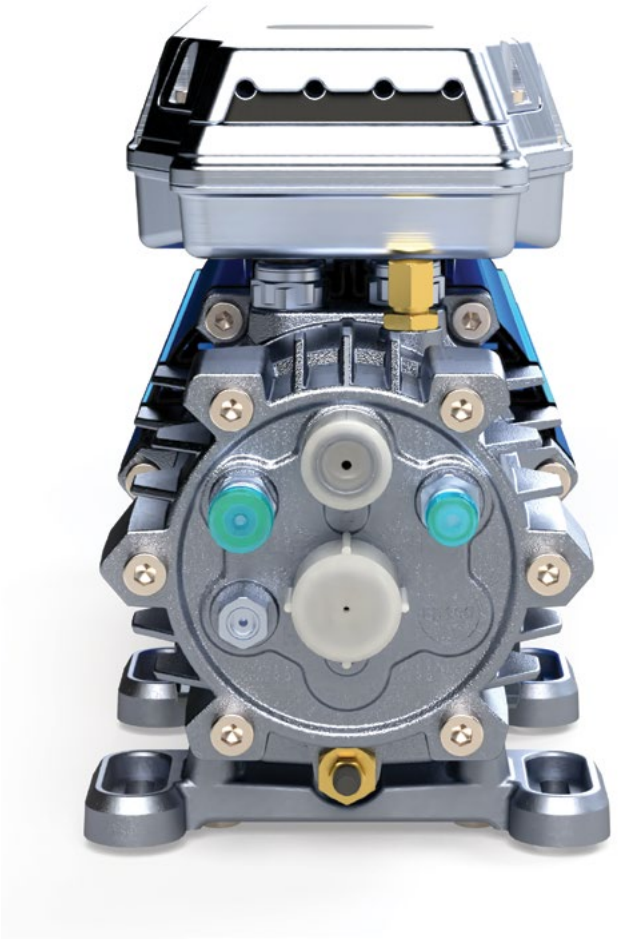
Mark Mitchell, Managing Director of SuperCool, believes working alongside IMCRC has deepened his team's partnership with Griffith University.

"We would never have been able to achieve what we have without the funding from IMCRC and collaboration with the Griffith University mechanical engineering department. Prior to the commencement of the research project, I didn't realise how vital science would be to achieving a research outcome. Our compressor product is a complex, high-energy device, and it was the science that delivered the solution for our project in the end. We wouldn't have been able to achieve these outcomes without the university and IMCRC."

Mr Mitchell also found the project management assistance provided by IMCRC valuable.

"The milestones and meetings set by IMCRC were very helpful. They held us to account, and we needed that diligent discipline to help us work effectively to achieve our goals. Their processes, reporting systems and paperwork are all very straightforward.

As a result of this project, we've created five new jobs and moved from a belt to an electric driven product. We're now an electric vehicle device manufacturer and a firmware company."



* photo credit: SuperCool

UTS Rapido

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

* photo credit: SPEE3D

We know from the projects we have been engaged with them on that IMCRC is great to work with. Based on our experience we regularly recommend IMCRC to potential industry research participants and even facilitate introductions.

HERVÉ HARVARD
FOUNDING DIRECTOR, UTS RAPIDO

UTS Rapido is an advanced technology development unit within the University of Technology Sydney (UTS).

Rapido's initial engagement with IMCRC was through the research collaboration with SPEE3D who had approached UTS to develop 'machine vision' and 3D scanning capability to automate the refining process of its metal 3D printing technology.

It was also the IMCRC's first industry research project.

Currently, UTS Rapido has an IMCRC project in partnership with Mineral Technologies that will revolutionise the manufacture of precision-engineered mineral separation and mining equipment by using additive manufacturing.

For Hervé Harvard, Founding Director of UTS Rapido, it is the IMCRC's stalwart determination to get things done and make an impact for the manufacturing sector at large that sets it apart in Australia's innovation ecosystem.

"We have had two successful projects with the IMCRC to date and, in both cases, we brought the industry participants to them," he said.

"They have an experienced team that instinctively know the right amount of oversight necessary to facilitate the project effectively and optimise the return on investment for all parties."

"This unique mix of rigour and reasonableness makes the IMCRC incredibly easy to deal with, not just for our researchers but for our industry partners as well."

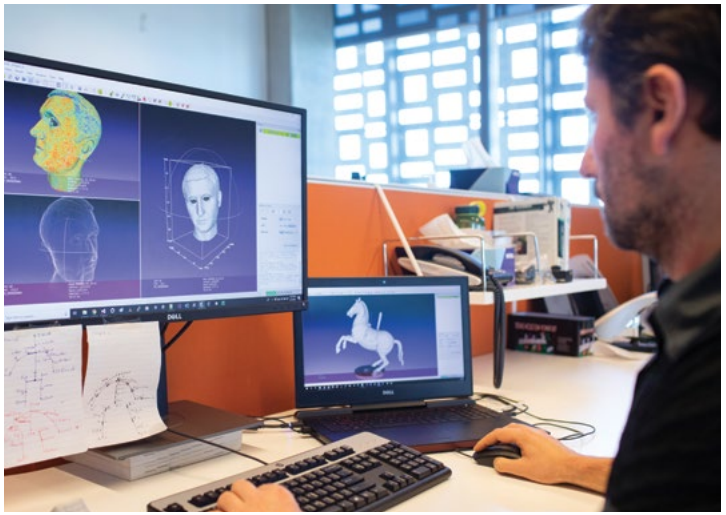
"IMCRC's only agenda is to drive industry 4.0 manufacturing for the benefit of Australia and it will be a significant loss to Australia's industry sector and its future competitiveness to see it come to its natural conclusion."

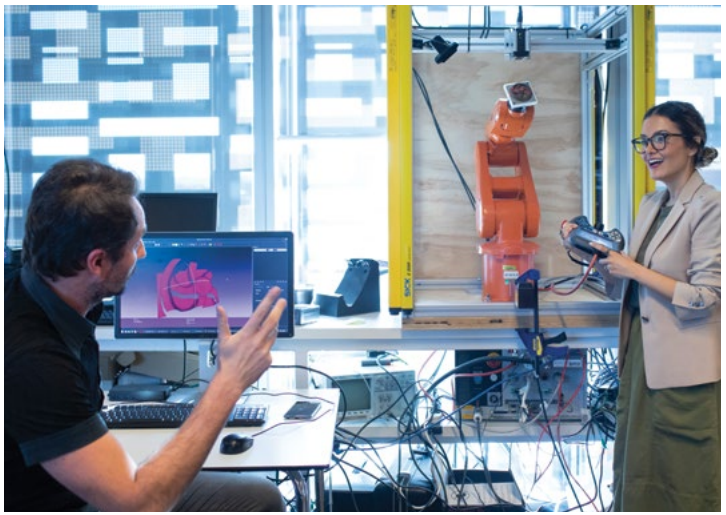
According to Harvard, the two successful IMCRC project collaborations have been instrumental in enhancing UTS Rapido's growth trajectory.

"As a direct result of the research projects, we've been able to develop strong relationships with our industry project partners, which are ongoing and creating even more opportunities," he said.

"At a unit level, we now have a tried and tested advanced technology development capability ready to support Australian manufacturers and the IMCRC projects are best practice case studies of our ability to add value."

"If these two world-class research projects hadn't happened, UTS Rapido would not be the size it is today," said Harvard.





* photo credit: SPEE3D

Mineral Technologies

Revolutionising mineral separation using additive manufacturing

* photo credit: UTS

There's a lot of respect, trust and belief amongst the collaborative design team in delivering this project successfully. We collectively believe in the outcome for the greater good of this environmentally sustainable mobile manufacturing technology.

ALEX DE ANDRADE
GENERAL MANAGER OF MINERAL TECHNOLOGIES

Currently, gravity concentrators (also known as spirals) are cumbersome and capital intensive to manufacture, often exposing operators to chemicals and other hazards.

In 2018, Mineral Technologies, a Downer Company, partnered with IMCRC and the University of Technology Sydney (UTS) to research solutions that will revolutionise how composite polymers are used to manufacture precision-engineered mineral separation equipment and other mining components, using additive manufacturing.

According to Mineral Technologies General Manager Alex de Andrade, as the project progressed, it became clear that additive manufacturing consumables had a substantially higher cost than the traditional spraying and casting polyurethane methods.

"We currently produce more than 600 containers a year filled with similar products, which customers then ship all over the world from Australia, creating a huge CO_2 carbon footprint by burning fuel in transit. By converting the production cell (printer) to something that can travel, this will allow us to have 10 or 20 printers traveling a year rather than 600 containers. It is important to us to consider not just the cost of manufacturing the product but look holistically, from order to commissioning costs and the savings on the environment that our customers can benefit from when adopting this technology."

De Andrade said that while Mineral Technologies has had many years of experience working with universities on research and development projects, he was impressed by the level of collaboration, respect and dedication to this project's end goal.

"We went through some difficult lockdowns and experienced delays on critical imported parts, but the UTS and IMCRC teams had a lot of mutual respect and understanding. The contribution from UTS has been equal to that of Mineral Technologies, as if they were in the business and it was as important for them as it was for us.

"IMCRC also helped us as a business understand and determine our technology roadmap and directive by setting a business vision for collaboration, advanced manufacturing and IoT adoption. The CRC's early guidance and stage gates for the project allowed us to fail safe. Their networking advice and introductions to other businesses also meant we were able to make industry connections that would not have been possible on our own."

* photo credit: UTS

Whiteley Corporation

A novel approach to biofilm disruption and removal

* photo credit: Whiteley

The IMCRC's approach is an innovation pathway that really facilitates collaboration. All parties to the project know their role and responsibilities and we are all singularly focussed on achieving the desired commercial outcomes together.

DR GREG WHITELEY
EXECUTIVE CHAIRMAN, WHITELEY CORPORATION

New South Wales-based Whiteley Corporation (Whiteley) is Australia's largest manufacturer of sterilants, disinfectants and healthcare cleaning technologies.

In 2018, Whiteley, the University of Sydney and IMCRC announced a $5 million-plus manufacturing research partnership for the development of new therapeutic treatments for biofilm mediated infections.

UNSW joined the project in 2020, bolstering the research capacity and significantly increasing the project's ability to develop and commercialise a series of combination therapies.

For Whiteley's Executive Chairman, Dr Greg Whiteley, the IMCRC's project management framework is an exemplar for industry research partnerships.

"We have 30 years' experience collaborating through a range of different university co-funded grants, so we were already comfortable collaborating in the tertiary institution space," he said.

"We found the IMCRC's framework to be highly effective and conducive to engendering collaboration between the partners."

"The connectivity between the project funding partners works really well."

"The IMCRC model removed a lot of the normal complexities around the relationship between the industry partner and research institute, which meant everyone was an equal participant and focussed on commercial outcomes from the very beginning," said Whiteley.

According to Whiteley, another benefit of the IMCRC's approach was the continuity of maintaining the researchers for the life of the project.

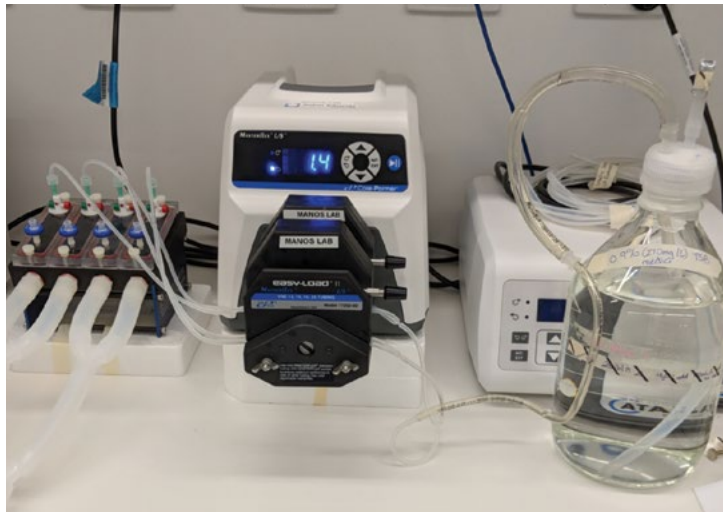
"While many research grant and co-investment programs are short term, one of the strengths of this project is that it has been structured so that our PhD students see the project right through with us, which we believe will ultimately deliver better outcomes for all parties," said Whiteley.

With Australia's economy so heavily weighted toward the SME sector, Whiteley believes the accessibility of the IMCRC collaboration model could help to drive the national manufacturing agenda post COVID-19.

"Traditionally, industry research partnerships have been heavily weighted toward the research institution and bogged down in disagreements around IP," he said.

"If we are to unlock the innovation potential in our manufacturing sector we need to make it easier for SMEs to engage in commercial outcome-focused research with our world-class universities.

"It is critical we not only encourage but facilitate such collaboration as the transformation of our manufacturing sector with industry."



* photo credit: Whiteley

Carbon Revolution

Industrialisation of composite wheel technology

* photo credit: Carbon Revolution

To maintain our competitive advantage we are locked into a perpetual high-performance development journey, and our IMCRC project with Deakin University has been instrumental in accelerating our progress on that continuum.

DR ASHLEY DENMEAD
ENGINEERING & DESIGN DIRECTOR AND FOUNDER OF CARBON REVOLUTION

In 2018, carbon fibre automotive wheels pioneer Carbon Revolution and Deakin University formed a $15 million research and development (R&D) partnership facilitated and part-funded by the IMCRC.

The three-and-a-half year project saw multiple streams of materials and process improvement R&D brought under the one umbrella agreement with access to Deakin's core materials science and engineering capabilities.

According to Dr Ashley Denmead, Carbon Revolution's Engineering & Design Director and Founder, the IMCRC project was notable for its seamless integration into Carbon Revolution's operations as much as the innovations it delivered.

"All of the Deakin researchers employed by the project were based onsite and fully integrated into our teams," he said.

"As our R&D program was very much focused on achieving commercial outcomes, the full immersion of researchers within our engineering, development and process engineering teams worked extremely well."

"Maintaining a capability edge is fundamental to our business and we were able to achieve far more than we expected over the life of the project," said Denmead.

Denmead said he believed IMCRC's facilitation of the project struck the right balance of oversight and reporting requirements while ensuring the multiple innovation streams remained on track.

"IMCRC's deep understanding of the realities and pressures we face as an export-led manufacturer ensured we were able to form a strong partnership from the beginning," he said.

"Their ability to facilitate the project efficiently and effectively without getting too involved allowed us to remain focused on the research outcomes and was a contributing factor to the project's success."

For Denmead, the project has had an immediate impact on his business, with significant commercial benefits likely to be felt for some time as a result.

"This is the longest and largest research project we have undertaken and by far our most successful one," he said.

"We have been so impressed with the collaborative approach and what we were able to achieve from an innovation standpoint we employed many of the project researchers directly into the business at the conclusion of the project."

"IMCRC's ability to leverage value and drive research collaboration to achieve commercial outcomes is extremely powerful and we need more of it, and at scale, if Australia's manufacturing sector is to thrive in the future," said Denmead.

* photo credit: Carbon Revolution

Codex Research

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

* photo credit: Codex

I am proud of the progress we've made and the fact we've been able to operate as a single team with a single purpose, despite the multiple stakeholders involved.

EDWIN BRACKENREG
CEO OF CODEX RESEARCH

Cardiovascular disease is a major cause of death, not just in Australia. To effectively treat the disease, new, more versatile vascular graft materials are needed. With the support of IMCRC funding, Codex Research has partnered with the University of Sydney to develop an advanced perfusion bioreactor technology that mimics biological environments in vitro – in this instance the human vasculature – to facilitate material research of vascular grafts. The project aims to radically change the way bioscience research is conducted going forward.

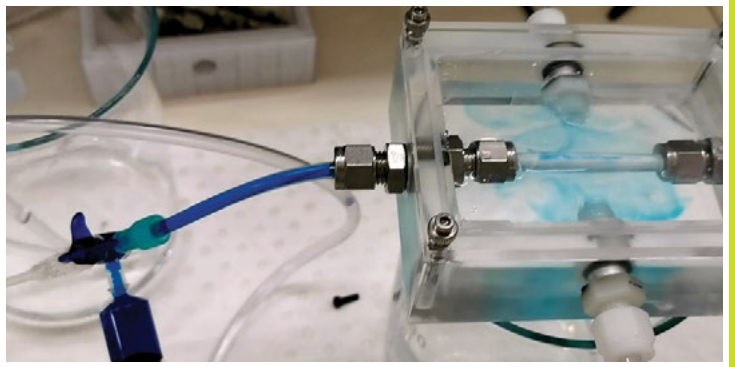
According to Codex Research CEO Edwin Brackenreg, to succeed in bringing the bioreactor technology to market, Codex required an injection of capital and expert-led research.

Brackenreg believed the business "needed to validate our novel technology with a great deal of expertise. Partnering with IMCRC allowed us to collaborate with the University of Sydney, which has the required expertise in this area. We've been able to access experts that we wouldn't have otherwise be able to engage with our limited resources".

"Thanks to the expertise of the scientists and academics, we achieved very interesting results from a much simpler device than we originally thought we would have to design and make. For example, we have achieved a proof of concept that goes beyond anything that can be replicated in a petri dish," Brackenreg said.

"The technology will push the boundaries of human biology and move the needle of diseases that we know how to cure. This means that our minimum viable product is going to be much easier to produce than expected.

As well as facilitating the research-led innovation project, Brackenreg noted that the IMCRC team "has had an enormous impact. They are going above and beyond to assist us in developing the manufacturing strategies we need to embrace Industry 4.0".



* photo credit: Codex

Lava Blue

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

* photo credit: QUT

This project has allowed us to focus on fundamental research and explore things that have never been done. The results have the potential to catalyse a billion-dollar industry in Australia over the next decade.

MICHAEL MCCANN
MANAGING DIRECTOR OF LAVA BLUE

As global demand for the chemically inert ceramic material, high purity alumina (HPA) rises, Lava Blue is using machine learning and automated manufacturing techniques to transform the way it is produced.

The high-value material is critical for the production of many household technology items such as LED lighting, electronic displays, semiconductors, lithium ion and aluminium batteries.

In collaboration with Queensland University of Technology (QUT), and with the support of IMCRC funding, Lava Blue's research is focused on developing a resilient, agile and highly competitive manufacturing process to transform kaolin, an aluminium-bearing clay, into HPA.

Having worked with universities and other research organisations on other projects, Michael McCann, Managing Director of Lava Blue, has found his first experience working with a cooperative research centre to be a positive one.

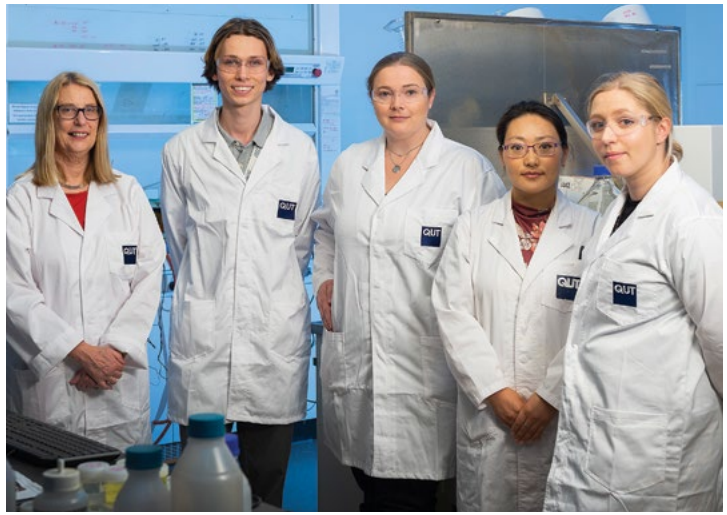
"When you're conducting research, you need to be flexible so you can update, refine and redirect resources and change the shape of the program as needed to achieve a better outcome. Originally, there were concerns that the constraints of reporting, management requirements and legal arrangements around using Commonwealth funds in combination with private money would impact on our flexibility.

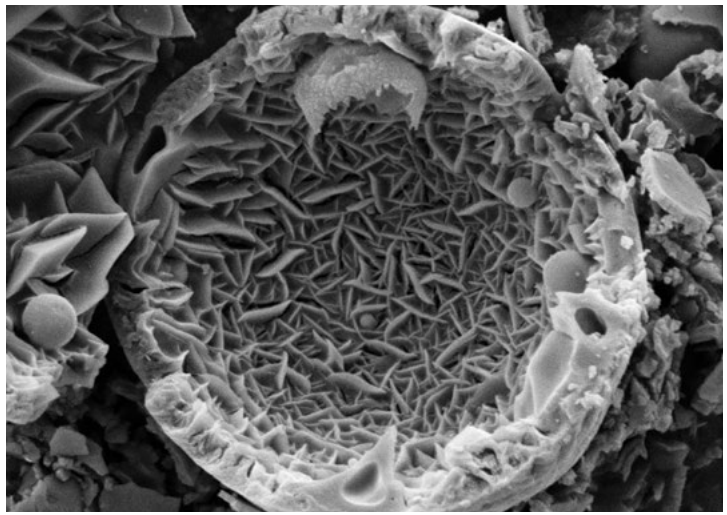
However, IMCRC has been completely open to redesign based on discovery and have also been willing to allow us to do what we see best.

This approach has been not only supportive but has also allowed the team to be aggressively risk taking in the research directions and frank and fearless in reporting. As a result the project partners have been extraordinarily productive in opening avenues for investigation and been ready to close down dead ends while focussing on the discoveries of relevance."

McCann notes one of the most valuable aspects of the collaboration has been the opportunity to work with a world-class research partner. He believes sharing knowledge and resources with QUT has catalysed true innovation.

"The best outcome of this project so far has been the skilled cohort of young researchers that we had access to through QUT. The team of analytical, industrial and process chemists are some of the best in the world in this field. The additional IMCRC funding has allowed us to pursue two and half years of fundamental research, which is very rare. We've been able to make some tremendous breakthroughs."





* photo credit: QUT

Hazer

Developing and optimising advanced carbon materials

* photo credit: Hazer

IMCRC understands research is not a linear process. Their accessibility and flexibility has ensured the project's success, while their ability to challenge our thinking and open doors has been invaluable to Hazer Group as an early stage company.

DR ANDREW CORNEJO
CO-FOUNDER AND CHIEF TECHNICAL OFFICER, HAZER GROUP

A pioneering ASX-listed technology development company, in 2019 Hazer Group Limited was awarded matching IMCRC funding to support its successful R&D collaboration with the University of Sydney's School of Chemical and Biomolecular Engineering into advanced carbon materials applications.

Specifically, the project would accelerate the commercialisation of the HAZER® Process, a low-emission hydrogen and graphite production process focusing on applications including Li-ion batteries, water purification, and various energy storage products.

According to Hazer Group's Co-founder and Chief Technical Officer, Dr Andrew Cornejo, IMCRC's streamlined approach to facilitation minimised the project administration while still maintaining rigour.

"As an early-stage company with a big vision, we need to maximise the R&D impact of every dollar spent," he said.

"IMCRC understood this from the very beginning and, as well as their eagerness to facilitate, they constantly sought to add value to the project and Hazer beyond just the provision of funding."

"Whether it was helping us to understand the potential of Industry 4.0 technologies for our business, or opening doors to other industry contacts with complementary capabilities, the team at IMCRC were invested in our success," said Cornejo.

With the project now nearing completion, Cornejo points to new capital investment and the potential for further collaborations as indications of its success.

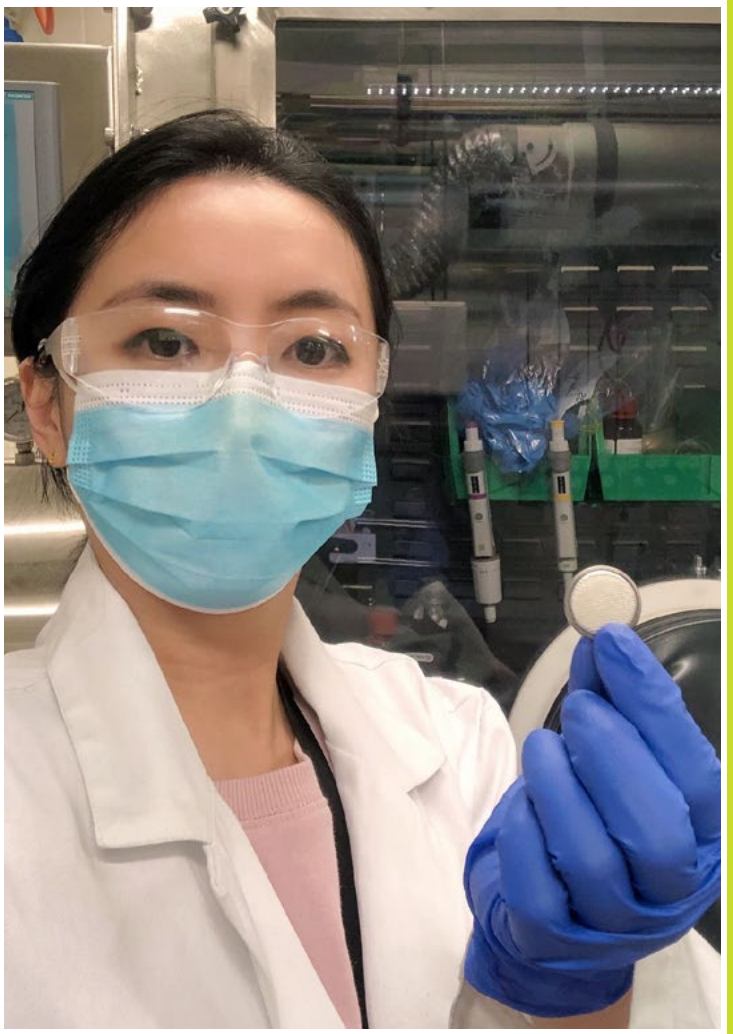
"As a direct outcome of this project we are progressing engineering studies of selected breakthroughs for further development through to demonstration plant scales." he said

"We're also looking at the potential for another short-term research project with the IMCRC."

Looking further into the future, Cornejo believes continued investment in innovative manufacturing will be critical if we are to retain the best talent and ultimately reduce Australia's reliance on "dig and ship it" industries.

"Funding for industry research collaborations is key, but unless we can create attractive, sustainable career opportunities here in Australia we will lose our best and brightest," he said.

"Focussing our R&D efforts on those areas where you can cut significant complexity from a production process and then develop innovative manufacturing and assembly capacity around it, will allow Australian companies to move forward globally."



* photo credit: Hazer

BAE Systems Maritime Australia

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

The application of interactive narrative visualisation and big data to improve high value manufacturing

* photo credit: Flinders

While the impact of the research projects on our capabilities is highly visible and tangible, we recognise that the engagement with IMCRC also yields benefits for our broader organisational culture through the highly collaborative processes and reinforcement of an innovation mindset.

SHARON WILSON
CONTINUOUS NATIONAL SHIPBUILDING DIRECTOR, BAE SYSTEMS AUSTRALIA

BAE Systems Maritime Australia's partnership with IMCRC includes two distinct research projects for the Hunter Class Frigate Program:

- a research project with Flinders University that involves local small and medium enterprises (SMEs) and focuses on driving digital transformation through advanced robotics, assistive manufacturing and readiness for Industry 4.0 utilisation.
- a data visualisation research project with the University of South Australia.

According to Sharon Wilson, BAE Systems Australia's Continuous National Shipbuilding Director, the IMCRC-facilitated projects are a benchmark for industry research collaboration.

"As a key enabler of the Government's vision for sovereign defence capability, we have a responsibility to drive innovation in manufacturing and engage with Australian research and industry partners on that journey," she said.

"Our engagement with our research and industry partners through the IMCRC has made a significant impression on multiple areas of our business, at both technical and non-technical levels."

That sentiment is echoed by Evangelos Lambrinos, BAE Systems Australia's Export and Innovation Manager (Hunter Class).

"The collaboration between all research and industry partners across the projects has been outstanding," he said.

"In the past, project research and industry teams were siloed. But, no more."

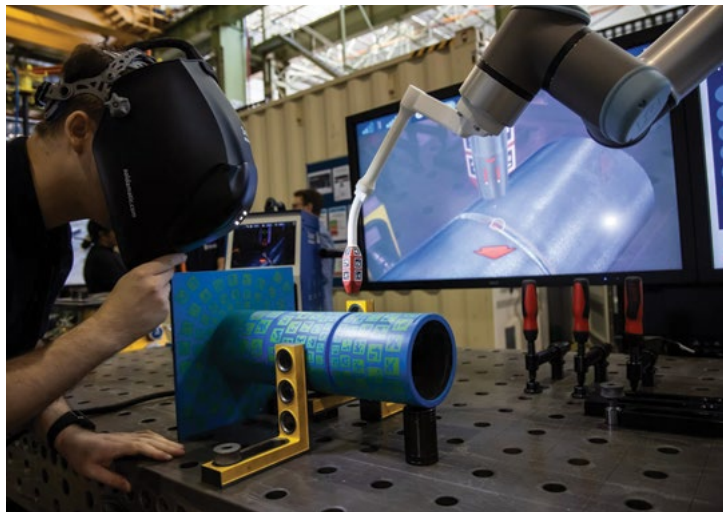
"The integration of the researchers into our sites has been seamless – a true collaboration built on mutual respect and a shared vision of what we want to achieve together."

While the research projects are still underway and their full outcomes yet to be determined, for Wilson their legacy is assured in the world-class ship building capability they have helped to develop.

"These IMCRC projects have redefined the role of research collaboration and leadership in an industrial environment," she said.

"Our ability to engage our workforce and SME partners on emerging Industry 4.0 technologies and show them not only the art of the possible but, more importantly, how they are central to our transformation has been a game changer."

"Meanwhile, our ability to share our data visualisation research with the wider industry, including our SME partners, has strengthened those relationships – which will no doubt translate into further opportunities for collaboration."



* photo credit: Flinders

Alcolizer

Rapid point of care SARS-CoV2 detection, using a sensitive antigen screening test

* photo credit: UTS

Thanks to the focus and collaborative nature of this research project, once the product is fully commercialised it will create three times as many jobs as we can currently offer and generate three times as much revenue for the business.

ROGER HUNT
GENERAL MANAGER OF ALCOLIZER

In the face of the global health pandemic, testing continues to be a vital component of managing the spread of COVID-19. Typically, polymerase chain reaction (PCR) tests are used to detect the virus, but they take several hours to deliver a result and require the assistance of trained scientists and specialised laboratory equipment.

Using existing manufacturing expertise and drug testing application technology, Alcolizer, in partnership with the University of Technology Sydney (UTS), has been developing a cost-effective COVID-19 test that can detect SARS-CoV-2 virus antigens in under 15 minutes while providing the same levels of detection as a PCR test.

Being the first project to be funded through IMCRC's activate initiative, the UTS research collaboration focused on advancing the design and testing of the rapid saliva test prototype to accelerate its commercialisation.

The test device will also be GPS-enabled and connected to cloud reporting tools, offering authorities assistance with contact tracing.

With the ability to provide much needed health, social and economic benefits to Australians, efficiency throughout the research project was paramount for fast-tracking the product to market.

General Manager of Alcolizer, Roger Hunt, noted that the IMCRC activate project was "the simplest and most efficient grant process we've been involved in."

"The IMCRC team understood the time sensitive nature of this approval process, so it was a simple process that moved along at a rapid pace," he said.

"We were able to scale up and start transitioning the idea from a research project out to a manufacturable, commercially viable product quickly. In six months, we successfully documented all operating procedures and processes and developed a prototype along with several hundred test cartridges."

Hunt also found the project focus on commercialisation, instead of on academic research outcomes, provided opportunities for Alcolizer.

"The project attracted two of the top scientists from the university because they wanted to move beyond research to commercialising and completing a product and getting it to market," aid Hunt.

"Additionally, we created higher education opportunities within Australian manufacturing R&D. The research project funded six post doctorates, allowing students to interact weekly with the commercial manufacturing world and providing them with an opportunity to understand how the industry operates."

* photo credit: UTS

Rux Energy

Scaling up high-performance hydrogen storage metal organic framework (MOF) materials manufacture for field trial prototypes of Hydrogen (H2) storage systems in heavy trucking and hydrogen hubs

* photo credit: IMCRC

I am incredibly proud of what we have achieved in a short amount of time with this project. What began as a $100,000 investment has led to more than $4 million being invested over the next three years. I hope this is the kind of story that will inspire others to explore what is possible.

DR JEHAN KANGA
FOUNDER AND CEO OF RUX ENERGY

Currently, the inability to store hydrogen gas (H2) efficiently is a key barrier to its uptake as a zero-carbon fuel. Rux Energy, in partnership with the University of Sydney, has developed new metal organic frameworks for the high-performance adsorption of H2.

According to founder and Chief Executive Officer Dr Jehan Kanga, the Rux Energy project is expected to accelerate the adoption of Green H2 as a low-cost zero carbon energy carrier in heavy and long-distance electric vehicles and solve systemic inefficiencies for H2 refuellers and exporters.

"Ultimately, the goal is to deliver game-changing volumetric efficiency for dispatchable hydrogen tanks, bringing down the end-user cost of green hydrogen," he said.

"Our objective is to take this material and integrate it into field-ready tank prototypes for trials and testing with SME and large industry partners in 2022."

The project commenced in 2021 as part of IMCRC's activate program, which offers manufacturers access to research and development expertise and matched cash funding between $50,000 – $100,000 for shorter-term, high impact research projects.

"IMCRC's activate program provided us with enough early-stage funding to invest in additional post doctorate resources from the University of Sydney in our first year," said Dr Kanga.

"Working together, we were able to progress development around materials to improve the gas sorption uptake and discover how to pelletise and manufacture them at scale."

Dr Kanga said while funding was key, so too was the support received throughout the project.

"I think the real impact was around the focus. The IMCRC team provided a lot of support throughout the application stage and beyond, helping us set milestones that have proven very useful for us and our research partners," they said.

"IMCRC encouraged us to be ambitious, yet realistic about what we could achieve in 12 months. This meant we didn't take on too much. They also provided us with mentoring, regular check ins and catch ups, which allowed us to benefit from their experience and avoid reinventing the wheel."

"We are on an incredible trajectory at Rux Energy. I am proud of what we have achieved to date and excited about what the future holds."

INNOVATIVE MANUFACTURING CRC (IMCRC)

* photo credit: IMCRC

Who we are

The Innovative Manufacturing CRC (IMCRC) is an independent and for-impact cooperative research centre that helps catalyse the transformation of Australian manufacturing.

By investing in research-led innovation in manufacturing products, processes and services, we bring together forward-thinking businesses and some of Australia's best universities and the CSIRO to collaborate, address pressing industry challenges and develop solutions that lead to commercial outcomes – helping those involved to scale up, transform their business operation and become more competitive and resilient.

Since our inception in 2016, we have been working with start-ups, small, medium, large and multinational manufacturing companies across all primary industry sectors – defence, mining equipment and resources, medical technologies and pharmaceutical, building and construction, energy, transport, and others – to establish pathways that help them:

- invest in new ideas, emerging technologies, research and development (R&D) and innovative business models
- connect and collaborate with scientists and researchers to solve industry-specific problems and identify solutions that translate into commercial outcomes
- improve manufacturing expertise and capabilities to move up the value chain
- discover new business opportunities that strengthen partnerships and expand into different supply chains and markets in Australia and around the world
- attract and develop new manufacturing talent to future-proof their operations
- focus on transformation and commercialisation to boost their productivity, scale, and competitiveness

To date, we have purposefully invested $33 million of Commonwealth and other funding to advance Australian manufacturing, catalysing more than $220 million in collaborative research, manufacturing innovation and education across Australia.

With Australian manufacturing being critical to a modern Australian economy, we want 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 design, make and sell new products, services and solutions to a global market.

What we do

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.

What we value

Purposeful investment

Applying commercial rigour and good business practices that ensure high-impact outcomes from the transformative projects and partnerships we invest in.

Industry-led focus and collaboration

Building strong partnerships between industry and research organisations with open, respectful conversations that inspire bigger thinking and leverage 'collective genius' to strengthen Australian manufacturing.

Bold entrepreneurship

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

Inspirational yet humble leadership

Combining experience and expertise to deliver positive impact that is needed to bring about industrial transformation. Prepared to question the norm, find better solutions and drive outcomes.

Passionate advocacy

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

Our Team

Through open and respectful conversations, IMCRC's management team and staff connect and collaborate with industry, research organisations, government and the wider manufacturing community.

The full-time employed IMCRC management team and staff are detailed right:

In FY 2020-21, IMCRC also engaged in full or part-time capacity:

Mr Rohann Chapman –
Industrial Transformation Program

DAVID CHUTER
CEO AND MANAGING DIRECTOR

DR JASON COONAN
CHIEF OPERATING OFFICER AND DEPUTY CEO

DR MATTHEW YOUNG
MANUFACTURING INNOVATION MANAGER

SIMON DAWSON
INDUSTRIAL TRANSFORMATION DIRECTOR

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

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 DAVID CHUTER
MANAGING DIRECTOR (AND CEO)

PROFESSOR MARY O'KANE, AC
INDEPENDENT DIRECTOR

DR ALEXANDER GOSLING, AM
INDEPENDENT DIRECTOR

MR INNES WILLOX, AM
NON-INDEPENDENT DIRECTOR
(INDUSTRY NOMINEE)

MR SIMON MARRIOT
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)

DR JENNI LIGHTOWLERS
ACTS AS IMCRC COMPANY SECRETARY

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

HEIQ
CADwalk
UAP
SPEE3D
BLUGLASS
TRADIEBOT
Corin
RUAG
Mineral Technologies
Whiteley Corporation
CARBON REVOLUTION
Allegra ORTHOPAEDICS
TITOMIC
vaxxas
MONITUM
Codex RESEARCH
xefco
ESN CLEER
LAVA BLUE
VERTON
HazerGroup
Neometals
BAE SYSTEMS Maritime Australia
Nutromics
TELIX PHARMACEUTICALS
LPI
BORAL
Melbourne Water
LASERBOND PRODUCTIVITY | INNOVATION | CONSERVATION
energy renaissance
ROMAR Scalable Manufacturing Solutions
Alcolizer
bnnt TECHNOLOGY LIMITED
QUEST SEMICONDUCTORS
FormFlow
Australian Red Cross Lifeblood
HYDAC
AML3D
The Remediation Group we do the groundwork
RUX energy
gTET
BiomeBank
AUSDRILL
CABLEX

Research

CSIRO
UTS
The University of Sydney
Griffith University
RMIT University
QUT
Swinburne University of Technology
Flinders University
Deakin University
University of South Australia
The University of Melbourne
UNSW Sydney
St Vincent's Hospital Melbourne

Other

Ai Group
Industry 4.0 Advanced Manufacturing Forum
APR Intern
ARM Hub
MTP Connect
prefabAUS
AMGC Advanced Manufacturing Growth Centre Ltd
AMTIL
South Australia
Government of South Australia Department of State Development
Fraunhofer
Callaghan Innovation

CHAMPIONING MANUFACTURING INNOVATION

* photo credit: Griffith

Championing Manufacturing Innovation

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

With the announcement of the $1.5 billion Modern Manufacturing Strategy in October 2020, Prime Minister Scott Morrision shone a spotlight on Australia's manufacturing sector.

Acknowledging that a resilient and competitive manufacturing sector is key to leading Australia's post COVID recovery and driving the economy forward, he introduced the Government's action plan to create the right incentives, partnerships, and business environment to help Australian manufacturers scale-up, by translating their ideas into commercial successes and integrating those into local and international value chains.

Accelerating innovation

As a champion for manufacturing innovation and transformation, IMCRC has established and proven an "innovation framework" for helping manufacturing businesses of all sizes across the country connect and build trusted research partnerships with Australia's leading universities and the CSIRO. By driving collaborative investment, research impact and innovation, IMCRC has supported more than 60 industry-led projects, across four research programs, that explore, develop and commercialise technologies and business models that address industry-specific problems. These projects are delivering transformational research and commercial outcomes for Australian manufacturing, enabling the sector to meet the challenges and opportunities of today's global economy.

IMCRC supports four multidisciplinary research programs that comprise of 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. These research programs are:

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

In FY 2020-21, IMCRC successfully managed a portfolio of 49 innovative manufacturing projects, meeting all its agreed Commonwealth research program milestones. With 'activate', IMCRC created a new funding program to support manufacturing businesses, particularly manufacturing SMEs, to

ADDITIVE MANUFACTURING PROCESSES

AUTOMATED AND ASSISTIVE TECHNOLOGIES

HIGH-VALUE PRODUCT DEVELOPMENT

INDUSTRIAL TRANSFORMATION

accelerate their COVID-19 recovery. Since launching the program in June 2020, IMCRC has invested more than $2 million in 25 shorter-term, high-impact research and development (R&D) collaborations spanning multiple industry sectors.

Out of 19 new research projects that commenced during the reporting period, 14 were activate projects, enabling SMEs to harness university expertise and address key challenges within their businesses, through the uptake of emerging technologies and new business models.

Safeguarded by IMCRC's proven project governance framework, which aligns industry, research and other supporting partners at each step of the project, especially in terms of research and commercial outcomes, the majority of IMCRC's projects have progressed without any significant technical or scientific impediments to impact their research collaboration. Five (5) projects were successfully completed, including the first activate project, taking the total completed IMCRC projects to 8. Unfortunately, due to the disruption of COVID-19 and other business priorities emerging, 3 of IMCRC's industry partners changed their investment strategy and elected to withdraw from their CRC project.

The research progress of several projects has been published in peer reviewed journals and conference papers*. IMCRC's 'Design Robotics for Mass Customisation' project was recognised for its achievement in addressing the gap between innovation in digital design and the realities in manufacturing by receiving the Cooperative Research Centre Association's 2020 Award for Excellence in Innovation.

Please note that the report references the details for each project, which are based on contractual agreements in place as at 30 June 2021 and does not include subsequent project variations.

* See Appendix

Icon Reference

Primary Industry Sector

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

Key Enabling Technology

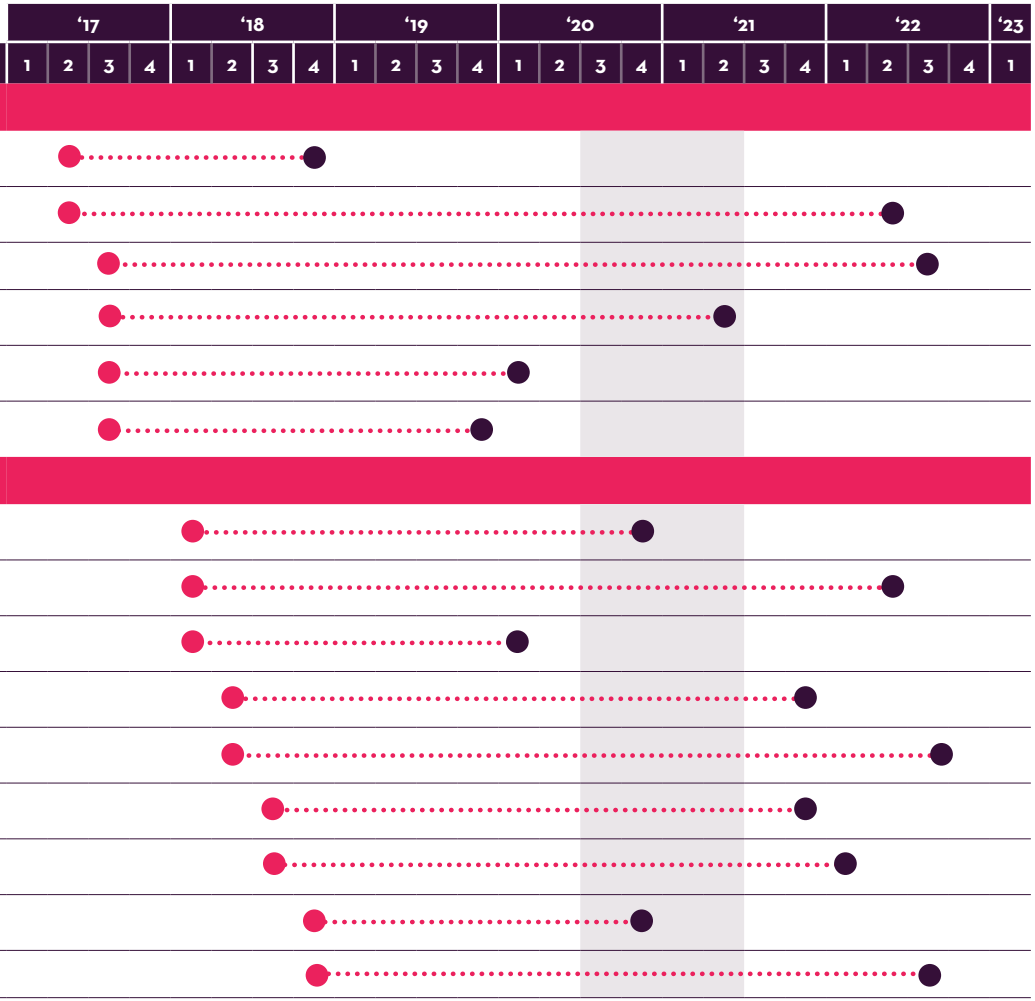
- Additive Manufacturing
- Advanced Materials
- Augmented and Virtual Reality
- Smart Robotics and Automation
- Sensors and Data Analytics

Project Status

- Start
- Completed
- In Progress
- Withdrawn
- Media

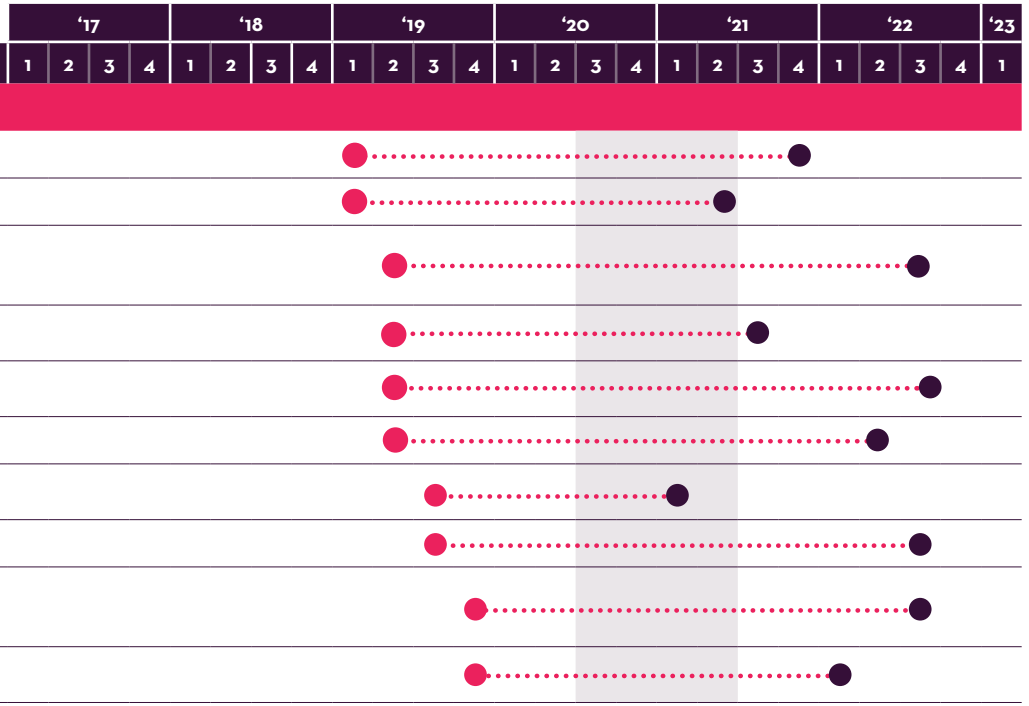
Research projects in FY 2020-21

#	Program	Industry Partner	Project Title
CY 2017			
1	I	SPEE3D	Machine vision for Industry 4.0 high-speed 3D printing
2	II	CADwalk	Visualisation tools for the design of manufactured high-end instrumented facilities
3	I	Stryker Australia	Just in time patient specific tumour implants
4	II	UAP Australia	Design robotics for mass customisation manufacturing
5	III	SuperCool	Smart electric compressor for refrigeration and air conditioning on electric vehicles
6	III	BluGlass	High performance normally OFF GaN High Electron Mobility Transistors (HEMT)
CY 2018			
7	II	Tradiebot Industries	Tradiebot
8	III	Corin (Global Orthopaedic)	Antimicrobial nanosurface for orthopaedic implants
9	I	RUAG Australia	Application of additive metal technology to operational aircraft
10	I	Mineral Technologies	Revolutionising mineral separation using additive manufacturing
11	III	Whiteley	A novel approach to biofilm disruption and removal
12	III	Carbon Revolution	Industrialisation of composite wheel technology
13	III	BLT, Allegra	Xenograft using kangaroo tendon as substitute for ligament reconstruction
14	I	Titomic	Additively manufactured titanium complex structures
15	III	Vaxxas	Innovative vaccine delivery technology



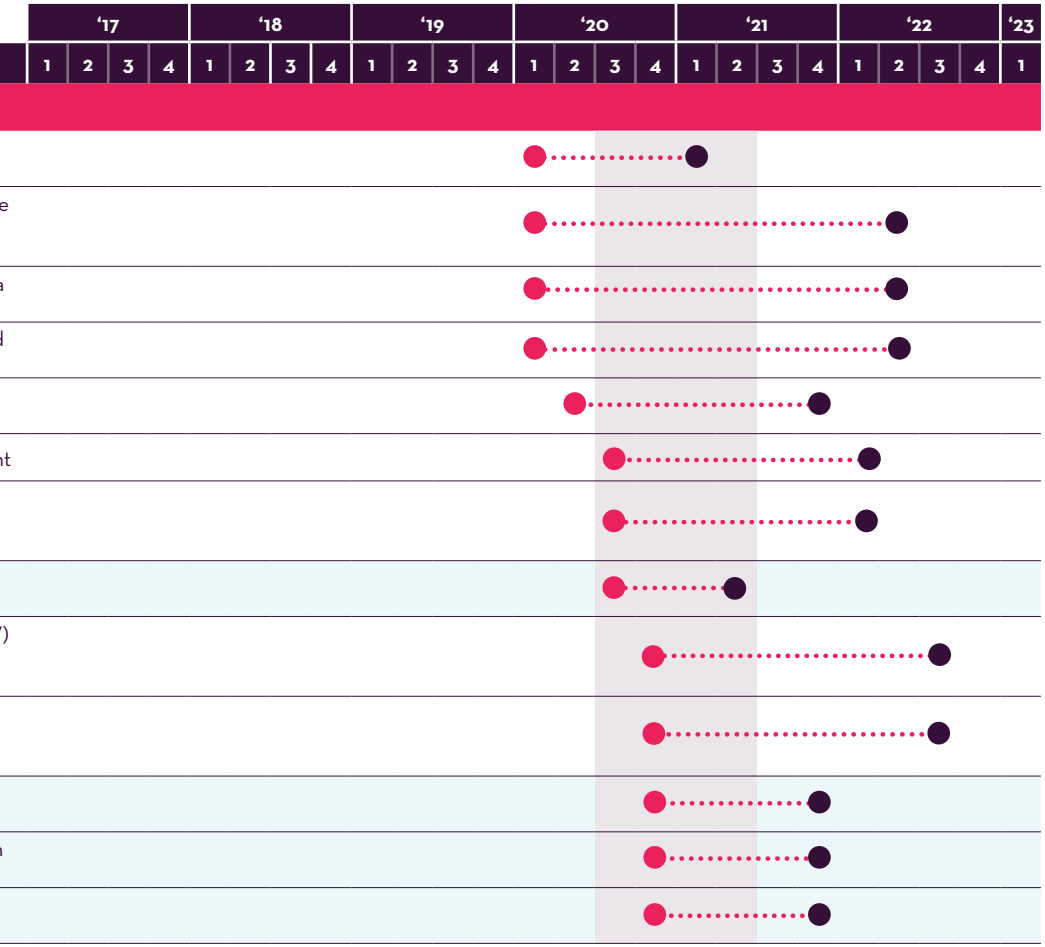
Financial Year IMCRC activate Project commenced Project completion

#	Program	Industry Partner	Project Title
CY 2019			
16	IIII	SleepCorp	A novel virtual manufacturing system approach
17	III	Speedpanel	Manufacture of the next generation Speedpanel
18	III	MTHING	Automated monitoring and analytics for geotechnical and structural performance using the internet of GNSS things
19	I	SPEE3D	Automated part repair using 3D scanning and supersonic 3D deposition
20	III	Codex	Engineering an advanced, high value bioreactor system for research and clinical applications
21	III	Xefco	Atmospheric plasma coating system
22	III	ESN Cleer	Preventing heart attacks with nanotechnology-enabled biomarker sensors
23	III	Lava Blue	Value adding Australian minerals
24	III	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



Financial Year IMCRC activate Project commenced Project completion

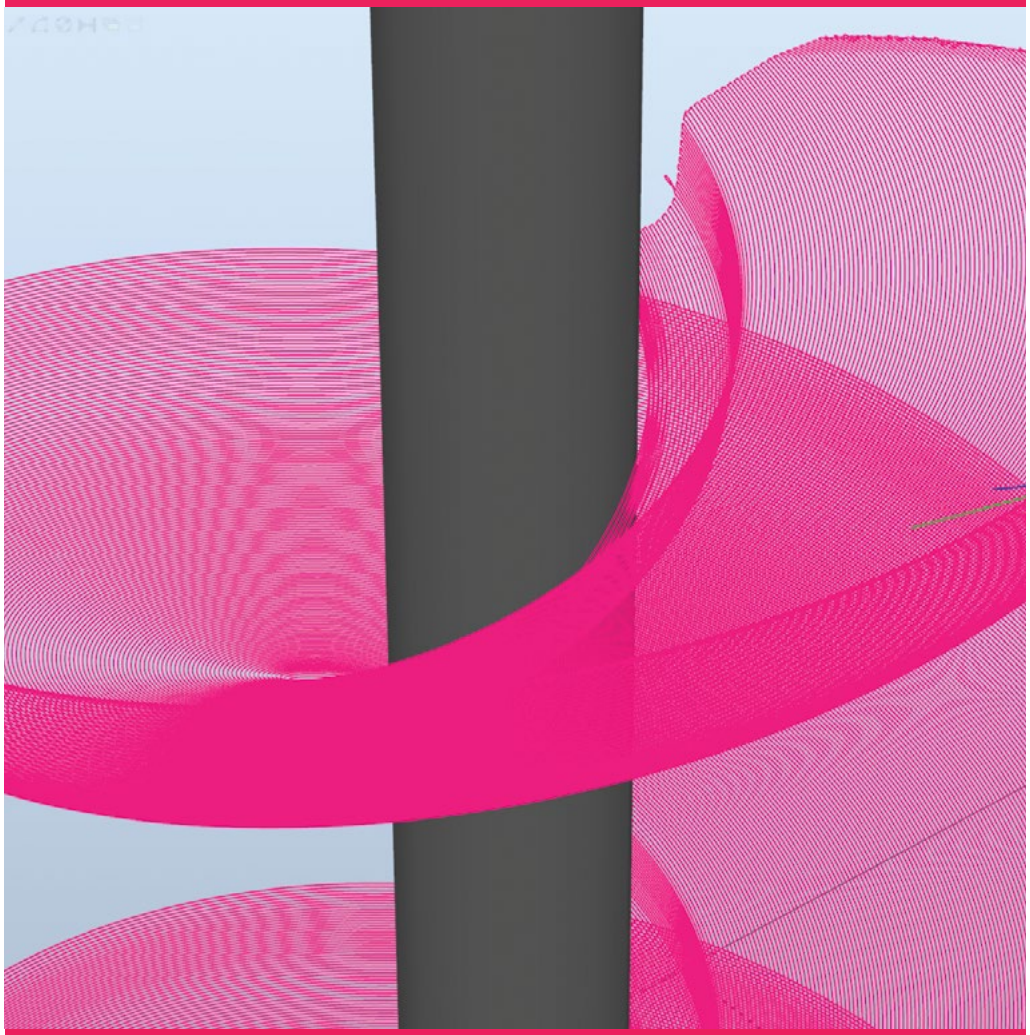
#	Program	Industry Partner	Project Title
CY 2020			
26	III	Neometals	Design and development of a work cell for the robotic folding of whole blood donation packs
27	IIII	BAE Systems Australia	Accelerating the uptake and diffusion of innovative manufacturing technologies in Australian shipbuilding and supply chain: the human factor
28	IIII	Nutromics	R2R printing for cost effective manufacturing of a smart patch for health monitoring
29	III	Telix	Centralised manufacture of Molecularly-targeted Radiation (MTR) drugs for cancer treatment
30	III	LPI	Smart coatings for the next generation of lightning strike protection devices
31	III	Boral	Ultra sustainable concrete with high SCM content
32	IIII	BAE Systems Australia	The application of interactive narrative visualisation and big data to improve high-value manufacturing
33	III	Alcolizer	Rapid point of care SARS-CoV2 detection, using a sensitive antigen screening test
34	IIII	Melbourne Water	Investigating Virtual Reality (VR) Low Voltage (LV) electrical safety rescue simulation for utilities and manufacturing sectors
35	III	LaserBond	Delivery of high-quality laser clad coatings for heavy wear and corrosion protection in slurry pumps
36	III	3D Dental	Development of novel 3D BNNT ceramic composite for advanced dental applications
37	III	Questsemi	SiC diode manufacturability and characterisation for commercialisation by Questsemi Australia
38	IIII	FormFlow	High volume, scalable manufacturing cell for enhanced building products



Financial Year IMCRC activate Project commenced Project completion

#	Program	Industry Partner	Project Title	'17 1	'17 2	'17 3	'17 4	'18 1	'18 2	'18 3	'18 4	'19 1	'19 2	'19 3	'19 4	'20 1	'20 2	'20 3	'20 4	'21 1	'21 2	'21 3	'21 4	'22 1	'22 2	'22 3	'22 4	'23 1
CY 2021																												
39	IIII	Australian Red Cross Lifeblood	Design and development of a work cell for the robotic folding of whole blood donation packs																	●	·····	·····	●					
40	III	HYDAC	Explosion diagram based virtual and augmented reality maintenance training for industrial machines																	●	·····	·····	●					
41	II	Energy Renaissance	Renaissance BMS development																	●	·····	·····	·····	·····	·····	·····	●	
42	I	AML3D	New Al-Sc welding wires for the emerging Australian arc additive manufacturing sector																	●	·····	·····	●					
43	II	The Remediation Group	Miasma meter – a novel continuous, internet connected, landfill gas monitoring solution																	●	·····	·····	·····	·····	●			
44	III	Rux Energy	Scaling up high-performance hydrogen storage Metal Organic Framework (MOF) materials manufacture for field trial prototypes of Hydrogen (H2) storage systems in heavy trucking and hydrogen hubs																	●	·····	·····	·····	·····	●			
45	III	g-TET	High-speed permanent magnet rotor post assembly magnetisation and power conversion systems manufacture																	●	·····	·····	●					
46	III	BiomeBank	Gut like hydrogel based perfusion bioreactor to engineer stable gut microbial composition for treating gut infections																	●	·····	·····	●					
47	II	Ausdrill	High Access Localised Operations (HALO)																		●	·····	●					
48	I	SPEE3D	Cold spray additive manufacturing product development via material dataset																		●	·····	·····	●				
49	III	Cablex	Automated closed loop verification of UV-C disinfection of COVID-19 using commercial of the shelf pulsed xenon source and detectors, certified by COVID testing on a range of surfaces																		●	·····	●					

Financial Year IMCRC activate ● Project commenced ● Project completion



* photo credit: UTS

Program 1: Additive Manufacturing Processes

Additive manufacturing, or 3D printing, has emerged as a viable and scalable manufacturing technology in its own right. Recognising its potential, Australian manufacturers have adopted the technology to fast-track product development, shorten the time to market and reduce waste and product cost.

As the technology matures into a production ready application, industry research and development requirements shift. 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 design including shape and topography optimisation, integration of creative design and additive process engineering.

IMCRC has invested in 8 'Additive Manufacturing Processes' research projects, with 3 projects to date being successfully completed.

In FY 2020-21, **2 new projects** were funded as part of IMCRC's activate program.

IMCRC activate

SPEE3D calibration scan

* photo credit: SPEE3D

Cold spray additive manufacturing product development via material dataset

Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
SPEE3D	Swinburne	$420,992	$50,005	01/05/21	1

Objective

- to develop standard operating procedures for common industrial materials – aluminium and copper – using SPEE3D's LightSPEE3D machine to 3D print reliable and repeatable material and mechanical properties

IMCRC activate

Aluminium-alloy welding wire

* photo credit: AML3D

New Al-Sc welding wires for the emerging Australian arc additive manufacturing sector

Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
AML3D	Deakin	$617,652	$75,105	01/03/21	1

Objective

- to develop new commercially viable aluminium-alloy welding wire tailored for wire additive manufacturing (WAM)

The following **3 projects** continue their research journey.

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	2

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

Based on our collective experiences from within industry and research organisations, we reimagined the model for research collaboration and designed a framework that bridges the divide between industry and universities, creating a way for them to come together with a shared purpose and vision for success.

Dr. Matthew Young
Manufacturing Innovation Manager

Matthew brings to IMCRC the knowledge and many benefits derived from his career in manufacturing, materials and process engineering.

He has a PhD in Materials Sciences and worked and led in the fields of research, development and application of materials and manufacturing processes, initially in primary metals production and processing and later in aerospace composites manufacturing before making the transition to IMCRC.

As IMCRC's Manufacturing Innovation Manager, Matthew has provided significant contribution in driving business development, working with industry partners and universities in the creation and execution of research projects.

Given his extensive and diverse industry background, it is no coincidence that IMCRC's projects span the breadth of the manufacturing sector as well as the full spectrum of transformative Industry 4.0 technologies.

Matthew's experience has also been invaluable in supporting the participant research and industry teams to navigate the many challenges and disruptions of COVID-19.

Central to his stewardship approach to IMCRC projects is his collaborative philosophy that you get out what you put in. For project participants this translates to defining the parameters of project success and then being united as one team to achieve that singular vision of transformation.

What are you most proud of during your time at IMCRC?

"Undoubtedly what we have achieved for, and with, our partners, but it would be impossible for me to choose between projects. Therefore, my proudest achievement is how we at the IMCRC have worked together as a very lean, close-knit team playing to each other's respective strengths to achieve our collective vision for Australian manufacturing. I know we have made a real difference."

Areas of focus:

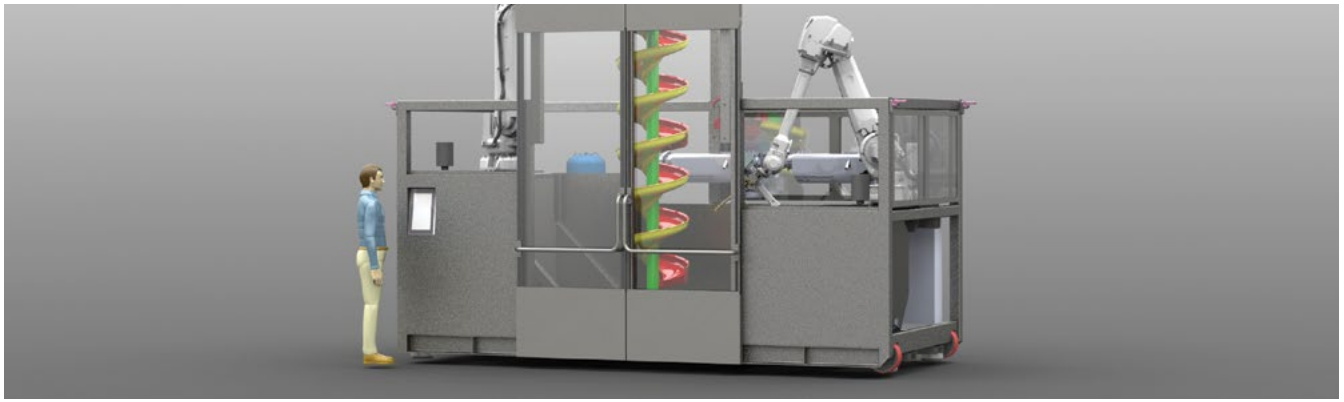
- Commercialisation
- Business development
- Project management
- Stakeholders

Revolutionising mineral separation using additive manufacturing

Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Mineral Technologies	UTS	$7,658,383	$1,400,000	01/04/2018	3.6

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



Sidewinder: 3D printer that is capable of printing a functional, full-size spiral

* photo credit: UTS

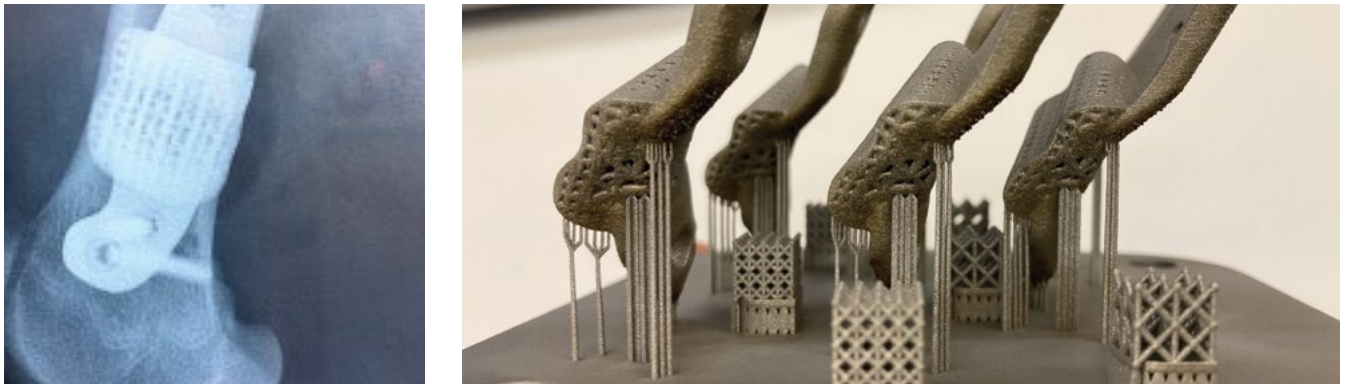
To find out more about the project's progress click here:

Just in time patient specific tumour implants

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Stryker Australia	RMIT, UTS, St Vincent's Hospital Melbourne, Melbourne University, Sydney University	$17,821,197	$3,000,00	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



Prototypes of 3D printed musculoskeletal tumour implants

* photo credit: RMIT

In FY 2020-21, the 'Additively manufactured titanium complex structures' project was completed, bringing the total of completed **'Additive Manufacturing Process' research projects to 3**.

Additively manufactured titanium complex structures

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

Outcomes

- tested 'Additively Manufactured Titanium Monocoque Structures' for use in commercial operations, and thus validated Titomic Kinetic Fusion™ as a competitive and novel advanced manufacturing solution
- evaluated and optimised Titomic Kinetic Fusion™ technology, titanium alloy powders, deposition paths, heat treatment and design for specific properties
- incorporated Industry 4.0 enabled post-manufacturing processes to enhance manufacturing capability across multiple industry sectors

Additively manufactured titanium complex structures

* photo credit: Titomic

Application of additive metal technology to operational aircraft

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
RUAG Australia	RMIT	$1,150,781	$124,263	01/03/2018	2

Outcomes

- developed an additive manufacturing process that addresses 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

Application of additive metal technology to operational aircraft

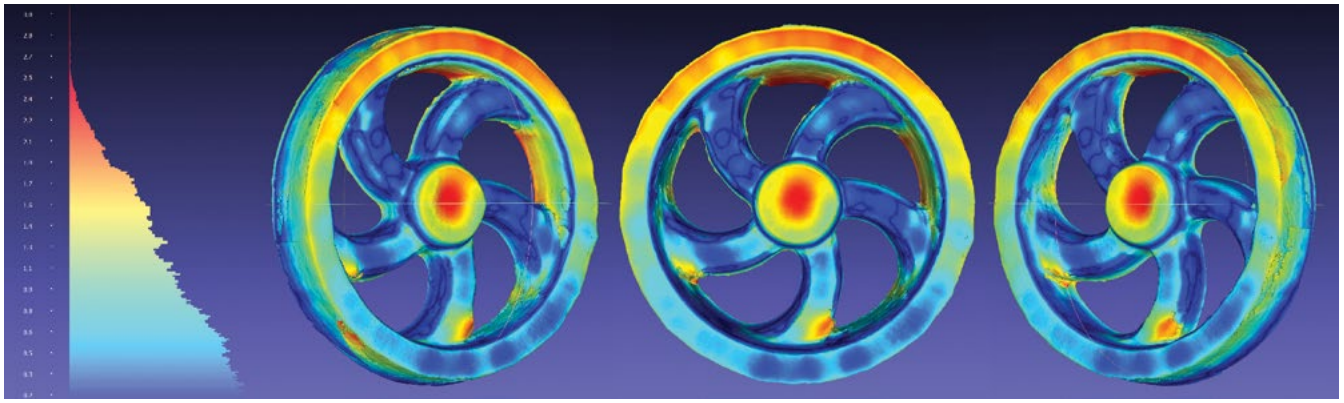
* photo credit: RUAG Australia

Machine vision for Industry 4.0 high-speed printing

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
SPEE3D	UTS	$1,312,412	$349,763	01/04/2017	1.4

Outcomes

- automated the 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

Working at IMCRC has taught me that you have to truly believe in what you set out to achieve. You are far more likely to succeed if you do.

David Chandler
Project Research and Systems Officer

David brings a varied skillset to IMCRC and primarily works within the project management and systems areas of the organisation. He administers half of the CRC's project portfolio and is also responsible for developing and maintaining the internal business systems.

David provides account management services to help research programs progress, overcome any challenges and remain within scope. He is the day-to-day contact for research and industry project leaders and uses his relationship and stakeholder management expertise to ensure the desired outcome is achieved.

Prior to joining IMCRC in 2017, David worked in the natural chemistry field and brings a deep scientific understanding to his role, as well as marketing and account management experience. He has delivered multiple transformative projects that have resulted in positive outcomes for Australian manufacturers.

Additionally, David develops and maintains internal systems designed to create a streamlined and efficient working environment for IMCRC.

What has interested you most during your time at IMCRC?

"The variety of the research projects that we are involved with. So many products, processes, business models and services, across multiple industries, depend on the manufacturing sector. I feel privileged to meet and work alongside experts from a range of fields, including robotics, healthcare, automation, data analytics and advanced materials."

What is the most important lesson you have learned while working at IMCRC?

"I have gained a greater understanding of leadership and the role it plays in complex innovative research projects. To catalyse the transformation of manufacturing, each initiative needs to start with a clear direction, inspiring vision and project pathway. This knowledge is applicable outside of manufacturing and I know it will be valuable in future roles."

Areas of focus:

- Project management
- Stakeholder management
- Client services
- Systems expertise

* photo credit: UAP

Program 2: Automated and Assistive Technologies

In today's world of unprecedented disruption and market turbulence, manufacturers are forced to rethink and adjust their business operations to stay ahead.

The adoption of automated and assistive technologies helps them simplify and streamline manufacturing processes and build capabilities to support their overarching business strategy.

Under Program 2 – Automated and assistive technologies – IMCRC invests in the research and development of agile manufacturing technologies that improve the performance and operational effectiveness of short run and personalised production systems. The program aims to help industry 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 heterogenous collaboration technologies that enhance OH&S, skill augmentation and continuous quality control and assessment. Please insert:

IMCRC has supported 9 research projects under the 'Automated and Assistive Technologies' program, with the first 2 projects being successfully completed in the reporting period.

In FY 2020-21, **4 new projects** commenced under the program.

IMCRC activate

Robotic and Virtual Reality (VR) technologies

* photo credit: Ausdrill

High Access Localised Operations (HALO)					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Ausdrill	UTS	$466,547	$74,945	15/04/21	1

Objective

- to utilise robotic and virtual reality (VR) technologies to create the next generation of a high access localised operations (HALO) platform that aims to improve the efficiency and safety of traditional rock scaling operations

IMCRC activate

Common land fill site

* photo credit: IMCRC

Miasma meter – a novel continuous, internet connected, landfill gas monitoring solution					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
The Remediation Group	Deakin	$765,266	$150,000	01/03/21	1.25

Objective

- to automate a low cost, real-time surface landfill gas (LFG) emissions monitoring solution that remotely collects and assesses LFG data to ensure regulatory requirements are met and necessary control measures are applied

IMCRC activate

HYDAC's hydraulics components

* photo credit: HYDAC

Explosion diagram based virtual and augmented reality maintenance training for industrial machines					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
HYDAC Australia	Deakin	$486,627	$78,358	15/02/21	1

Objective

- to develop virtual and augmented reality training package that guides maintenance staff and trainees on how to assemble and disassemble HYDAC's most complex hydraulics components

Renaissance Battery Management Systems (BMS) development

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Energy Renaissance	CSIRO	$1,777,261	$352,658	01/02/21	1

Objectives

- to develop a defence-grade cybersecure Battery Management System (BMS) for its super storage family of batteries
- to monitor and report on the battery's usage, lifespan and faults to ensure real-time data, analytics and remote management

Battery Management System (BMS)

* photo credit: Energy Renaissance

The following **3 research projects** continued their research into automated and assistive technologies to support their organisation.

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

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Verton	QUT	$3,970,221	$412,118	10/10/2019	3

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

David Chuter
Chief Executive Officer and Managing Director

As IMCRC's Chief Executive Officer and Managing Director, David ensures the Commonwealth funding his team is tasked with overseeing delivers substantial and scalable research and commercial outcomes for Australian manufacturing.

With a background in engineering and an extensive manufacturing industry career of over 30 years, David considers each project's challenges and opportunities through the perspective of all stakeholders to find win-win outcomes for all parties involved.

He understands how to design programs for success, to push industry participants beyond their comfort zone, to surpass any preconceived limitations and boundaries and embrace the opportunity to achieve transformational change rather than mere incremental improvements.

David's unwavering focus on achieving transformation is the fundamental principle that sets IMCRC apart, both operationally and in its approach to inspiring that same drive and ambition in industry participants.

IMCRC's futuremap® business diagnostic, as well as the establishment of the Advanced Robotics for Manufacturing (ARM) Hub, the Tonsley Manufacturing Innovation (TMI) Hub, and most recently Stryker's announcement to invest in an Australian R&D and manufacturing facility, are all cases in point of David's vision for IMCRC being a platform to catalyse change and investment in the broader ecosystem.

Our philosophy is to stretch the ambition and thinking of every aspect of every project to try and optimise and maximise the opportunity for all parties involved. We are constantly looking at how we can inspire and add value to our participants and partners – to both catalyse genuine transformational change and to use our platform to do that proactively and transparently.

What has been your most important learning over your time at IMCRC?

"I have come to appreciate the incredible amount of untapped potential in Australia's universities that should be better utilised to support our national endeavour of a truly modern manufacturing sector. What we lack is a collaborative framework at scale that makes it easy for manufacturers of all sizes to engage and partner with universities to achieve transformational change that in turn drives greater commercial outcomes."

Areas of focus

- Advocacy
- Business and industry development
- Governance and operations
- Stakeholder engagement

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

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
MTHING	QUT	$4,502,248	$875,305	30/04/2019	3

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

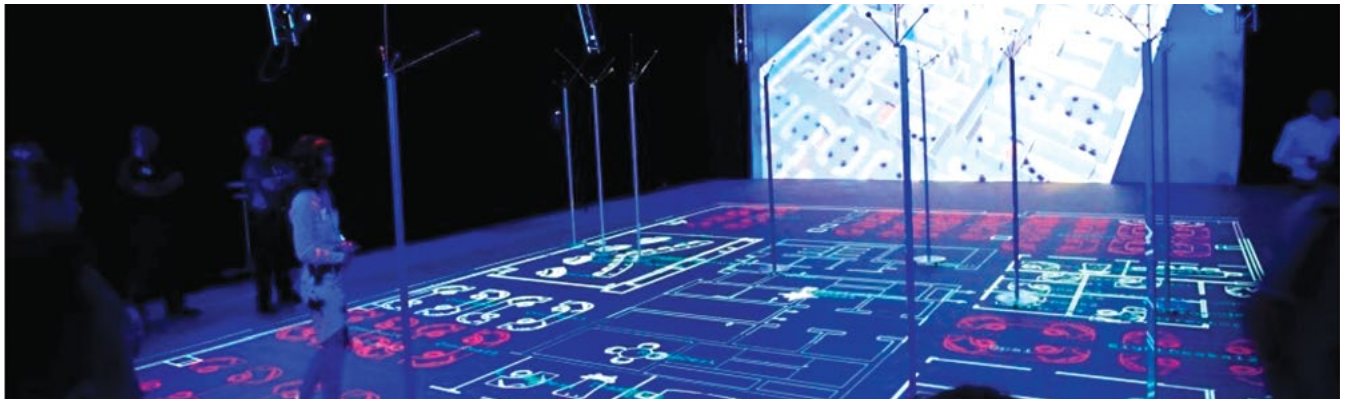
* photo credit: Monitum

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

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
CADwalk	UniSA	$6,516,318	$1,060,626	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 and 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

With the 'Design robotics for mass customisation manufacturing' and 'Tradiebot' projects, the **first 2 projects** under the **'Automated and assistive technologies'** research program were completed in FY2020-21.

Design robotics for mass customisation manufacturing

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
UAP	QUT, RMIT	$6,560,238	$1,202,066	01/07/2017	4

Outcomes

- developed robotic vision systems and software user-interfaces to support the custom design-to-manufacture cycle
- integrated the systems with industrial robots and improved the manufacture of high-value, complex products in time and cost
- set up a Design Robotics Open Innovation Network that enabled peer-to-peer business knowledge transfer through the establishment of a Living Laboratory network which led to the formation of the Advanced Robotics for Manufacturing (ARM) Hub in Brisbane
- won the CRC Association's 2020 Award for Excellence in Innovation

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

The Design Robotics team at UAP in Brisbane

* photo credit: UAP

Tradiebot

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Tradiebot Industries	Swinburne	$1,881,498	$390,247	18/01/2018	3

Outcomes

- demonstrated a “Repair-bot” that integrates 3D printing, 3D scanning and robotics for in-situ automotive part repairs, with the replacement part being directly printed on the damaged component and thus reducing repair cost, time, waste and environmental impact
- created novel polymer material solutions compatible with standard 3D printing processes

Tradiebot

* photo credit: Tradiebot

* photo credit: RMIT

Program 3: High Value Product Development

With new business models emerging and the entire 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.

Twenty-six(26) 'High Value Product Development' research projects have been co-funded by IMCRC, with 4 projects being completed in FY2020-21.

In FY 2020-1921, the following **9 research projects** commenced, with **one IMCRC activate project** being successfully completed during the reporting period.

IMCRC activate

Sensor array

* photo credit: IMCRC

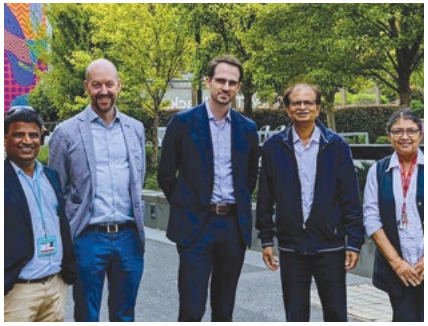
Automated closed loop verification of UV-C disinfection of COVID-19 using commercial off the shelf pulsed xenon source and detectors, certified by COVID testing on a range of surfaces

Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Cablex	Swinburne	$725,587	$79,848	01/06/21	0.5

Objectives

- to develop a sensor array that captures the energy distribution of a miniaturised pulsed xenon UV disinfection system and can disinfect pathogens based on the detected energy distribution

IMCRC activate



RMIT BioBank team

* photo credit: BiomeBank

Hydrogel-based perfusion bioreactor to engineer stable gut microbial composition

Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
BiomeBank	RMIT	$603,544	$101,171	15/3/21	1

Objectives

- to develop a cellulose hydrogel-based bioreactor that mimics the human gut to allow the large-scale manufacture of a complex microbial therapy or synthetic Faecal Matter Transplant (FMT)

IMCRC activate

Hydrogen storage

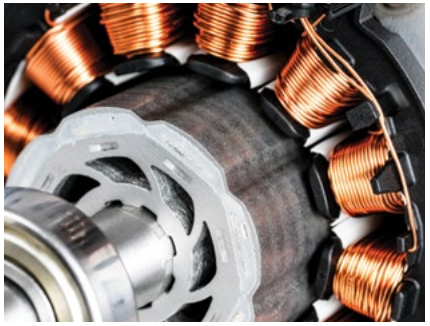
* photo credit: IMCRC

Scaling up high-performance hydrogen storage metal organic framework (MOF) materials manufacture for field trial prototypes of Hydrogen (H2) storage systems in heavy trucking and hydrogen hubs					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
RUX Energy	University of Sydney	$723,132	$99,775	01/03/21	1

Objectives

- to scale up the manufacturing process of high-performance hydrogen storage metal organic framework (MOF) material from batch to continuous processing, and allow for pilot production volumes and demonstration of prototype hydrogen storage tanks

IMCRC activate



High-speed permanent magnet (PM)

* photo credit: IMCRC

High-speed permanent magnet rotor post assembly magnetisation and power conversion systems manufacture					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
g-TET	RMIT	$373,615	$50,237	01/03/21	0.75

Objectives

- to develop a post-assembly magnetiser for high-speed permanent magnet (PM) machine rotor magnetisation, and high-speed PM compressor power converter uesd in high temparture heat pumps as an energy efficient alternative to gas boilers

81

There is a strong desire amongst Australian manufacturers to be the best in the world. IMCRC is committed to growing the number of Australian manufacturers able and ready to compete on the world stage through catalysing research collaboration and innovation.

Dr. Jason Coonan
Chief Operating Officer and Deputy CEO

A self-confessed continuous learner, Jason's professional pathway to IMCRC has been underpinned by one consistent theme: innovation.

After earning his PhD, Jason started his career in neuroscience research before transitioning to innovation law, becoming a qualified patent and trade mark attorney along the way. He later moved to, and subsequently led, the commercialisation team of a leading Australian university and, from there, made the transition to CRCs.

Jason joined the IMCRC as Chief Operating Officer in 2016 and immediately found the breadth of industry participants and research projects focussed on Industry 4.0 technology invigorating.

Passionate about the power of innovation, Jason has been inspired by the focus and determination of both industry leaders and researchers taking on the risk to create something new in what is a challenging and rapidly evolving sector.

He has been able to apply his experience as a researcher and his understanding of Australia's research and commercialisation ecosystem to support IMCRC's industry participants to maximise the impact of their collaborative research projects.

Jason recently completed an MBA which has given him further insight into the commercial realities facing IMCRC's industry participants.

Whether in his professional or personal life, Jason has a strong ethos of giving back and works to ensure he is contributing towards positive social outcomes for the communities he is a part of.

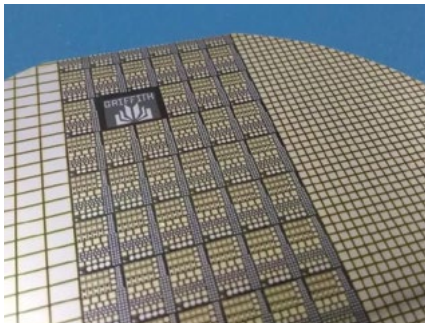
What has most inspired you in your time so far at IMCRC?

"It is a privilege to partner with Australia's world-class industry and research organisations operating at the bleeding edge of innovation and to work with the incredible visionaries who make them what they are."

Areas of focus:

- Organisational leadership
- Business operations
- Intellectual property commercialisation
- Stakeholder management

IMCRC activate



SiC Schottky Diodes

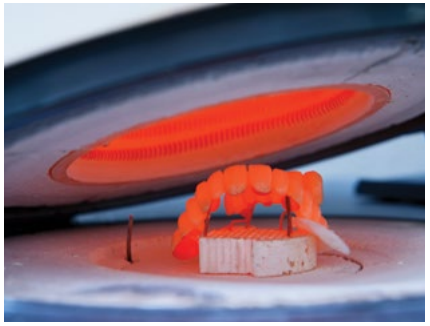
* photo credit: Griffin

SiC diode manufacturability and characterisation for commercialisation by Questsemi Australia					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Questsemi	Griffith	$1,297,549	$143,710	1/11/20	1

Objectives

- to establish a simple and cost-effective manufacturing process of SiC Schottky Diodes, with the performance of the technology being tested in a pilot production facility that also supports early production runs

IMCRC activate



Dental ceramic oven

* photo credit: IMCRC

Development of novel 3D BNNT ceramic composite for advanced dental applications					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
3D Dental Technology	Deakin	$1,047,998	$149,992	15/10/20	1

Objectives

- to enhance the mechanical and material property of two dental ceramics by optimising the percentage of Boron Nitrate nanotubes (BNNT) and establish new manufacturing methods for these BNNT reinforced ceramics

Delivery of high-quality laser clad coatings for heavy wear and corrosion protection

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
LaserBond	UniSA	$3,331,521	$499,547	15/10/20	2

Objectives

- to refine LaserBond's laser cladding technology and develop resilient mineral processing equipment
- to adjust coating composition to the component and the dominant wear mechanism

LaserBond's laser cladding technology

* photo credit: LaserBond

Ultra-sustainable concrete with high SCM content

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Boral	UTS	$6,167,290	$772,538	1/7/20	2

Objectives

- to develop advanced technology for manufacturing, placing, and curing new ultra-sustainable concrete with an increased binder content of 70% SMC
- to evaluate the effectiveness of proposed manufacturing approaches to tackle strength development and improve surface finishing techniques

Boral ultra-sustainable concrete

* photo credit: Boral

In FY 2020-21, the following **11 research projects** continued.

Smart coatings for the next generation of lightning strike protection devices

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
LPI	Swinburne	$981,865	$154,229	01/06/20	1.6

Objectives

- to develop novel materials that optimise the performance of corona-minimising technologies and 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 Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Telix Cyclotek Iphase Technologies Genisis Care	University of Melbourne	$2,491,726	$499,215	30/02/20	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 Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Nutromics Romar Engineering	RMIT, Griffith	$7,674,239	$1,379,394	01/02/20	2

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 targets 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 that the smart patch can be mass produced on a large substrate area at high speeds using automated systems with minimal human involvement

Dr Summeet Walia working in the Nutromics laboratory

* photo credit: Nutromics

I feel privileged to work alongside colleagues who communicate openly and are united by a common purpose. I believe this has helped us catalyse and achieve the best outcomes for our industry and research partners.

Sameera Silva
Finance and IT Manager

With over 9 years' experience working within the manufacturing and research space, Sam brings a deep understanding of the financial management of cooperative research centres (CRC) to his role at IMCRC.

As the Finance and IT Manager, he is responsible for end-to-end financial management including analysis, budgeting, reporting and providing recommendations to IMCRC's Audit and Risk Committee and the Board. Additionally, he guides the technological direction of IMCRC, overseeing the IT services, network security and cloud management.

Sam's financial management and corporate governance skills have been critical in IMCRC successfully allocating all available Commonwealth and other funds to innovative projects.

What has inspired you most during your time at IMCRC?

"Since rebooting IMCRC five years ago, I have been inspired by the non-traditional, industry-led approach we have taken to running the CRC. As part of our unique business model, the intellectual property is owned by the industry and research partners (rather than the CRC) and that has enabled us to drive commercial outcomes that are contributing significantly to Australia's manufacturing capability.

I am also very proud of the way we have been able to successfully allocate all available Commonwealth funds to manufacturing research projects and also provide additional funding to support shorter-term, high impact projects during the COVID-19 pandemic through IMCRC's activate program. Our ability to do so demonstrates in my view the commercial strength of IMCRC's business model."

Areas of focus:

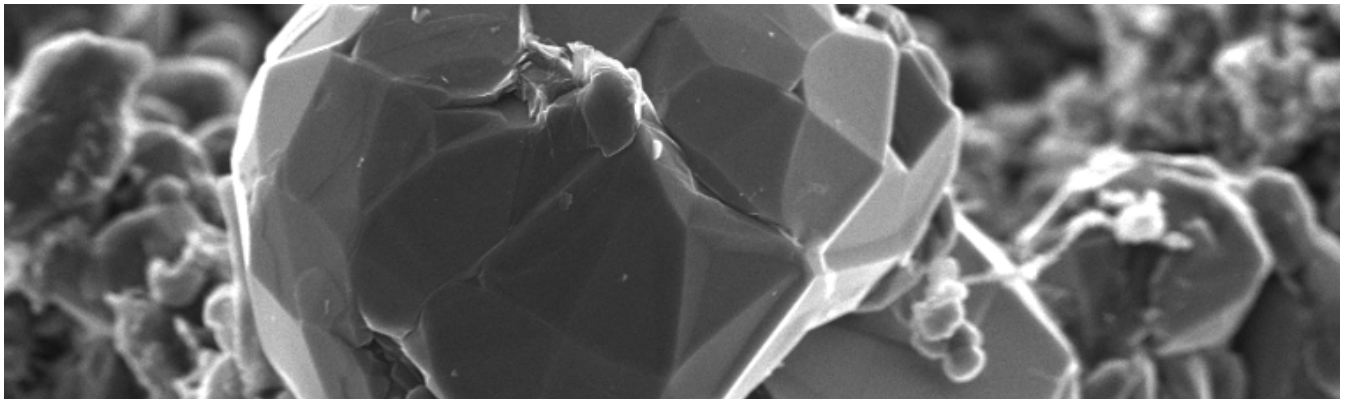
- Financial management
- IT and cyber security
- Corporate governance
- Compliance

Developing and optimising advanced carbon materials

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Hazer	University of Sydney	$4,540,753	$921,713	01/11/2019	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 Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Lava Blue	QUT	$10,461,003	$1,454,785	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

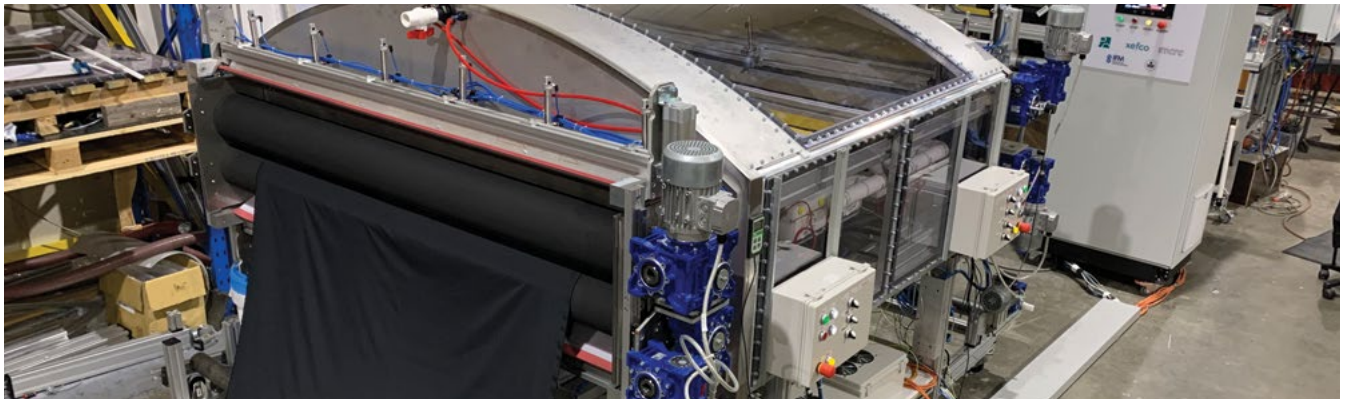
* photo credit: QUT

Atmospheric plasma coating system

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Xefco, Proficiency Contracting	Deakin	$4,300,902	$786,333	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

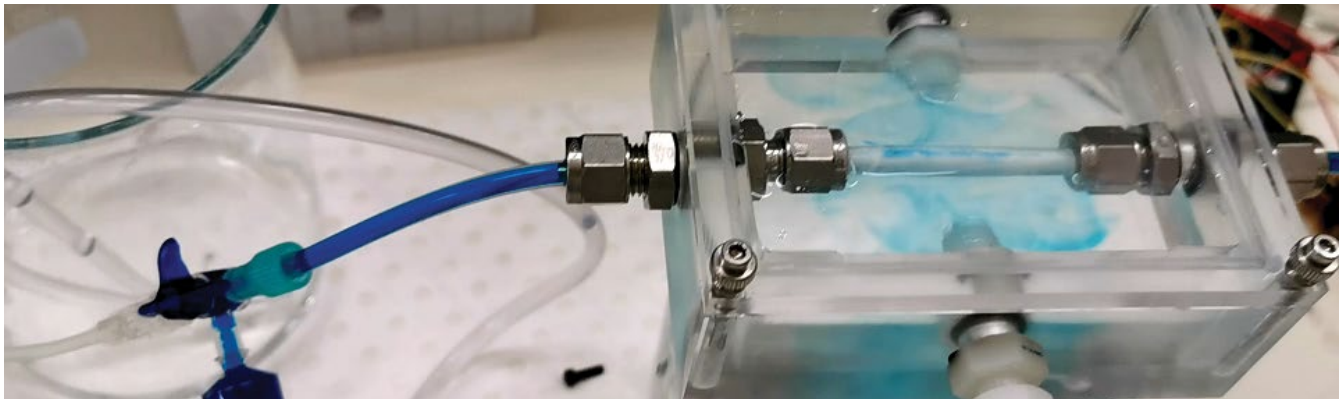
* photo credit: Xefco

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

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Codex Research	University of Sydney	$5,111,769	$975,109	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 use advance sensing technology to achieve real-time monitoring and control of its physical parameters



Codex blood vessel pump

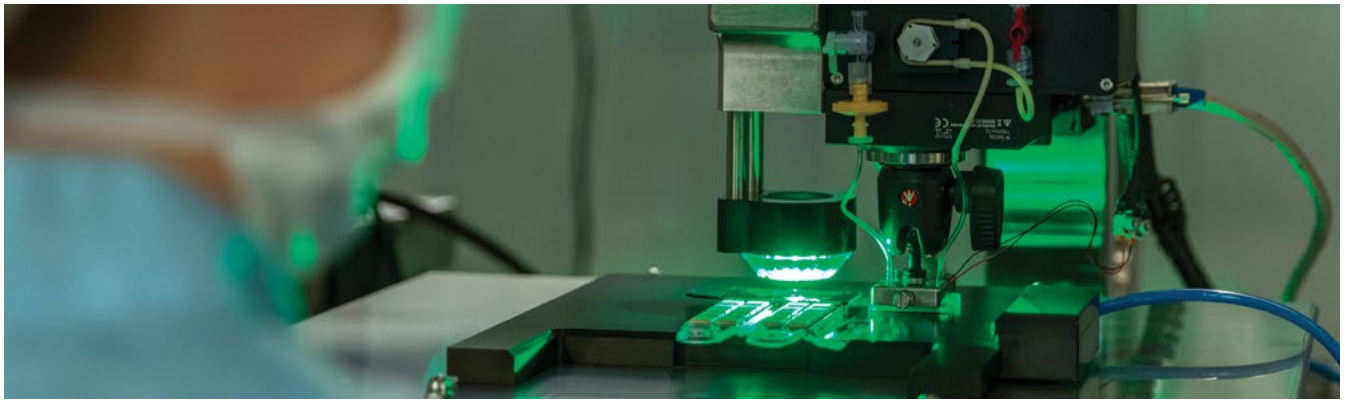
* photo credit: Codex

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

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Vaxxas	University of Sydney	$3,806,996	$556,231	01/11/2018	3.5

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

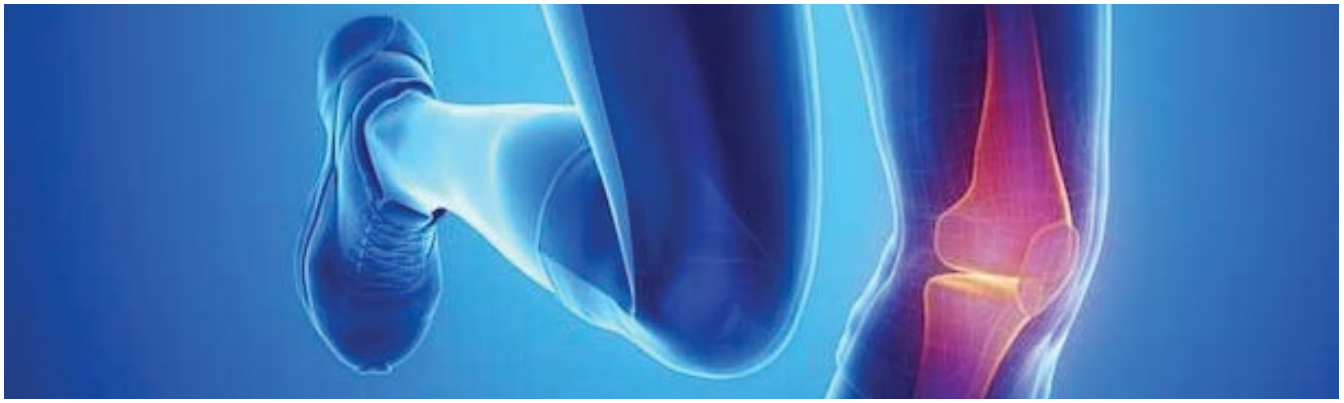
* photo credit: Vaxxas

Xenograft using Kangaroo tendon as substitute for ligament reconstruction

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
BLT Allegra Orthopaedics	University of Sydney	$7,767,902	$1,483,485	01/09/2018	3.6

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 techniques 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

Industrialisation of composite wheel technology

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Carbon Revolution	Deakin	$15,886,500	$2,998,628	01/07/2018	3.5

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 though the development of data-driven statistical analysis techniques

Industrialisation of composite wheel technology

* photo credit: Carbon Revolution

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

A novel approach to biofilm disruption and removal

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Whiteley Corporation	University of Sydney	$4,961,273	$977,086	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

At IMCRC, we champion manufacturing innovation. Working with innovative people that see things from a different perspective and are not afraid to push boundaries, whether it's within business, research or their life outside of work, is very rewarding.

Jana Kuthe

Communications, Marketing and Events Manager

Since joining IMCRC in 2017, Jana has helped to build IMCRC's brand as a champion of innovation and industrial transformation within Australia's manufacturing industry.

Jana is a strong advocate for the power of industry collaboration and embodies that spirit in her engagement with IMCRC's stakeholders. Working closely with IMCRC research and industry partners, Jana is responsible for ideating and executing strategic marketing communications activities that demonstrate the impact, value and benefits of industry-led research collaboration. With extensive experience in establishing new brands within the technology industry, she brings to IMCRC a passion for telling the stories of innovators, no matter how big or small as well as a wealth of technical marketing knowledge and skill.

Over the past four years, Jana has delivered milestone initiatives that have successfully positioned IMCRC as a leading voice and catalyst for industry transformation with stakeholders. These have included IMCRC's conference which created a forum for authentic and compelling conversations about the role of research, development and innovation in the future of the Australian manufacturing industry.

Outside of work, as a volunteer for Marketing Women Inc, a not-for-profit association that inspires, educates and supports female marketers, Jana uses her experience working collaboratively with partners and across multiple teams to connect and support women throughout their careers.

What has inspired you most during your time at IMCRC?

"Realising the power of industry-research collaborations to positively impact and transform manufacturing businesses – big or small.

I believe that when passionate people with great minds come together to achieve a shared goal, new ideas are created, and anything is possible."

Areas of focus:

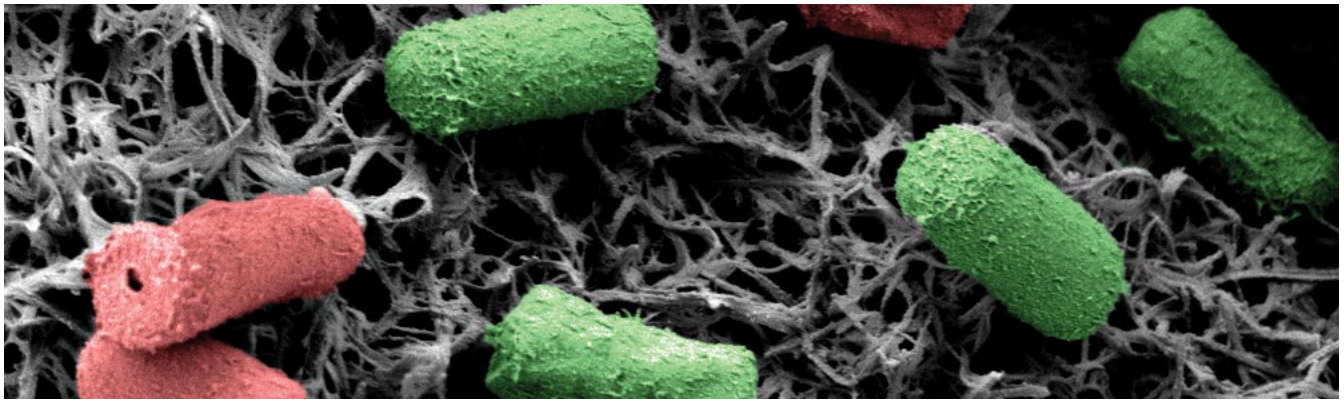
- Brand
- Marketing Communications
- Public Relations
- Events

Antimicrobial nanosurface for orthopaedic implants

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Corin	UniSA	$15,123,465	$2,853,588	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



Antibacterial surface modification

* photo credit: Corin

In FY 2020-21, with Alcolizer the first IMCRC activate project was successfully completed. Under the **'High Value Product Development'** program a total of **3 projects** have now been delivered.

IMCRC activate

Virulizer: rapid COVID-19 testing

* photo credit: Alcolizer

Rapid point of care SARS-CoV2 detection, using a sensitive antigen screening test					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Alcolizer	UTS	$1,472,719	$245,751	21/09/20	0.5

Objectives

- developed a point of risk saliva test for the COVID-19 virus that uses existing hand-held devices and a new process to upconvert nanoparticles to detect virus antigens for symptomatic and asymptomatic subjects
- advanced the design and testing of the prototype to accelerate commercialisation

High Performance Normally OFF GaN High Electron Mobility Transistors (HEMT)

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
BluGlass	Griffith	$2,096,662	$330,001	01/09/2017	2.2

Outcomes

- 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

BluGlass laboratory

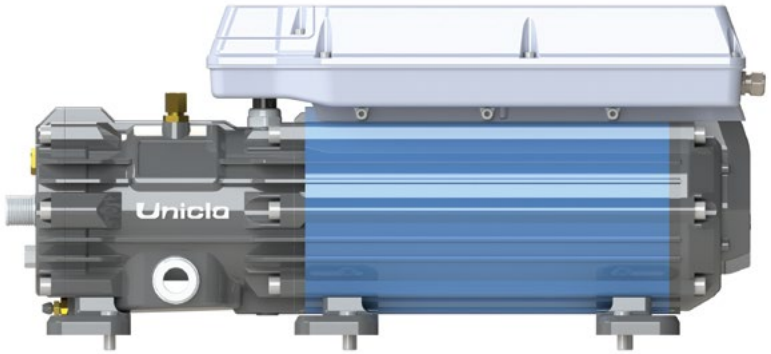
* photo credit: BluGlass

Smart electric compressor for refrigeration and air conditioning on electric vehicles

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
SuperCool	Griffith	$2,370,366	$ 296,325	01/09/2017	2.5

Outcomes

- 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, and suitable for harsh Australian environments, technology that will offer transformational 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

Due to COVID-19 disruption and a change in strategic priorities, the following 3 industry partners withdrew their research projects from the program.

Lithium mining sector

* photo credit: Neometals

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

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Neometals	QUT	$898,886	$62,552	01/01/2020	1

ESN product

* photo credit: ESN Cleer

Preventing heart attacks with nanotechnology-enabled biomarker sensors

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
ESN Cleer	RMIT	$1,582,082	$252,709	15/09/2019	1

Speedpanel lab

* photo credit: Speedpanel

Manufacture of the next generation Speedpanel

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Speedpanel	Swinburne	$2,919,450	$397,998	01/02/2019	2.5

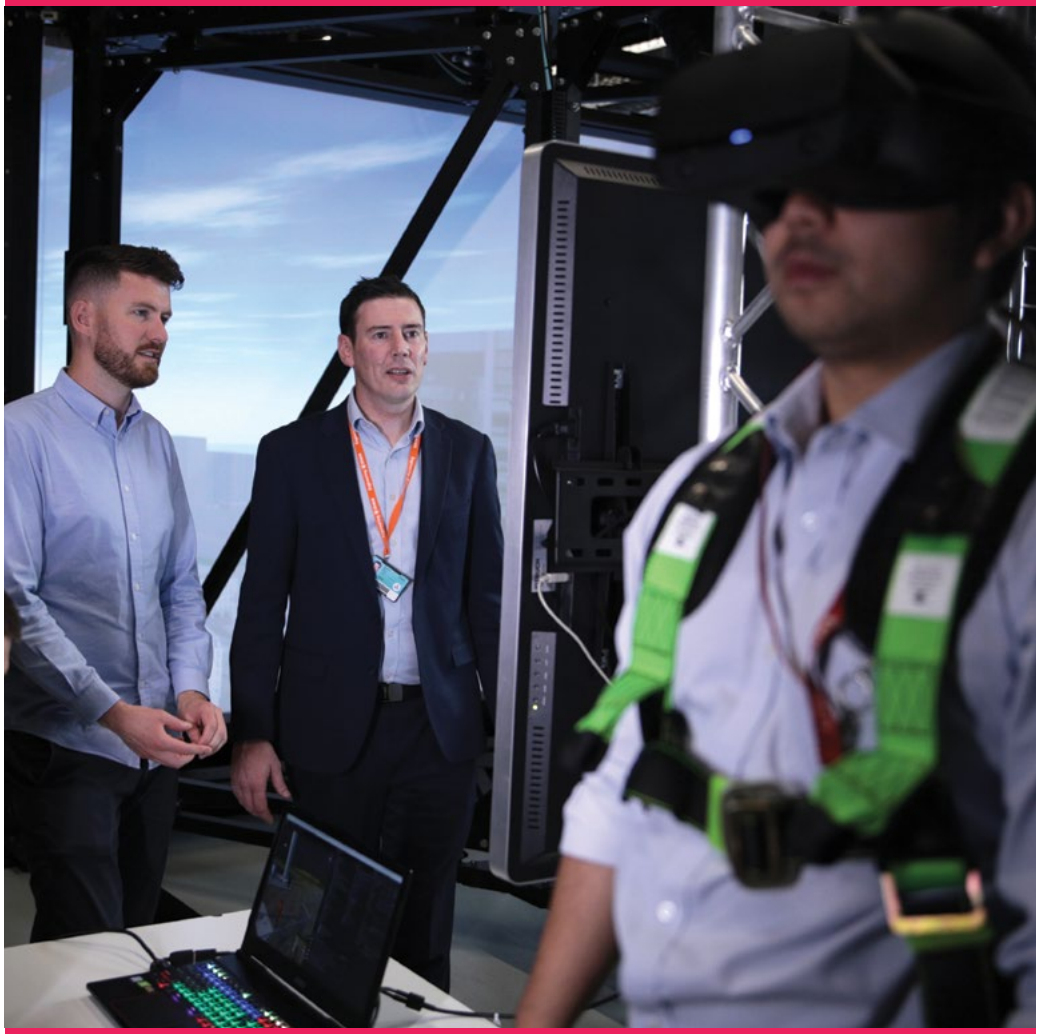
Program 4: Industrial Transformation

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 2020-21, the **Industrial Transformation Program** has successfully:

- worked with IMCRC's delivery partners to move the proven futuremap® workshops to an online environment, allowing IMCRC to continue to inspire and motivate Australian SMEs to commence or accelerate their Industry 4.0 journey. During the year 23 events were held (19 virtually, 4 in person) engaging 115 manufacturing businesses.
- expanded the futuremap partner network by bringing University Technology Sydney (UTS), New South Wales, and Flinders University, South Australia, on board. With these new partners, IMCRC developed individual engagement models, training key executives and hosting several events with the objective of establishing on-going futuremap delivery capability in NSW and SA.



* photo credit: Deakin

* photo credit: IMCRC

- developed and deployed a new futuremap platform – launched in May 2021 – that creates a virtual solution / holistic approach allowing futuremap participants to complete the diagnostic in a personalised environment as well as offering them access to their results and a tailored library of resources.
- advanced futuremap's analytical capabilities by integrating new machine learning algorithms that offer participating manufacturers - in addition to the traditional futuremap report (a radar diagram that visualises the current state and level of ambition) - a list of priority actions.
- offered futuremap delivery partners tailored access to futuremap results through virtual dashboards that allows them to view individual results and also create an aggregate futuremap view for the workshops they hosted. This helps them to build on-going discussions with the businesses that attended their workshop.
- delivered 11 futuremap Industry 4.0 assessments via Swinburne University's Factory of the Future (enabled by IMCRC's Industry 4.0 license agreement with Fraunhofer). Backed by the assessment, participating manufacturing SMEs have been able to establish specific roadmaps that allow them to adopt and integrate Industry 4.0 technologies and processes within their production facilities.
- trained 40 new Growth Facilitators from the Entrepreneurs' Programme in how to incorporate futuremap into their client development activities.
- launched "futuremap – Towards an Industry 4.0 future", a virtual summary of the adoption of Industry 4.0 across Australia. The summary taps into, and analyses, the aggregated futuremap data of 646 manufacturing SMEs that have completed business diagnostic since its launch in 2018. The findings have been shared with the Australian manufacturing community through speaking engagements at industry events organised by, for instance, Austrade and the Industry 4.0 Advanced Manufacturing Forum.
- in FY 2020-21, IMCRC invested in 6 research projects as part of the Industrial Transformation Program.

Simon Dawson
Industrial Transformation Director

Technology is changing the industry landscape, and we help to interpret that for manufacturers, acknowledging that it is different for everybody. IMCRC has a role and responsibility in facilitating manufacturing and industrial transformation to ensure they can see what is possible.

Simon describes his 30-year career in the manufacturing industry across both in-house and consulting roles as the perfect proving ground for his position at IMCRC.

As the Industrial Transformation Director, Simon's role is at the heart of what drives IMCRC – supporting manufacturers, regardless of their size, who want to embrace transformation, and guiding them on the pathway to realising it.

Simon works with predominantly SME manufacturers to chart and progress their journeys towards a greater uptake of Industry 4.0 technologies using education and training diagnostic such as IMCRC's futuremap®.

An ice hockey coach in his spare time, there are parallels with preparing his players and his role as an Industry 4.0 transformation mentor to SMEs. Whether it is understanding the fundamentals of new skills and techniques or how to overcome challenges as a team, Simon is passionate about accelerating performance and helps those he works with to see and understand, the art of the possible.

What's the most important thing you've learned so far while at IMCRC?

"The shift to Industry 4.0 globally is only going to keep accelerating. The time is now for Australian manufacturing to rapidly embrace these technologies – because our competitors are, and we cannot afford to fall behind."

How are you using your skills and experience to build a better world?

"After delivering lean process improvement over many years in previous roles I understand that for change to succeed it is the chosen path that is important, not just the tools. Transformational change is an outcome of leadership – it's not just the advanced manufacturing machines and tools; it's how you establish the culture, share knowledge and embed a change mindset."

Areas of focus:

- Manufacturing performance
- Education and training
- Stakeholder management
- Driving transformational change

The following **4 projects** commenced in the reporting period.

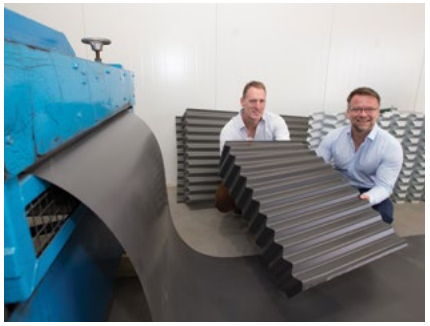
Blood donation

* photo credit: IMCRC

Design and development of a work cell for robotic folding of whole blood donation packs					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Australian Red Cross Lifeblood	Swinburne	$420,233	$79,436	01/02/21	1

Objectives

- to automate the folding process of whole blood donation packs, including their process data collection, to advance the digitalisation of Lifeblood's production operation and improve the work, health and safety for blood processing staff



Corrugated steel strips

* photo credit: FormFlow

High volume, scalable manufacturing cell for enhanced building products					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
FormFlow	Deakin	$548,294	$103,498	01/11/20	1

Objectives

- to establish an Industry 4.0 enabled manufacturing cell equipped with smart vision technologies to trace, evaluate and continuously monitor forming loads and the profile share of corrugated steel strips to enable robuts and high-volume production

Investigating Virtual Reality (VR) Low Voltage (LV) electrical safety rescue simulation for utilities and manufacturing sectors

Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Melbourne Water	Deakin	$1,396,905	$200,000	01/10/20	2

Objectives

- to advance the application of virtual reality to train and improve the safety of current and future utility industry workers
- to develop an electrical safety simulator that applies advanced robotics and control algorithms to create training scenarios

Investigating Virtual Reality (VR)

* photo credit: Deakin

The application of interactive narrative visualisation and big data to improve high-value manufacturing

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
BAE Systems Maritime Australia	UniSA	$4,570,788	$897,079	1/07/20	2

Objectives

- to develop narrative visualisation and big data processing to define and shape the manufacturing environment for the Hunter Class Frigate Program and its supply chain
- to build a "big data dashboard" that autonomously consolidates and analyses multiple Industry 4.0 data streams

Hunter Class Frigate Program

* photo credit: UniSA

In FY 2020-21, the following **2 projects** continued.

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

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
BAE Systems Maritime Australia	Flinders	$9,177,875	$1,459,260	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

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

Industry Partner	Research Partners	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
SleepCorp	Swinburne	$2,749,961	$373,952	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 SleepCorp'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

SleepCorp virtual design

* photo credit: SleepCorp

SME Engagement

Australian manufacturing SMEs are the backbone of 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 and transformation.

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 2020-21, IMCRC:

- co-funded 19 new industry-led manufacturing research projects involving small and medium businesses from a diverse cross section of industries and locations, all adhering to IMCRC's SME collaboration requirement.
- granted 14 SME manufacturers $1.49 million in matched cash funding and access to R&D expertise though IMCRC activate, a funding initiative designed by IMCRC to support shorter-term, industry-led research projects in innovative manufacturing and digital technologies.
- raised awareness and shared 'manufacturing' insights impacting SME manufacturers at industry events, webinars and workshops. Through interviews and thought leadership articles placed in publications such as Manufacturers' Monthly, @aumanufacturing and AMT Magazine, IMCRC informed the wider community about the benefits of industry-led research collaborations and discussed topics pressing Australian manufacturing.
- strengthened its SME engagement process by deepening the collaboration with the Industry 4.0 engagement hubs. SME@UTS joined the Advanced Robotics in Manufacturing (ARM) Hub, Swinburne's Factory of the Future and Tonsley Manufacturing Innovation (TMI) Hub in their quest to accelerate the uptake and diffusion of digital and advanced manufacturing technologies among SMEs.
- conducted 23 futuremap workshops of which 19 were delivered virtually due to COVID-19 restrictions. In collaboration with deployment partners and supported by state and local governments, industry associations and industry experts, IMCRC guided 115 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.
- helped 12 manufacturing SMEs access the specialist expertise of PhD students via the Australian Mathematical Sciences Institute (AMSI) APR.Intern program. The short-term internships help SMEs drive advanced manufacturing and optimisation solutions within their business.
- Partnered with the Australian Technology Competition to help manufacturing SMEs to scale up and solidify their position in the market, connect with established collaborators and investors to identify new opportunities for growth.

futuremap®

Insights into Industry 4.0 adoption from Australian SMEs

With traditional manufacturing value chains being disrupted and customer expectations constantly shifting, manufacturing businesses are now exploring and implementing Industry 4.0 technologies and looking for smart, cost-effective ways to integrate these within their organisation. Whilst COVID-19 has accelerated their digital thinking, there remains a gap between the initial exploration and subsequent adoption.

Through futuremap – IMCRC's proprietary and unique business diagnostic tool – more than 600 manufacturing SME's have assessed their current business capabilities across 13 key areas of industrial and manufacturing competitiveness and identified possible pathways as to how they can adopt and integrate Industry 4.0 technologies and principles across their organisation.

Analysing the aggregate, anonymised futuremap data has revealed valuable insights into how Australia manufacturing SMEs are approaching the adoption of Industry 4.0.

60% are aware of Industry 4.0 but only 25% discuss the topics regularly as a leadership team

98% of businesses will be increasing their investment in key enabling technologies in the next two years

...but 79% say their current investment in technology is primarily focused on improving productivity and lowering cost and not yet creating new value opportunities

More than 51% want to move to a more innovative culture in their business

Whilst only 23% regularly communicate their strategies to their workforce, 93% want this to be true within 2 years

For more information on futuremap, visit **futuremap.org.au.**

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 and also helping skill the manufacturing workforce of the future through PhD and Masters scholarships and industry internships.

In FY 2020-21, 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 23 PhD and six master students from seven universities, with one additional PhD and two Masters students commencing their candidature in FY 2020-21. One Masters student completed his candidature successfully throughout the reporting period. Two students gained first-hand industry experience through Industry 4.0 internships.
- IMCRC believes in the value of getting involved and provides various opportunities for its PhD and Masters students to present their research. In March 2021, IMCRC launched the "Unlocking potential in Manufacturing" a monthly webinar series that has offered so far six PhD students and three early career researchers a platform to present their work and share their experience in working with industry. Over 100 people from research and industry joined the three webinars hosted in a relaxing atmosphere on a Friday afternoon.
- IMCRC advanced its partnership with the Australian Mathematical Sciences Institute's APR. Intern program. As of 30 June 2021, a further 12 PhD students have embarked on internships with Australian manufacturing SMEs. Despite the difficulties in gaining access to research and industry partner facilities due to COVID-19 restrictions, 7 students completed their internship in FY2020-21, with another 5 slated to be completed by the end of the next reporting period.
- At the beginning of 2021, IMCRC launched a competitive $5,000 scholarship for Masters by Coursework students undertaking a semester-long manufacturing focused research project as part of their degree. With the aim to encourage students to collaborate with industry and consider manufacturing as a potential career path, IMCRC supported three domestic students through the scholarship. One of the industry partners has integrated the technology developed during the project into the day to day running of their manufacturing facility.

IMCRC unites people with different professional backgrounds and motivations, helping them reach mutually beneficial outcomes. I take pride in facilitating collaborative projects that help catalyse the transformation of the Australian manufacturing industry.

Dr. Min Yin Yap
Project Research and Education Officer

Driven by her desire to foster collaborative relationships, Min is responsible for the coordination of more than 30 of IMCRC's industry-led collaborative research projects.

With a PhD in Biochemistry and Molecular Biology and extensive experience as a research scientist, Min's combination of technical knowledge and project management expertise has helped her form trusted relationships with IMCRC's research and industry participants.

During her four years at IMCRC, Min has supported the delivery of research and development projects across a broad range of industries, including one of IMCRC's flagship projects with global medical technology firm Stryker and research partners RMIT University, the University of Technology Sydney, University of Sydney, University of Melbourne and St Vincent's Hospital Melbourne.

Passionate about developing the capability of Australia's next generation of researchers and manufacturing talent, Min also works with IMCRC's PhD and Masters students, helping them connect, share research insights and consider the next steps in their career. Throughout 2021, with the launch of the "Unlocking potential in manufacturing" webinar series, she provided them a platform to present their research to the wider manufacturing community and build valuable professional connections.

What has inspired you most during your time at IMCRC?

"Experiencing firsthand how effective collaboration between academia and industry can deliver outcomes that truly benefit our society. I believe it is critical for research to move from the world of academia to commercialisation to have a positive impact on the world. Through my role at IMCRC it has been very rewarding to have played a part in catalysing this impact.

Areas of focus:

- Project management
- Education
- Client services
- Research

Industry Training

- Together with its deployment partners, IMCRC hosted 23 futuremap workshops throughout the reporting period, of which 19 were delivered in an online setting due to COVID-19 restrictions. 115 manufacturing businesses from across Australia participated in 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 646 manufacturers have used the business diagnostic tool to assess their business capabilities and map out the best path for adopting advanced manufacturing in their operations.
- Despite COVID restrictions easing toward the end of 2020, less happened across the sector in terms of industry events and conferences. IMCRC virtually presented at 10 manufacturing-focused forums with Austrade's Masterclass, MaDE New Zealand and Techtonic 2.0 generating local as well as international reach.
- At the annual conference of the Industry 4.0 Advanced Manufacturing Forum in October 2021, IMCRC presented 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. By hosting a virtual panel of industry experts who shared their Industry 4.0 story, IMCRC outlined practical pathways to accelerate the uptake of Industry 4.0 in Australia. The session was attended by 120 people from industry, research and government.
- On behalf of IMCRC, Swinburne's Factory of the Future assessed the digital manufacturing capabilities of 11 companies using IMCRC's futuremap Industry 4.0 assessment methodology.
- The past year saw IMCRC expand its commitment to establishing a national network of Industry 4.0 hubs. True to its mission to help catalyse the transformation of Australian manufacturing, IMCRC supported the establishment of the ARM Hub and has since been involved in establishing programs of activity applying Industry 4.0 technologies and processes.

* photo credit: IMCRC

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 Industry Growth Centre
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
Griffith	Griffith University

IIC	Innovation Investment Committee
IP	Intellectual Property
ITP	Industrial Transformation Program
MD	Managing Director
MTP Connect	Medtech and Pharma Industry Growth Centre
MOU	Memorandum of Understanding
NRC	Nominations and Remuneration Committee
SUT	Swinburne University
TC	Transition Committee
TMI	Tonsley Manufacturing Innovation Hub
UniSA	University of South Australia
UTS	University of Technology Sydney
UTAS	University of Tasmania
QUT	Queensland University of Technology

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