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Innovative Manufacturing Cooperative Research Centre (IMCRC)

HIGHLIGHTS AND ACHIEVEMENTS REPORT 2016-2022

Australian Government
Department of Industry, Science and Resources

AusIndustry
Cooperative Research Centres Program

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Disclaimer
IIMCRC has endeavoured to ensure that the information in this publication is correct. This report has been prepared to align with IMCRC's Commonwealth Agreement, referencing the outcomes, activities, participants and other matters as at 31 December 2022, unless it is otherwise specified in the document.

The Report has been produced sustainably in Australia, using recycled material. Only a limited number of reports have been printed, adhering to IMCRC's paperless office policy.

CONTENTS

HIGHLIGHTS AND ACHIEVEMENTS

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Achievements 2016 - 2022

71
MANUFACTURING R&D PROJECTS COMPLETED

$40M
COMMONWEALTH FUNDING

78
INDUSTRY PROJECT PARTNERS

300+
INDUSTRY EVENTS, CONFERENCES AND WORKSHOPS SUPPORTED

14
RESEARCH ORGANISATIONS

24 PhD & 9 MASTERS
STUDENTS ENGAGED IN IMCRC'S RESEARCH COHORT

170+
RESEARCH PUBLICATIONS PUBLISHED

9
"MASTERS BY COURSEWORK" SCHOLARSHIPS SUPPORTED

$254M
TOTAL MANUFACTURING R&D INVESTMENT

800+
MANUFACTURING SMES COMPLETED FUTUREMAP®

25
MANUFACTURING INTERNSHIPS IN COLLABORATION WITH APR.INTERN

IMCRC has been a highly successful industry-led, for impact cooperative research centre with a vision for Australian manufacturing to be thriving, relevant and globally integrated. Through collaborative investment, research impact and innovation, IMCRC helped transform Australian manufacturers, particularly small and medium enterprises (SMEs). Working with industry and by investing $40m of Commonwealth funding from 2016 to 2022, IMCRC drove more than $250m of investment in innovative manufacturing and Industry 4.0 R&D projects as well as SME engagement and education programs.

An independent impact evaluation on IMCRC completed by ACIL Allen determined that this investment will by 2030 create at least $4.2bn in economic benefit to Australian industry, more than 6,000 jobs and a further $2Bn in R&D and technology investment. ACIL Allen included that “the results of our analysis and the strong testimonies provided by participants in the case studies show that IMCRC’s industry-led model has resulted in significant positive impacts for the Australian manufacturing industry. There is also evidence that IMCRC’s approach has encouraged strong and sustained industry and research collaboration for project participants.”

"Over its lifespan, IMCRC has driven significant change for Australia’s manufacturing ecosystem, helping catalyse the transformation of the sector through collaborative investment, research impact and innovation."

THE HON IAN MACFARLANE
CHAIR, IMCRC

Industry-led Manufacturing Research across Australia and New Zealand

* as at 31 December 2022
projects shown per industry partner location

Impact and Outcomes

Since its launch in 2016, IMCRC has purposefully invested **$34 million of Commonwealth and other funding** to advance Australian manufacturing catalysing **$254m investment** in collaborative research, manufacturing innovation and education across Australia.

$34m
CRC cash co-invested in projects

71
transformative industry-led R&D projects

80%
of projects with Australian owned SMEs

7.6x
multiplier on Commonwealth funding

$254m
total R&D investment

$4.2bn+
industry economic benefit to 2030

FOCUS	INDUSTRY FOCUS	RESEARCH COLLABORATION	MANUFACTURING INNOVATION	INDUSTRIAL TRANSFORMATION	ACROSS AUSTRALIA AND BEYOND
APPROACH	• Being industry-led • Driving real-world manufacturing, commercial and global outcomes • Removing barriers to SME participation • Taking proof of concepts through to pilot readiness and commercial investment (TRL/MRL 4-7/8) • Project IP owned and commercialised by project partners, not by the CRC	• Accessing a network of 12 universities, the CSIRO and St Vincent's Hospital • 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
OUTCOMES	• **78 industry project participants** • **67% cash and 80% projects funded with Australian SMEs** • **$4.2 billion economic benefit to 2030**	• **71 projects completed** • **24 PhD and 9 Masters students, plus 25 manufacturing internships backed by APR.Intern** • **$2 billion in further R&D through to 2030**	• **Projects across the Government's Key Priority Sectors as well as National Manufacturing Priorties** • **Investment in all CSIRO defined key enabling manufacturing technologies**	• **futuremap® inspired 1,000+ manufacturers (80% SMEs) to future-proof their business and invest in Industry 4.0** • **Catalysed the ARM Hub establishment in QLD**	• **Industry-led investment across all states and the ACT** • **>80% CRC cash co-invested with Australian owned businesses**

The Industry Impact of IMCRC

IMCRC has successfully invested $34 million of Commonwealth and other funding in 71 industry-led research collaborations to help catalyse the transformation of Australian manufacturing. The significant economic, social and environmental benefits of these collaborations have been highlighted in an independent impact report produced by leading economic, policy and strategy advisory firm ACIL Allen. The report identfied:

$4.2 BILLION

IN FINANCIAL BENEFITS TO INDUSTRY BY 2030

OTHER SOCIAL AND ENVIRONMENTAL BENEFITS BY 2030 INCLUDE:

6,000+
ON-GOING FULL-TIME EQUIVALENT JOBS

224
COLLABORATIONS AND NEW PARTNERSHIPS BETWEEN RESEARCHERS AND BUSINESSES

$2 billion
OF FUTURE R&D INVESTMENT PLANNED BY INDUSTRY PARTNERS

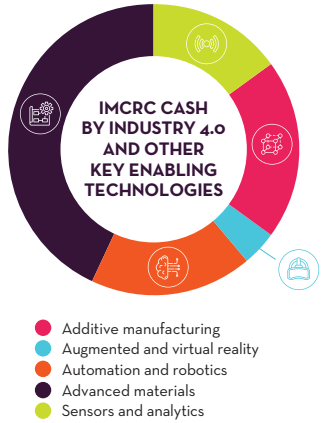
45
POSTGRADUATE COMPLETIONS (INCL. 33 PHD AND MASTER STUDENTS DIRECTLY FUNDED BY IMCRC)

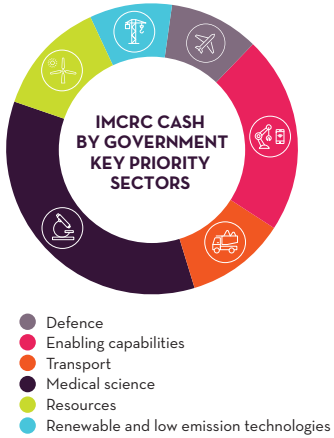
22
NEW BUSINESSES AND BUSINESS OPPORTUNITIES

181
CASES OF INDUSTRY PARTNERS TRIALING NEW TECHNOLOGIES – AI, AUTOMATION AND ROBOTICS, ADVANCED MATERIALS, VIRTUAL AND AUGMENTED REALITY, ETC

REDUCTION IN GREENHOUSE GAS EMISSIONS OF MORE THAN 3,300,000 TONNES CO_2

IMPROVED ENVIRONMENTAL OUTCOMES / MORE SUSTAINABLE BUSINESSES





The Model behind the Success

AN INNOVATIVE AND PROVEN CRC SUCCESS MODEL

- Industry-led – Board, management and programs - with a strong focus on manufacturing, commercial and global outcomes, through removing barriers to SME participation
- Transformative and collaborative projects that take proof of concepts through to pilot readiness and commercial investment (MRL/TRL 4-7/8)
- Network of 14 research organisations including the CSIRO
- Project funding capped at $3m matched cash per business
- Shorter, faster IMCRC activate project collaborations for SMEs
- In-kind contribution not matched with CRC cash
- No project IP owned by the CRC
- Independent Investment Committee assessed new projects, including for ROI
- Successful education and awareness programs designed uniquely for industry SMEs

A DRIVER OF COMMERCIAL OUTCOMES

WHY?

projects solved problems, delivered outcomes and benefits to broader Australian manufacturing industry

HOW?

projects applied innovative manufacturing / Industry 4.0 technologies and unique business models, accessed global supply chains and involved effective collaboration (with SMEs)

WHAT?

projects provided pathways to new markets, addressed the competition, developed an IP and commercialisation strategy and delivered a return on investment

A CATALYST FOR SME INDUSTRIAL TRANSFORMATION

- futuremap®, IMCRC's unique and proprietary SME maturity diagnostic, challenged 800+ manufacturing SMEs and many larger businesses to future-proof their businesses and invest in Industry 4.0
- Strategic partner for Fraunhofer engagements on Industry 4.0 in Australia and New Zealand
- Led the Technology Applications and Digital Business Models workstream as part of the Industry 4.0 Advanced Manufacturing Forum

A CATALYST FOR INVESTMENT INTO BROADER AUSTRALIAN DESIGN AND MANUFACTURING CAPABILITY AND CAPACITY

- Establishment of the Advanced Robotics for Manufacturing (ARM) Hub with IMCRC participants UAP and QUT
- Foreign direct investment into Australia by Fortune 500 medical technology company Stryker to establish a global R&D Hub
- Establishment of the BAE Systems Australia and Flinders University Line Zero and Factory of the Future at Tonsley

My hope and expectation is that this report will motivate and encourage many more Australian manufacturers to find collaborative partners to drive innovation and industry transformation. IMCRC has shown what is possible, and this report is filled with case studies of exemplars who have achieved significant and scalable success.

A Message from the CEO and Managing Director

Australian manufacturing innovation matters. In 2016, IMCRC set out to grow Australia's manufacturing capability and capacity and drive real-world commercial outcomes, purposely investing in an array of projects spanning from mining to defence. And to encourage growth across the whole sector, we supported start-ups, small and medium enterprises (SMEs) and global multinationals alike.

Together with our partners, we have delivered a robust portfolio of 71 industry-led research and development (R&D) projects. And we did so with a passion for Australian manufacturing and a deep commitment to helping the sector become thriving, relevant and globally integrated. Backed by a transparent governance structure and clear framework for commercialisation, we strategically chose to support innovative collaborations that leveraged Australia's research strength.

From an initial pool of $40m of Commonwealth funding, IMCRC's business model catalysed a $250m project portfolio, which will continue to drive transformative commercial outcomes and shape the future of Australian manufacturing.

Every one of IMCRC's projects has resulted in successful outcomes. Many are already delivering substantial commercial results, growth, new and high-value jobs and exports, and catalysing further investment to benefit Australian manufacturing. While much of the R&D has embraced technology, materials and digital, in each case, success has come by bringing together like-minded, curious, ambitious and willing people. It is people who work out how to best utilise technology to bring new ideas, business models, products, processes, services and platforms to a global market. This is what collaborative R&D can do, and why Australia must intensify investment in capability and capacity building, just as IMCRC has done.

In addition to project outcomes, we have continued to see wider impact through futuremap®, IMCRC's business diagnostic and education platform. In collaboration with our deployment partners, we have helped over 1,000 manufacturers, particularly SMEs, on their digital transformation journey by demonstrating how Industry 4.0 can improve productivity and create opportunities.

In 2022, leading advisory firm ACIL Allen published an independent impact evaluation report that examined the significant economic, social and environmental benefits of IMCRC's collaborations. The report, "The Impact of the IMCRC", found that by strategically investing Commonwealth and other funding, IMCRC has helped generate estimated financial benefits of almost $4.2 billion for industry by 2030 including $3.7 billion in additional revenue.

Looking to 2030, further benefits include the creation of over 6,000 ongoing full-time jobs, 224 collaborations and new partnerships, planned industry investment of $2 billion in future R&D and a reduction in greenhouse gas emissions of over 3,300,000 tonnes CO_2.

While these figures highlight the critical importance of strong commercial and governance frameworks, good relationships have also emerged as key drivers of effective collaboration. Thus, it is exciting to see that IMCRC's collaborative ecosystem facilitates enduring relationships between research and industry partners.

I would like to thank our team, Board of Directors and project partners for their trust and confidence in IMCRC. I especially want to acknowledge their unwavering commitment over the past six years. I am extremely proud to have worked alongside people so invested in Australia's manufacturing industry.

IMCRC leaves behind a strong legacy and a clear framework for commercialising research innovation. It has been a great responsibility and privilege to co-invest Commonwealth funding with industry for the benefit of Australian manufacturing. After witnessing the strength, resilience, passion and ambition of our partners, I have full confidence in their ability to build the industry we need.

Thank you.

David Chuter
CEO and Managing Director

CHAMPIONING MANUFACTURING INNOVATION

* photo credit: IMCRC

Research-led Innovation

As a champion for manufacturing innovation and transformation, IMCRC established a proven innovation framework for helping manufacturing businesses of all sizes connect and build trusted research partnerships with Australia's leading universities and the CSIRO.

By driving collaborative investment, research impact and innovation, IMCRC supported 71 industry-led projects, across four research programs that explored, developed and commercialised technologies and business models that addressed industry-specific problems. By investing $30m of Commonwealth cash into R&D, IMCRC catalysed more than $220m in project investment, at a greater than 7x multiple. These projects delivered transformational research and commercial outcomes for Australian manufacturing, helping the sector meet the challenges and opportunities of today's global economy.

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

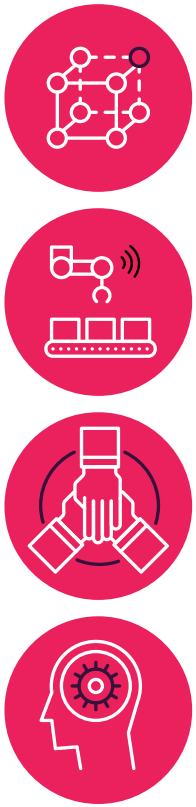
IMCRC supported four research programs:

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

Diverse in nature, IMCRC co-funded projects across multiple industry growth sectors including the National Manufacturing Priority and Government Key Priority Sectors, with investment in all CSIRO defined key enabling manufacturing technologies.

With 'activate', IMCRC developed and deployed a unique funding program to support manufacturing businesses, particularly manufacturing SMEs, to accelerate their COVID-19 recovery. Since launching the program in June 2020, IMCRC invested around $4 million in 36 shorter-term, high-impact R&D collaborations spanning multiple industry sectors.

173 research publications have been published.



ADDITIVE MANUFACTURING PROCESSES

AUTOMATED AND ASSISTIVE TECHNOLOGIES

HIGH-VALUE PRODUCT DEVELOPMENT

INDUSTRIAL TRANSFORMATION

Commercialisation and utilisation

It is expected that the majority of research translation into commercialisation and utilisation outcomes will occur after IMCRC's term ended in 2022. Within the CRC's term, there were already many successful outcomes arising from IMCRC's research activities, including as examples:

- FormFlow developed a new high volume, scalable manufacturing cell
- HYDAC developed a new virtual and augmented reality maintenance training for industrial machines
- Monitum developed and launched Kurloo, a new IoT enabled solution to monitor ground movement
- SPEE3D developed a new machine vision technology for Industry 4.0 high speed printing
- BiomeBank developed a new hydrogen-based perfusion bioreactor to engineer stable gut microbial composition
- gTET developed a new high speed permanent magnet rotor post assembly magnetisation and power conversion systems manufacture
- Boral developed a new ultra-sustainable concrete with high supplementary cementitious material (SCM) content
- Thales developed a new lightweight Australian composite overwrapped gun barrels
- Xefxo developed a new atmospheric plasma coating system
- Sleep Corp developed a novel virtual manufacturing system approach for integrated flexible low-cost manufacturing
- UAP established the ARM Hub with QUT
- Stryker established a new R&D Lab in Brisbane

In addition to utilisation of research outcomes, IMCRC also successfully utilised outcomes from its Industrial Transformation Program, particularly through futuremap®. Even in a COVID-19 disrupted period, IMCRC was able to continue to deliver futuremap® to manufacturing businesses in Australia, supporting them with the insights they need in order to success transform to modern manufacturing businesses.

Spin-off companies and inventions

As a result of IMCRC's operating model which involved Project IP being owned by project partners, IMCRC did not generate spin-off companies in its own right.

As noted in the prior Commercialisation and Utilisation section, the outputs of IMCRC's research portfolio (including any inventions) were intended to largely be commercialised/utilised by the industry partners as exemplified by the industry partners highlighted in that section and in the Annual Report.

At IMCRC's term end, many examples of spin-out companies by industry partners existed, particularly to hold technology created and to accelerate commercialisation of IMCRC project research outcomes, including

- CADWalk
- Nutromics
- Corin (Anisop)
- Bone Ligament Tendon (Ginan)
- Monitum (Kurloo)
- UAP (FARM and the Advanced Robotics for Manufacturing (ARM) Hub)
- Plastfix (Tradiebot)
- Semifab (Questsemi Australia)

Importantly, IMCRC catalysed the creation of several new spin-offs from its research project partners including

- the Queensland Advanced Robotics for Manufacturing (ARM) Hub arising from IMCRC's UAP, QUT and RMIT project
- the Tonsley Line Zero and now Factory of the Future facility with BAE Systems and Flinders University
- the Australian R&D lab arising from IMCRC's Stryker project in partnership with the Queensland Government.

SME Engagement

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

IMCRC's business model included a specific focus on incentivising SME manufacturers to engage and collaborate with Australian research organisations, with the programs designed intentionally to remove barriers to participation for SMEs.

- IMCRC co-invested around 67% of its cash and 80% of projects with Australian SMEs.
- During COVID, IMCRC designed and launched an SME targeted 'activate' program, resulting in additional 36 manufacturing projects. Participation required that industry SMEs own the IP created to maximise commercial opportunities.
- IMCRC raised awareness and shared 'manufacturing' insights impacting Australian SME manufacturers at industry events, webinars and workshops, as well as frequent thought and action leadership artciles dedicated to SMEs.
- IMCRC developed a unique and IMCRC proprietary education program and maturity diagnostic for manufacturing SMEs. Since its launch in 2018, over 800 Australian manufacturing SMEs have participated in futuremap® and outlined their first or next step in their digital transformation journey. This included a partnership engagement with the Entrepreneurs' Programme.
- IMCRC strengthened its SME engagement process by deepening the collaboration with the Industry 4.0 engagement hubs. The University of Technology Sydney's SME engagement program 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 of digital and advanced manufacturing technologies among SMEs.
- IMCRC 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.

* photo credit: IMCRC

* photo credit: IMCRC

futuremap®

Australian manufacturers know about the benefits of Industry 4.0: smarter, more efficient, sustainable operations and new business models. What's hard is getting started and turning that knowledge into action, particularly for manufacturing SMEs.

With that in mind, IMCRC as part of its Industrial Transformation Program designed futuremap®, a business diagnostic and education platform that addresses the challenges and inertias of Australian manufacturing SMEs around Industry 4.0 and digital transformation.

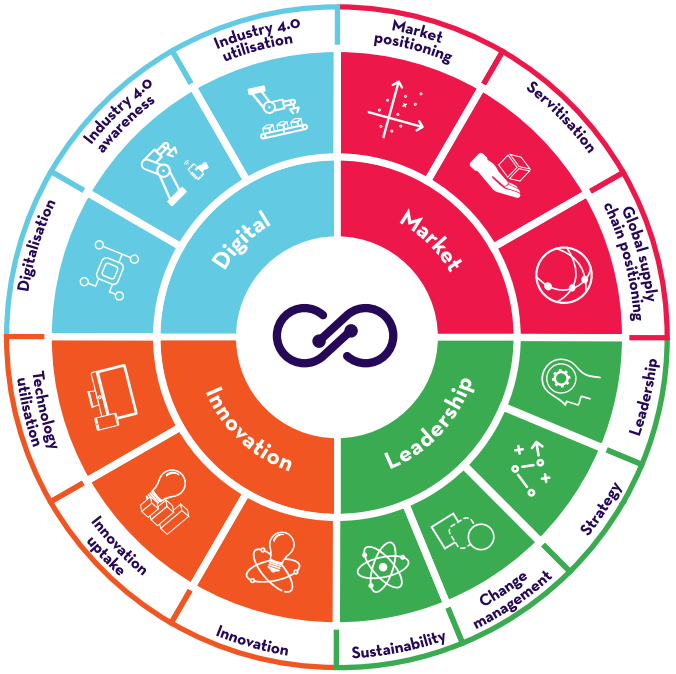
Across 13 key areas of industrial and manufacturing competitiveness the diagnostic prompts manufacturers (business owners and executives) to reflect on their business' current performance as well as encouraging them to think ahead two years - highlighting key ambition gaps and areas of potential focusas well as action. By combining this detailed diagnostic with a workshop filled with relatable use cases, manufacturers have the opportunity to discuss latest advancements and use their futuremap® results to prioritise areas of innovation and define their own pathways to integrate Industry 4.0 technologies across their organisation.

Since the launch of futuremap in 2018, over 800 Australian manufacturing SMEs have taken part in workshops or one-on-one discussions so far, using the opportunity to outline the first or next step in their digital transformation journey.

Reviewing the aggregated data of those who participated in futuremap® shows that many SME manufacturers will be increasing their investment in Industry 4.0 and key enabling technologies over the coming years. Importantly, the more ambitious companies also look beyond simple investment and see the potential for bigger benefits by integrating Industry 4.0 across their entire value chain and developing a robust innovation culture.

Helping SMEs innovate and grow

An independent evaluation of the impact and effectiveness of futuremap® conducted by the Centre for Transformative Innovation at Swinburne University of Technology in July 2022 revealed that manufacturing businesses that engaged in a futuremap® workshop were found to be growing faster and innovating more than their closest peers, reporting an average increase of 15.5% in sales, 21.5% in wages and 6.6% in staff. Also, by them prioriting investments in marketing and sales, operational transformation and human capital, the report suggests, futuremap® has encouraged manufacturers to think differently and complement their existing business strength.



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

International Engagement

IMCRC catalysed substantial structural investment into Australia.

IMCRC helped build ongoing Australian design and manufacturing capability and capacity by leveraging the project funding and outcomes from its projects, including:

- BAE Systems Australia with the establishment of the Tonsley Line Zero and subsequent Factory of the Future facility with Flinders University in South Australia
- Stryker with the establishment of their Australian R&D Lab in Queensland

IMCRC's Industrial Transformation Program was enhanced through a continued strategic and collaborative engagement with Germany's Fraunhofer Institutes, formalised through an Engagement Framework and Licensing Agreement for Industry 4.0 research, know-how and materials. This Agreement defined IMCRC as the strategic engagement partner for Industry 4.0 with all Fraunhofer Institutes for Australia and New Zealand. IP licensed from Fraunhofer was embedded into IMCRC's proprietary futuremap® platform, the education and training program specifically designed by IMCRC for Australian manufacturing and industrial SMEs, to raise awareness and stimulate investment in leadership, business models, innovation and digitalisation (Industry 4.0 investment).

IMCRC also collaborated with Germany's Platform Industrie 4.0 work stream leads, including being a frequent representative of Australian innovation, research and manufacturing in Germany, and as part of the Prime Minister's Taskforce (now Forum) for Industry 4.0.

IMCRC engaged with several UK Catapult Centres, Manufacturing USA Institutes, Israel high-tech hubs, Hong Kong Productivity Council and New Zealand's Callaghan Innovation to drive collaboration and best practice internationally and within Australia and New Zealand.

IMCRC frequently supported Austrade initiatives internationally to help drive international engagement, export and foreign investment opportunities.

Education and Training

IMCRC's Education and Training activities focused on helping to catalyse the transformation of the Australian manufacturing sector. A large component of this involved 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.

Student Engagement and Development

- IMCRC's student community included 24 PhD and nine Masters students.
- IMCRC PhD student Dylan Ashton won the 2021 Cooperative Research Australia Early Career Researchers Competition for his research presentation about investigating the effectiveness of kangaroo tendons to treat anterior cruciate ligament (ACL) injuries.
- A further 25 PhD students have been supported for PhD internships with Australian manufacturing SMEs through IMCRC's partnership with the Australian Mathematical Sciences Institute's APR.Intern program.
- IMCRC granted nine Masters by Coursework scholarships.

Industry Training

- Since the launch of futuremap® in March 2018, more than 800 SME manufacturers together with many larger businesses, have used the education platform and business diagnostic to assess their business capabilities and map out the best path for adopting Industry 4.0 principles and technologies within their operations. futuremap was designed to help manufacturing businesses demystify Industry 4.0 and weigh up the benefits, costs and practicalities of its implementation, as well as focusing on leadership, innovation and digital business models.
- IMCRC partnered with select universities as futuremap deployment partners to further catalyse industry engagement with universities.

Australian Manufacturing SMEs benefit from PhD Expertise

In 2019, IMCRC partnered with Australian Postgraduate Research Intern (APR.Intern) – Australia's only PhD internship program spanning all sectors, disciplines and universities – to help small to medium enterprises (SMEs) lift their advanced and digital manufacturing capabilities and to take advantage of the fourth industrial revolution (Industry 4.0).

Through the partnership, IMCRC subsidised 50% of the cost to each business for short-term internships that explored the adoption of Industry 4.0 technologies and business models to address manufacturing-specific challenges. Over the course of four years, 25 manufacturing SMEs from across Australia have taken advantage of the program and secured the support of a skilled intern.

Tapping into research expertise and talent

Working with all universities across Australia and operating as a single point of access, APR.Intern makes it easy and cost-effective for manufacturing SMEs to tap into the specialised skills they need to take the first or next step to advance an in-house R&D project.

After defining the business problem, APR.Intern finds a suitable PhD student who brings the right expertise – be it automation, robotics, artificial intelligence, additive manufacturing or augmented reality – to the manufacturing table. With the support of the student over three to six months, SMEs then have the opportunity to rapidly prove, develop and scale their new product, process or service – enabling them to turn ideas into reality. And importantly, the SME retains the IP and benefits over the long term.

APR.Intern National Program Manager, Lisa Farrar, said the partnership with IMCRC had received overwhelmingly positive feedback from industry and universities alike.

"The subsidy that IMCRC provided has undoubtedly strengthened industry-university collaboration within the sector. 90% of businesses that utilised the subsidy were start-ups or SMEs, providing them with much-needed support to engage in research collaborations and fast-track innovative R&D," she said.

"Upon completion of the internship, 87% of industry reported that project outcomes were directly implemented in the company, and 75% reported they were seeking co-funding to continue the research."

Creating career opportunities

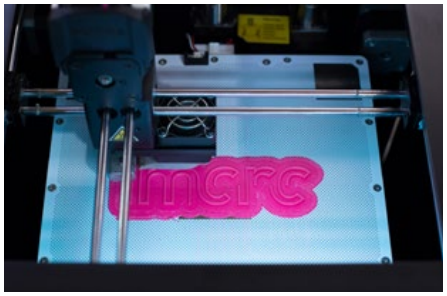
The APR.Intern program has provided students with invaluable industry expertise and real career opportunities. Of the 25 interns placed, nine have continued to work with the industry partner since finishing their internship, eight in newly created roles and one in an existing position. This is a testament to the unique potential of the program, especially in the manufacturing sector. By accessing the skillsets and expertise needed to accelerate their R&D, businesses are seeing the value in embedding researchers into their workforce moving forward.

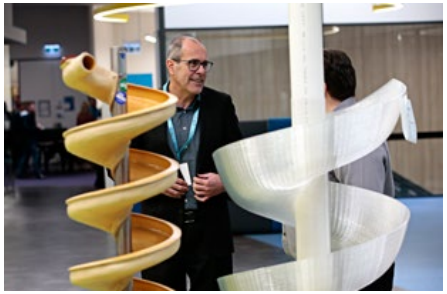
* photo credit: IMCRC

IMCRC Conferences and Showcase

IMCRC's Conferences through the years

* photo credit: IMCRC





* 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."

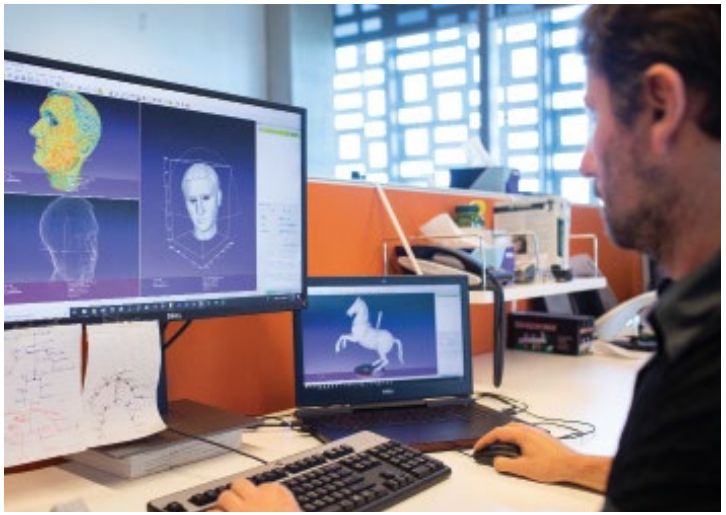
"IMCRC's only agenda is to drive industry 4.0 manufacturing for the benefit of Australia and it will be a significant loss to Australia's industry sector and its future competitiveness to see it come to its natural conclusion."

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.

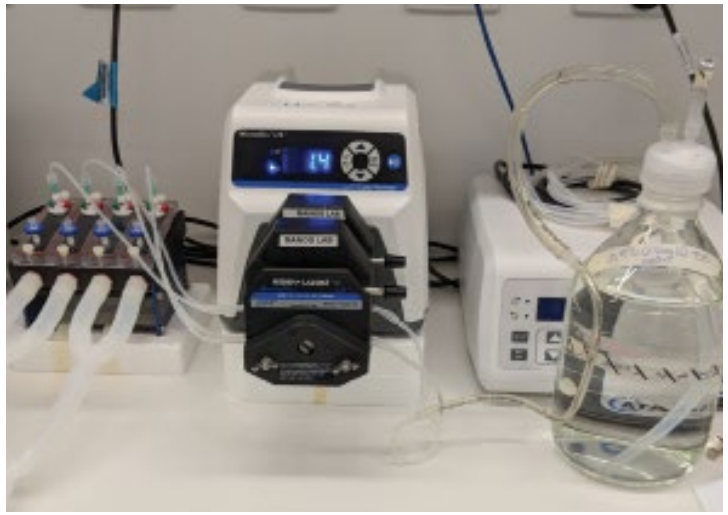
"While many research grant and co-investment programs are short term, one of the strengths of this project is that it has been structured so that our PhD students see the project right through with us, which we believe will ultimately deliver better outcomes for all parties," said Whiteley.

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.

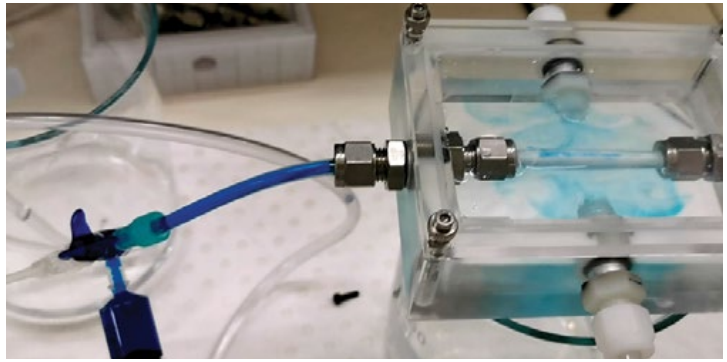
According to Codex Research CEO Edwin Brackenreg, to succeed in bringing the bioreactor technology to market, Codex required an injection of capital and expert-led research.

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.

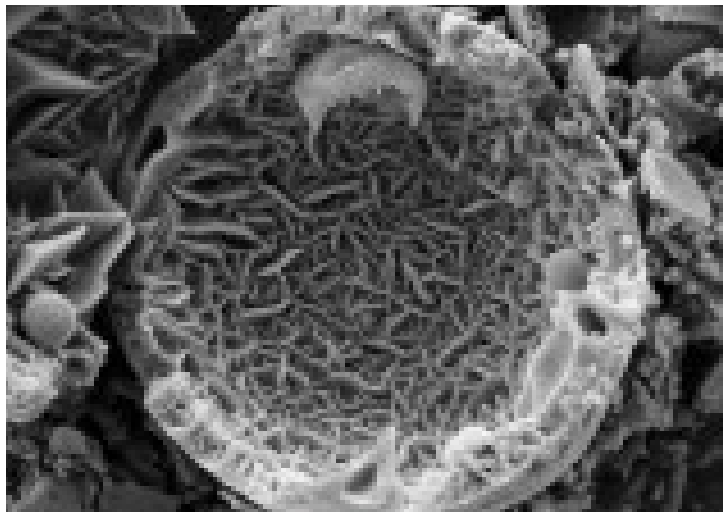
"When you're conducting research, you need to be flexible so you can update, refine and redirect resources and change the shape of the program as needed to achieve a better outcome. Originally, there were concerns that the constraints of reporting, management requirements and legal arrangements around 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.

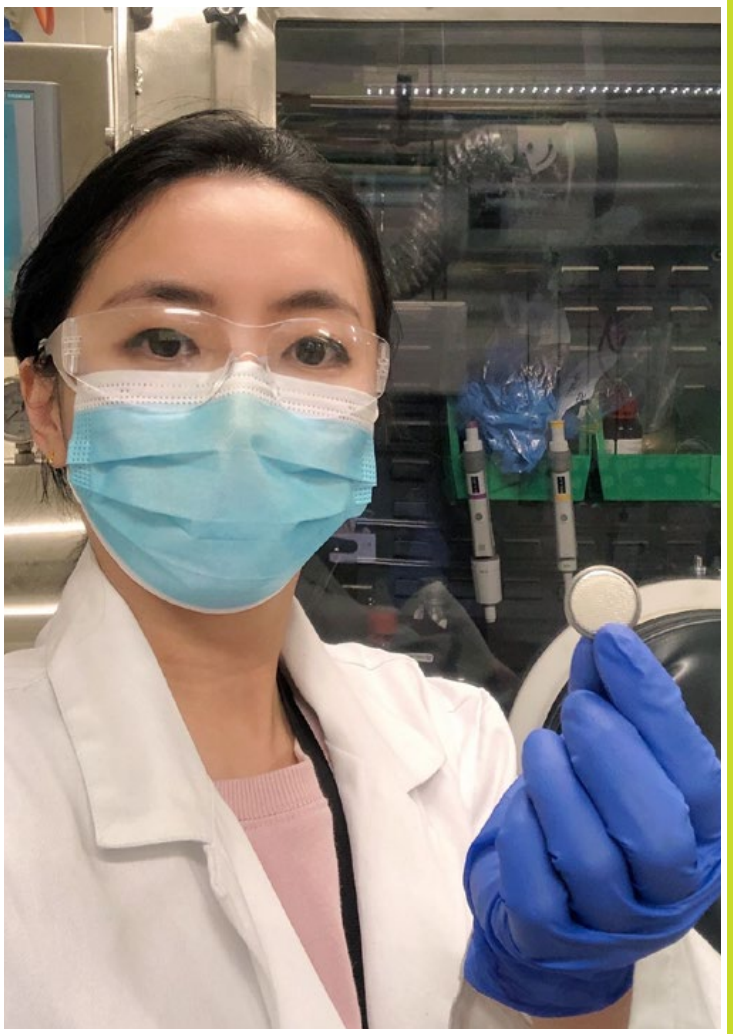
"As a direct outcome of this project we are progressing engineering studies of selected breakthroughs for further development through to demonstration plant scales." he said

"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."

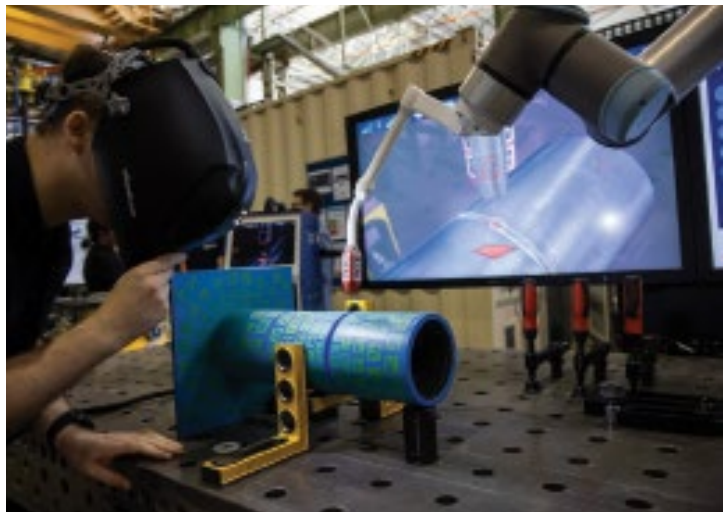
"The integration of the researchers into our sites has been seamless – a true collaboration built on mutual respect and a shared vision of what we want to achieve together."

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: Alcolizer

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: Alcolizer

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."

FormFlow

High volume, scalable manufacturing cell for enhanced building products

* photo credit: FormFlow

It's been a fantastic project. We've met all the milestones we expected to meet and more, in part due to the support and dedication of IMCRC's team.

DR MATTHEW DINGLE
MANAGING DIRECTOR, FORMFLOW

In 2021, Geelong-based manufacturing start-up FormFlow partnered with Deakin University to develop an Industry 4.0 enabled manufacturing cell to optimise and upscale its production capability.

"The scrap rate in the steel manufacturing industry can be as high as 6%," said Dr Matthew Dingle, FormFlow's Managing Director. "One of our motivations was reducing waste by gaining greater oversight into the process monitoring and control of steel forming operations."

With a total project investment of around $1 million catalysed by IMCRC, the 12-month project began by exploring the use of smart vision technologies to trace, evaluate, and monitor forming loads and the profile shape of corrugated steel before and after bending in FormFlow's process.

According to Matthias Weiss, Senior Research Fellow at Deakin University, as the project progressed, it became clear the fundamental research into the solution could inform different directions which would deliver greater efficiencies.

"IMCRC is incredibly committed to delivering real world outcomes for industry. When we approached them with a request to adjust the scope of the project and articulated the benefits for FormFlow and the broader industry, IMCRC approved it straight away. Because of this flexibility, we were able to realise unexpected – but fantastic – commercial outcomes. It's been one of the most successful and fulfilling projects that we have participated in," he said.

Matthew added, "By facilitating a change in scope, IMCRC supported two new FormFlow innovations: a 2D laser system that enables the manufacturer to perform continuous, real-time quality control and an Industry 4.0 manufacturing cell capable of producing a corrugated corner bend from a flat sheet of steel."

"We've already had significant interest in both products, and the research has also helped to expand other areas of FormFlow's business. It's been a fantastic project. We've met all the milestones we expected to meet and more, in part due to the support and dedication of IMCRC's team."

* photo credit: FormFlow

HYDAC Australia

Explosion diagram based virtual and augmented reality maintenance training for industrial machines

* photo credit: HYDAC

The collaboration with Deakin Motion.Lab and IMCRC has been seamless. Collectively, our team had the breadth and depth of experience we needed to navigate the unknowns of virtual reality and move from prototype to commercialisation.

MARK KEEN
MANAGING DIRECTOR, HYDAC AUSTRALIA

Currently, Australia has a significant shortage of workers qualified to maintain hydraulic machinery.

In 2020, HYDAC Australia partnered with Deakin University to bridge this skills gap. The solution? A virtual reality technology that enabled HYDAC to remotely deliver its nationally recognised training courses in hydraulics.

After successfully prototyping the technology, HYDAC embarked on a 24-month collaboration with Deakin Motion Lab and IMCRC to develop the virtual and augmented reality solution for commercial use.

According to HYDAC Australia's Managing Director, Mark Keen, the IMCRC-facilitated research collaboration greatly enhanced the features and functionality of HYDAC's technology.

"This project has transformed HYDAC's initial concept to an exciting, engaging mixed reality training environment that supports collaboration and delivers a virtual hands-on experience," he said.

"Through the HoloLens, trainees on the ground can receive real-time assistance from a master technician. Despite being at separate locations, the master technician can provide verbal guidance, send technical documentation and review and assess the trainee's completed work."

Key to developing the innovative training solution was IMCRC's structured, milestone focused approach, which ensured HYDAC was guided by strategic and commercial objectives.

"The collaboration with Deakin Motion.Lab and IMCRC has been seamless. Collectively, our team had the breadth and depth of experience we needed to navigate the unknowns of virtual reality and move from prototype to commercialisation," Mr. Keen said.

For HYDAC, the opportunity to access assistance and funding from IMCRC was the catalyst for moving forward with the project.

"It's been a tremendous collaboration that has generated unexpected commercial opportunities," Keen said.

"We started out by designing a mixed-reality solution for HYDAC's existing customers. But what we ended up creating has applications across many industrial sectors.

"It's particularly relevant for businesses based in remote locations or those requiring high-risk maintenance work, including defence, mining and agriculture.

"This project has also catalysed further investment into virtual reality research with Deakin, enabling two PhD students to continue advancing HYDAC's technology for other applications.

"It's a great result, and IMCRC's support has been critical to achieving this outcome. We couldn't have asked for more," Mr. Keen concluded.

* photo credit: HYDAC

Monitum

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

* photo credit: QUT

This IMCRC project is an exemplar of how a small business with innovative ideas, passion and drive can partner with a leading university to transform its offering and create opportunities for Australia's manufacturing sector.

LEE HELLEN
MANAGING DIRECTOR, MONITUM

Geospatial data is a critical component of every construction project, reducing risk and improving efficiencies. But gathering this data is often costly and labour intensive. And while some automated options exist, more affordable, simpler products are needed to enable broader uptake of precise positioning technology.

Monitum, in partnership with Queensland University of Technology (QUT), has developed a cost-effective Internet of Things (IoT) solution using low-medium-end Global Navigation Satellite System sensors and low-power wide-area networks.

According to Monitum's Managing Director Lee Hellen, Monitum's Australian made product will make precise positioning accessible and affordable, with applications across industries such as infrastructure, transport and mining.

"We've created a fully integrated smart device that is supported by a cloud processing and data analytics service. Together, they enable millimetre-precise deformation data to be obtained automatically, remotely and in near real-time," he said.

Critical to delivering such an innovative outcome was the collective research competence provided by QUT's project team, led by Professor Yanming Feng.

"Closely collaborating with a foresightful business like Monitum enables researchers to focus on technological challenges and achieve the expected outcome," said Professor Feng.

"In this instance, we were able to work together as one team, and the project outcome is a testament to the importance of this effective collaboration."

Raymond Johnson, Manager, Industry Engagement (Science and Engineering) at QUT, added that the successful research findings had strengthened the university's credibility within the geospatial sector.

"QUT now has a persuasive case study in geospatial science to demonstrate its capability, allowing the university to undertake more diversified research in IoT and positioning technologies," he said.

Throughout the collaboration, Monitum installed and tested the sensor devices across multiple environments including large scale infrastructure for the likes of Port of Brisbane and Queensland Rail. A leading geotechnical consultancy, Butler Partners, tested the sensors across three diverse environments and Australian electronics manufacturer, Intellidesign, assisted with the design and production.

In addition to the industry partnerships, Hellen identified IMCRC's business model as key to supporting the fruitful project, as it incentivised university-industry collaboration and drove co-investment.

"By championing the project and being a hands-on advisor, IMCRC helped formalise our idea, kept us committed to the innovation, and ensured we were able to reach mutually beneficial outcomes," he said.

"This enabled us to engage a local Australian manufacturer, giving greater design control and certainty of a local supply chain. Monitum can now offers customers a 100% Australian made product in a market currently dominated by overseas competitors.

"And by embracing Industry 4.0 technologies, we've been able to future-proof our business," Hellen concluded.

Monitum launched its new technology under the name Kurloo in June 2022.

kurloo

* photo credit: Kurloo Technologies

SPEE3D

Machine vision for Industry 4.0 high-speed printing

* photo credit: SPEE3D

As a start-up, we knew we had to tap into the research ecosystem to access the skills and resources we didn't have in-house. By partnering with IMCRC and UTS Rapido, we have been able to develop something we wouldn't have been able to do on our own.

BYRON KENNEDY
CO-FOUNDER AND CEO, SPEE3D

Melbourne-based manufacturer SPEE3D was established by two engineers with an ambitious mission: to make it easier to manufacture high-quality, cost-effective industrial metal parts.

SPEE3D had the metal additive manufacturing technology to support its vision, with the ability the create metal parts in just minutes. However, to compete with traditional sand-casting techniques, there was an opportunity to further improve its existing process and address complex manufacturing problems. The manufacturer looked to R&D to do so, partnering with IMCRC and Rapido at the University of Technology Sydney (UTS) on a one and half year, $1.3 million project in 2017.

This research partnership aimed to develop 3D scanning technology to monitor the manufacture of metal parts during and after printing, improving speed, quality and accuracy.

SPEE3D and UTS Rapido were ultimately successful, and the outcomes of their research led them to invest in another project with IMCRC. Commencing in 2019, the project sought to further upscale the technology and expand its application to automate and digitalise the repair and replacement process of metal parts.

"As a start-up, we knew we had to tap into the research ecosystem to access the skills and resources we didn't have in-house. By partnering with IMCRC and UTS Rapido, we have been able to develop something we wouldn't have been able to do on our own," said Byron Kennedy, Co-founder and CEO, SPEE3D.

"We're now moving to commercialise the technology, testing it with customers and assessing the demand across various sectors including defence and automotive. And there's no doubt we will invest in some follow-on projects as well.

"Our work with IMCRC and UTS has also supported SPEE3D's expansion. In five years, we have grown from two employees in Melbourne to 60 employees spread across offices in four countries."

Byron credited the success of the projects to IMCRC's business model, as it enabled commercial companies and academia to effectively work together and negotiate intellectual property ownership.

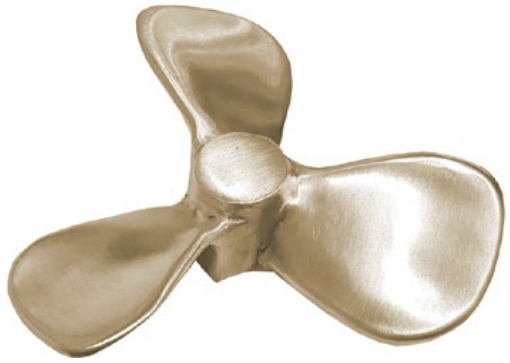
Hervé Harvard, Founding Executive Director of UTS Rapido, UTS' advanced R&D engineering and technology consultancy, echoed Byron's sentiments.

"With IMCRC's support, we established something more than just a simple transaction or project collaboration. We built a trusting and respectful relationship with SPEE3D, and the projects serve to demonstrate how UTS Rapido can help our partners with their R&D and innovation strategies," he said.

Stuart Warren, Principal Delivery Manager at UTS Rapido and the driving force behind both projects, attributed their success to the in-person interactions between UTS Rapido and SPEE3D.

"Having one-on-one time with the engineering team at SPEE3D built invaluable relationships and enabled us to problem solve more easily," he said.

"IMCRC was cognisant of these benefits and facilitated additional travel to Charles Darwin University to test programming on installed operational machines. As a result, we have concluded the project with software that's fully integrated into SPEE3D's system. We can't thank IMCRC more. The team has been phenomenally supportive."



*Aluminium Bronze Propeller

* photo credit: SPEE3D

BiomeBank

Hydrogen-based perfusion bioreactor to engineer stable gut microbial composition

* photo credit: RMIT

The work that we're doing with RMIT University, with the support of IMCRC, is propelling us into the future. We're developing new microbiome-based therapies that are now scalable and can be made available globally.

THOMAS MITCHELL
CEO, BIOMEBANK

Clinical stage biotechnology company BiomeBank specialises in Faecal Microbiota Transplantation (FMT) therapy, which involves transplanting the microbial community from a healthy donor into a person with chronic disease. By traditionally taking individual stool samples, extracting the bacteria under anaerobic conditions, mixing it with excipients before freeze drying and encapsulating the end product for oral ingestion, BiomeBank has helped many patients restore their gut microbiome.

To reach more patients and overcome the current production limitations of donor-derived FMT therapy, BiomeBank needed to investigate whether it could co-culture the extracted bacteria in a single bioreactor capable of replicating the complexity of the gut microbiome, thereby reducing costs and creating efficiencies.

"The aim of this bioreactor is to be able reliably produce a complex microbial community of human gut organisms at scale. This has potential to allow us to treat disease on global scale" said Dr Sam Costello, BiomeBank Co-founder and Chief Medical Officer.

With the support of IMCRC, BiomeBank partnered with RMIT University to develop a novel hyrogel bioreactor capable of co-culturing multiple bacteria within one community.

Professor Namita Choudhury, Associate Dean Chemical & Environmental, STEM College, RMIT, said that, while challenging, it was an incredibly exciting project that allowed the team to stretch their thinking and develop an Australian-first biomedical manufacturing technology.

"We have been able to grow up to four communities at once and we're looking to ramp this up to meet the growing demand for innovative and life-saving microbiome-based therapies," said Professor Choudhury.

"For us, knowing that we have the potential to make a significant impact to the health and wellbeing of our society is incredibly satisfying.

"In addition, there is the potential to patent the design of this new manufacturing technology as well as a process patent. Looking forward, we have created an opportunity for Australia to export new microbiome therapies to the world."

BiomeBank Chief Executive Officer Thomas Mitchell said the new technology enables BiomeBank to commercialise at scale, with reproducibility, which would not have been possible without the funding and support provided by IMCRC. Mitchell was also appreciative of the mentoring provided throughout the project, which encouraged the research teams to consider the entire value chain and where the break-through technology sits.

"Being asked to think about how we position our technology and how we communicate our value proposition was very helpful for us. Because we're so entrenched in the day to day, having the ability to work with IMCRC to be more strategic helped us to create a longer-term vision.

"We are now well-placed for success and for creating a meaningful impact on the lives of people around the world."

gTET

High-speed permanent magnet rotor post assembly magnetisation and power conversion systems manufacture

* photo credit: gTET

Without the support of IMCRC, we would not have had the financial means to undertake this project. The integration and support throughout has been incredibly valuable to us.

PAUL KEEN
MANAGING DIRECTOR AND CEO, GTET

The shift to renewable energy has seen the sector for clean technology grow rapidly, with the value of the global market projected to almost double between 2016 and 2025 and expand exponentially to 2050. Australian innovators are embracing the change and fuelling the transition.

Victorian-based gTET is one such innovator, designing and manufacturing thermal energy efficiency equipment. It's the only company in Australia, and one of only a few in the world that produces high speed turbo machinery which helps convert solid waste to energy, heat waste to energy and heat waste to heat.

Paul Keen, Managing Director and CEO of gTET, says the company's core technologies are vital to the clean energy and heat recovery industries and will help companies transition away from gas.

"One of our technologies takes waste heat sources, such as industrial waste heat or renewable heat and generates electrical power from it," he explains. "Essentially, it works in the reverse of refrigeration in that we put heat into refrigerant, we drive it through a turbine, and the turbine generates power.

"Our second product is a high temperature heat pump. It's like a reverse cycle air conditioner, but instead of generating cold it generates heat – up to 150C of heat.

"In the broader context of our net zero targets, electrification and heat, and high temperature heat pumps are a key technology in reducing our reliance on gas."

In partnership with RMIT University, supported by IMCRC, gTET has designed and developed intricate technical components such as a high-speed magnetizer and a power converter that will allow the company not only advance both technologies but bring some of its manufacturing back onshore.

"Due to the specialised nature of our technology, and smaller volumes, we've been importing the turbines however, we're now in a position to be able to investigate local manufacturing and take greater control of our supply chain."

Paul and the team at gTET are grateful for the collaboration with RMIT University and IMCRC, citing the financial support as the driving force for the successful delivery of its project.

"If it wasn't for the contribution from IMCRC, we would not have been able to get to this stage," he says.

"The process was smooth and streamlined and, overall, very pleasant for us which we really appreciated. The level of technical support from RMIT was excellent and the team's ability to identify unique parts supply globally surpassed expectations.

"gTET has undertaken several university collaborations respectively since 2010 and all of the outcomes have provided significant value. We would certainly recommend a collaborative research approach to other businesses as a cost competitive method to drive innovation."

* photo credit: gTET

Boral

Ultra-sustainable concrete with high supplementary cementitious material (SCM) content

* photo credit: Boral

The concrete industry is inherently conservative because of the risks involved. To get our customers to trust Boral's lower carbon concrete, it has to look, feel and behave like regular concrete.

DR ALI NEZHAD
GENERAL MANAGER OF INNOVATION, BORAL

For centuries, concrete has formed the foundations of modern society, shaping the buildings we reside in and roads we drive on.

It's also one of the world's biggest industrial contributors to carbon emissions, accounting for up to 8% globally.

While some lower carbon concretes exist, Australia's largest construction materials and building products supplier, Boral, believes it is possible to further reduce the embodied carbon in concrete through the continuous improvement of its design.

That's why in 2020, Boral worked with IMCRC and the University of Technology Sydney (UTS) on a two-year research collaboration to produce, test and commercialise a new generation of lower carbon concrete.

By replacing 70% of the commonly used concrete binder, Ordinary Portland Cement, with supplementary cementitious materials, Boral's lower carbon concrete will enable further reductions in the embodied carbon of concrete buildings and infrastructure, without compromising concrete's mechanical and durability performance, compared to that achievable using conventional concrete.

Boral's General Manager of Innovation, Dr Ali Nezhad, said the IMCRC-facilitated research project was set to accelerate industry uptake of lower-carbon concrete.

"When we started, we were confident we could develop a lower carbon concrete that met the required standards at 70% cement replacement. The real challenge has been ensuring this concrete behaves like traditional concrete and that our customers can pump and place it using conventional methods," he said.

To achieve this, Boral has worked closely with researchers at UTS on both the hardened and plastic properties of the concrete.

"One of the great things about working with the team at UTS is their expertise in durability and durability testing. This is critical because we have to be confident the embodied carbon reduction objectives are met without compromising the mechanical performance and long-term durability of the concrete," said Dr Nezhad.

Once the required hardened properties had been achieved in the lab, Boral started working with its customers in the field to ensure the concrete's plastic properties would meet industry workability requirements.

Now in its final stages, the research collaboration has created and tested a commercial, scalable solution. Dr Nezhad credits the success of the project to strong collaboration between the parties facilitated by IMCRC's industry-focused approach.

"IMCRC provided invaluable support from day one, shaping the design of the project and encouraging us to engage with UTS across multiple research disciplines including business and Built Environment," he said.

"By facilitating this 'whole of house' approach and setting clear milestones, IMCRC has helped to ensure we will achieve a commercial outcome that our customers will embrace.

"This project represents a significant step change for Boral's lower carbon concrete offering. At the same time, it has generated knowledge, capability and opportunities for researchers and PhD students, as they now have experience solving a real-world, industry-specific problem.

"By focusing on industry needs, IMCRC has helped to raise the credibility of research collaboration within the construction sector and paved the way for future projects," Dr Nezhad concluded.

Thales

Development of lightweight Australian composite overwrapped gun barrels

* photo credit: Thales

The opportunity to finance the project with the help of MCRC was an opportunity that couldn't be missed. We're incredibly pleased we decided to develop and commercialise an Australian-made material of the future.

GABRIEL GUDAS
MANUFACTURING TECHNOLOGY MANAGER, INTEGRATED WEAPONS AND SENSORS, THALES AUSTRALIA

Material made from carbon fibres is incredibly strong and light, making it an ideal replacement for steel or plastic when manufacturing next-generation weapons.

However, the fibres aren't currently made in Australia and procuring them from international suppliers can be difficult due to export restrictions and supply chain disruptions.

In 2021, these factors motivated leading defence contractor Thales Australia to partner with Deakin University on a 6-month, $234,000 research and development (R&D) project.

The project focused on developing Australian-manufactured intermediate modulus carbon fibres for use in civil gun barrels. The novel fibres form an overwrap for the barrel, reducing its thickness and enabling Thales to deliver a lighter, more precise product.

Gabriel Gudas, Manufacturing Technology Manager, Integrated Weapons and Sensors at Thales, said the product had already garnered significant interest from industry, other composite experts and customers across the globe.

"It's a very topical R&D project. We're currently qualifying the product and are planning to manufacture over 1000 units for commercial use in 2023," he said.

"In addition to developing the fibres, one of the main benefits has been the specialised training in composite manufacturing that Deakin provided to our staff from the Lithgow Arms Facility. We've successfully developed a composite demonstrator and our staff now have the skills to support the ongoing manufacture of carbon fibres.

"The research expertise Thales has seen and supported at Deakin is a great indicator of what's possible in Australia. Our industry is growing, and Australia has to be part of it. "

Gudas said in addition to the funding, a key benefit of the collaboration was the critical guidance IMCRC provided at every stage.

"IMCRC's project management structure promoted collaboration, ensured we met our milestones and, I believe, delivered a better outcome as a result," he said.

Prof Russell Varley, Professor of Composite Materials at Deakin University, said the team at Carbon Nexus was grateful for the opportunity to partner with Thales and IMCRC.

"This collaboration enabled us to develop a completely novel intermediate modulus fibre. The knowledge we've honed has expanded our skill set and manufacturing capital, and Carbon Nexus is now looking to see how we can fulfill the demand for low-volume manufacture of bespoke carbon fibre." he said.

* photo credit: Thales

Xefco

Atmospheric plasma coating system

* photo credit: IMCRC

IMCRC encouraged us to think and approach manufacturing in new and unconventional ways. This has not only steered how we shaped our products but informed how we intend to get them to the market.

TOM HUSSEY
CHIEF EXECUTIVE OFFICER, XEFCO

Applying plasma coatings to textiles can create functional products with improved performance. However, conventional coating technology requires the use of a high-pressure vacuum chamber, and as a result, the process is restrictive and costly.

To revolutionise the technology and enable textile coating at atmospheric pressure, advanced textile technology company Xefco partnered with Proficiency Contracting and Deakin University on a three-year, $4.3 million research and development (R&D) project.

The core focus of the research was accelerating the development of Xefco's plasma coating system to deliver a large-scale roll-to-roll prototype.

"By advancing the plasma treatment technology, we will be able to coat and treat large format materials like textile rolls, at a low cost and high production efficiency," said Tom Hussey, Xefco's Chief Executive Officer.

Once a small-scale plasma coating system was successfully delivering functional coatings similar in quality to those produced by commercial solutions, Xefco and Deakin were able to invest in a second IMCRC R&D project. The project's focus was to extend the system's application and develop an alternative, less-water-dependent approach to conventional textile dyeing.

"By utilising our plasma technology to produce different, highly durable treatment options including colour that uses less water and dyeing agent, we hope to tackle some of the environmental challenges associated with current processes, including water pollution and waste," said Scott Whitby, Xefco's General Manager of Plasma Technologies.

According to Hussey, while the grant funding was a key benefit of working with IMCRC, another advantage was the program's focus on exploring longer-term commercial opportunities.

"IMCRC encouraged us to think and approach manufacturing in new and unconventional ways. This has not only steered how we shaped our products but informed how we intend to get them to the market," he said.

"Xefco has also grown as a result of the project, employing new team members and raising money to fund the ongoing development and commercialisation of our plasma coating system.

"And by expanding our project portfolio to explore dyeing applications, we've unlocked new capabilities and new markets which are critical and fundamental to Xefco's success in the future."

* photo credit: Xefco

Sleep Corp

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

* photo credit: Sleep Corp

One of the big awakening moments for me was provided through futuremap®. While completing IMCRC's business assessment, I realised that if we want to go into the future, we have to align and incorporate Industry 4.0 in every aspect of our business.

DAVID KAPLAN
MANAGING DIRECTOR AND CEO, SLEEP CORP

Since 2019, Melbourne-based textile and top-of-bed manufacturer Sleep Corp has been working with IMCRC to overhaul its production processes and develop a sustainable vision for the future.

Valuing resilience, wholeheartedness and interdependence, the business has been on a three-year long transformative journey that commenced with the IMCRC's futuremap business assessment, setting out the strategic priorities for the company.

"We knew we needed to think long term and to put Industry 4.0 and continuous improvement at the core of the next phase of our business journey," said Sleep Corp Managing Director and CEO David Kaplan.

"As a business we wanted to be more self-reliant, while looking for ways to bring down costs and improve efficiencies, but it was difficult to know where to start.

According to Kaplan, it was at this stage that Sleep Corp was introduced to IMCRC.

"futuremap was a critical first step in identifying how we would achieve our vision, and better reflect Industry 4.0 in our business throughout the value chain."

With the Industry 4.0 strategy outlined, the Sleep Corp team partnered with Swinburne University of Technology to design and set up a novel Virtual Manufacturing System (VMS).

"The VMS connects robotics-based machinery to a digital twin allowing for a faster and more flexible manufacturing approach to address changing customer requirements while maintaining cost competitiveness for its range of products," said Kaplan.

Originally looking to retrofit this innovative capability within its existing facility, it quickly became evident to Sleep Corp that more space was required, and the company moved its operations to a greenfield site in November 2021.

Ryland Joyce, Sleep Corp's Operations Manager, who oversaw the delivery of the project and the setup of the new factory, pointed out that IMCRC and futuremap helped shape Sleep Corp's manufacturing future of in more ways than one.

"futuremap made us aware of other technologies and how they could be implemented to benefit the organisation. Warehousing is a classic example. As a result we also implemented an AMR - Autonomous Mobile Robot – system to complement the new manufacturing operation."

"Together with the consciousness of Industry 4.0, futuremap helped us recognise the possibility of doing things differently," Joyce added.

David Kaplan added that they were very deliberate and careful in their transformation and building a manufacturing future versus becoming a net importer of product.

"We now have space to house current and future manufacturing and wholesaling needs, which has not just modernised our processes, but also our culture."

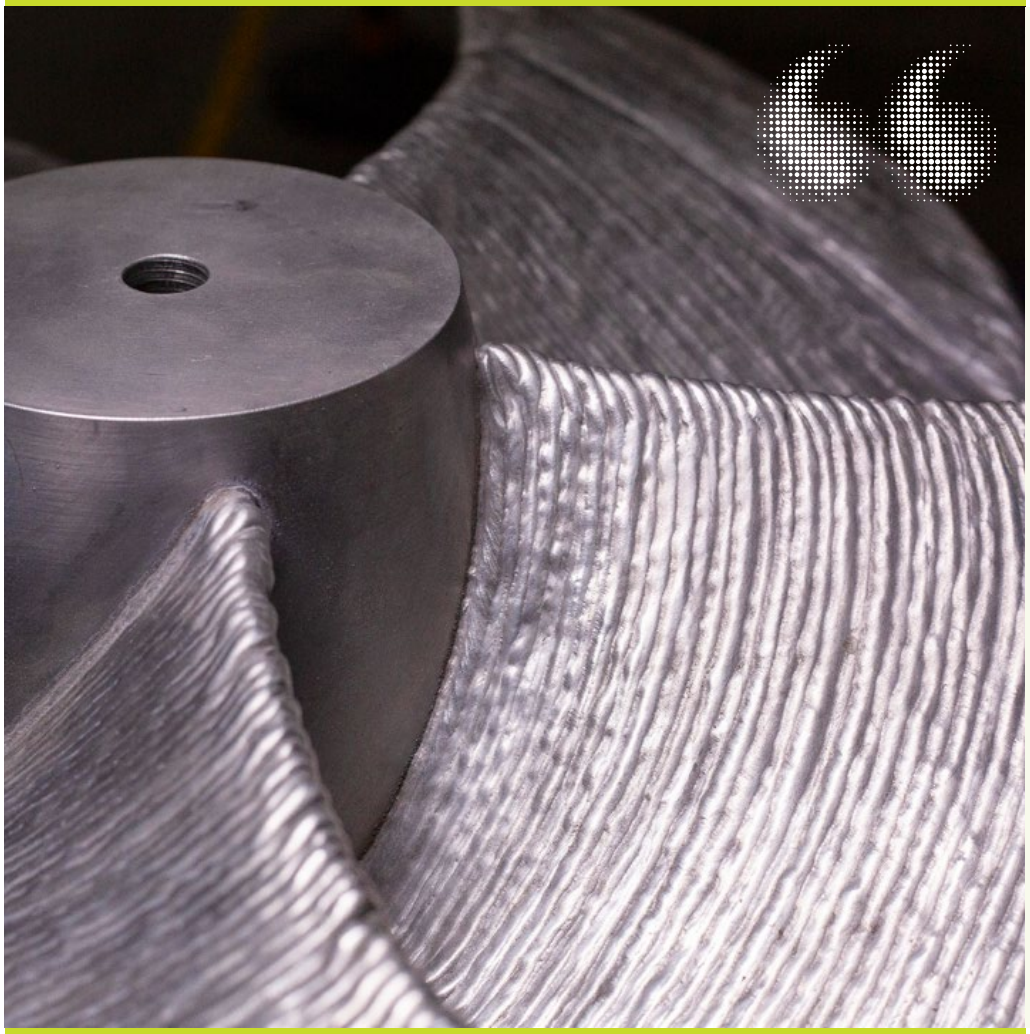
The project has had numerous other business benefits, including firming up Sleep Corp's supply chain stability and helping improve its environmental footprint.

Hampered by a series of ongoing COVID-19 lockdowns which led to delays, the team is thankful for the support and counsel provided by IMCRC throughout the project.

"Following our transformation, we're proud to be considered as a business at the cutting edge of Australian manufacturing and we couldn't have felt more supported by IMCRC," said David. "The team was there for us throughout the entire process which was invaluable to the project's success."

AML3D

New Al-Sc welding wire for the emerging Australian Wire Arc Additive Manufacturing Sector



* photo credit: AML3D

By supporting the project and facilitating the introduction to IFM, IMCRC has helped change the trajectory of our business, expanding our potential customer base and creating further opportunities to innovate through R&D.

ANDREW SALES
EXECUTIVE DIRECTOR I CHIEF TECHNICAL OFFICER, AML3D

3D printing technology is revolutionising the manufacturing industry, enabling the rapid and low-cost production of complex objects. However, the welding wire currently used in large-scale 3D printing requires time-intensive heat treatment to reach optimum strength, which can be costly and creates some logistical complexities.

To overcome this challenge, ASX-listed metal additive manufacturing company AML3D sought funding from IMCRC to develop novel high-strength aluminium welding wire that required minimal or no heat treatment post-manufacture.

Leveraging its established relationship with Deakin University's Institute for Frontier Materials (IFM), IMCRC was able to facilitate an introduction and subsequent collaboration between the research team and AML3D.

Through this partnership, AML3D and IFM have successfully developed a new high-strength aluminium-scandium welding wire for use with AML3D's Wire Additive Manufacturing (WAM®) 3D printing technique.

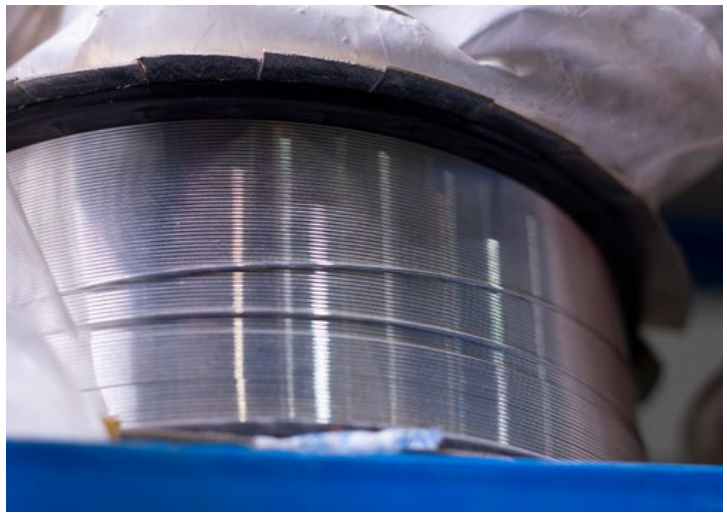
"Our cost-effective, high-strength aluminium alloy requires just 30 minutes of heat treatment once printed. When used with our WAM® technology, this wire has the potential to replace traditional manufacturing processes across industries that use aluminium, such as shipbuilding and aviation," said Andy Sales, ALM3D's Executive Director and Chief Technical Officer.

Thomas Dorin, Senior Research Fellow at IFM, added, "We were pleased to work with AML3D and IMCRC on this ambitious project, which encompassed over 20 different compositions and iterations. Our chosen alloy, a mixture of aluminium, magnesium and scandium, has recently been patented, and we've also commenced commercial production."

"The next phase of the project involves manufacturing five tonnes of welding wire and printing products to demonstrate its potential applications. We'll then work with AML3D to show boatbuilders how they can print directly at the shipyard, which is an effective way to reduce material waste and streamline logistics."

It's hoped that with a solid business case, this innovation can help bring wire production back onshore in Australia. Most of the welding wire used in Australia comes from Bahrain, with very few manufacturers left producing locally. But in time, Thomas believes the demand from the shipbuilding and aviation industries will reinvigorate the local market.

For Deakin University and AML3D, the work through IMCRC has been incredibly rewarding, with both parties describing the process as mutually supportive. "We loved working with Thomas and the team," said Andy. "It was seamless, smooth, fun and overall, we're genuinely excited about what the future holds for this research."



* photo credit: AML3D

Ausdrill

High Access Localised Operations (HALO)

* photo credit: UTS

The hard rock mining environment poses many challenges in regards to safe systems of work. The introduction of an automated rockwall scaling robot is a game changer for the protection of our people and is in line with our company principals of “Smarter Together” and “Enabling Tomorrow”.

RAEGAN RUMBOLD
GEOTECHNICAL AREA MANAGER, AUSDRILL

Ausdrill is a leading Australian provider of drilling project management services. Its offering encompasses everything from exploration to geotechnical operations. This includes scaling the walls of open pit and underground mines to remove loose or unstable rock, a dangerous and demanding task currently performed by specialist abseilers.

In 2020, Ausdrill partnered with experts at the University of Technology Sydney (UTS) to explore the concept of a robotic system that could take the place of abseilers and improve the efficiency and safety of its rock scaling service.

A year later, with the support of IMCRC, the project team took the next step and harnessed robotic and virtual reality (VR) technologies to develop a proof-of-concept prototype capable of scaling rock in a range of mining environments.

“We started the project with an early-stage, rudimentary prototype and ended it with an intuitive robot boasting a custom-built arm and VR assisted controls,” said Dr Gavin Paul, Senior Lecturer and Researcher at UTS’ School of Mechanical and Mechatronic Engineering.

“We’ve successfully demonstrated the technology across three different test sites and are now seeking additional funding to support a larger scale developed prototype.”

“Working with IMCRC gave UTS the opportunity to build a bigger, better project team including students with different skillsets who helped us explore new avenues of research. And IMCRC’s support, coupled with the program’s industry focus, strengthened the ties between UTS and Ausdrill and facilitated an open and trusting relationship.”

For Gavin, another key benefit of the project was the experience his students gained working directly with industry to solve a real-world challenge.

“My students now have an engineering project they can reference as a useful outlet for their research, something that’s incredibly important as they start to look for employment,” he said.

Raegan Rumbold, Geotechnical Area Manager at Ausdrill, who has led the project, is excited to start working with the prototype in the field.

“We are eager to mobilise the prototype into a live mining environment to conduct the trial and highlight and improvements going forward. The removal of personnel from harm’s way is the ultimate goal and I think we are on the right track with this project”, he said.

* photo credit: Ausdrill

Verton

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

* photo credit: Verton

The success of Verton's second-generation load management system, which has been released across Australia, Europe and USA, is a direct result of the partnership with IMCRC and QUT.

STANLEY THOMSON
CHIEF EXECUTIVE OFFICER, VERTON

Currently, when a crane is moving a suspended load, it must be manually positioned or oriented by a person on the ground. Given the operator's proximity to the load, this is a risky process that has the potential to result in injuries or fatalities.

To de-risk load management, Queensland-based technology company Verton designed, engineered, prototyped, and manufactured a hands-free lifting solution, and in 2019, partnered with IMCRC and the Queensland University of Technology (QUT) to further refine and commercialise the product.

Three years on, Verton and QUT have successfully harnessed artificial intelligence, data science and robotics to deliver a revolutionary remote-controlled system that safely and accurately orients the loads.

"Using gyroscopic technology, our system enables an operator to remotely manipulate and hold loads in place from up to 200 meters away," said Marcio Casagranda, Verton's Head of Business Development.

"The main motivation behind developing this product was improving safety, but as we have deployed the equipment and started monitoring its performance, we have noticed a significant improvement in efficiency as well.

"We have now got the results, proof points and case studies we need to go out to industry to demonstrate how our technology can save time and money. And with key components of our load-management system manufactured in Australia, and with it assembled in-house in Brisbane, we can offer our customers an Australian-made product."

Stanley Thomson, Verton's Chief Executive Officer, added that working with IMCRC and QUT was a great experience.

"By providing funding and connecting us to QUT's expertise and resources, IMCRC helped us to accelerate the commercialisation of our technology, reduce costs and create a more robust and reliable product for our customers.

"IMCRC was able to ensure QUT's research aligned with Verton's commercial objectives. And QUT's team was incredibly supportive of IMCRC's industry-led approach, as it enabled researchers to integrate with our team and solve a real-world challenge."

* photo credit: Verton, IMCRC

Geoinventions Consulting Services

Development of a smart sensor system for soft soil engineering and construction safety

* photo credit: Geoinventions

IMCRC has enabled us to push boundaries – not just by financially supporting this unique project – but by stretching our thinking around applying the technology and connecting us to key people within the industry.

BARRY KOK
OPERATIONS DIRECTOR, GEOINVENTIONS CONSULTING SERVICES

Australia's coastal roadways are under stress from overuse and extreme weather events, with many requiring maintenance and upgrades. This type of soft soil construction comes with risks, the management of which geotechnical engineering consultancy Geoinventions Consulting Services is set to transform with the advent of its world-first smart sensor.

Developed in collaboration with Griffith University and supported by co-funding from IMCRC, the sensor harnesses micro-electro-mechanical systems (MEMS) technology and the Internet of Things to measure stress-strain behaviour and soil-infrastructure interaction.

The robust, waterproof and energy-efficient sensor is designed to withstand Australia's harsh environment, and with its many functions, can do the job of two devices traditionally used in geotechnical engineering.

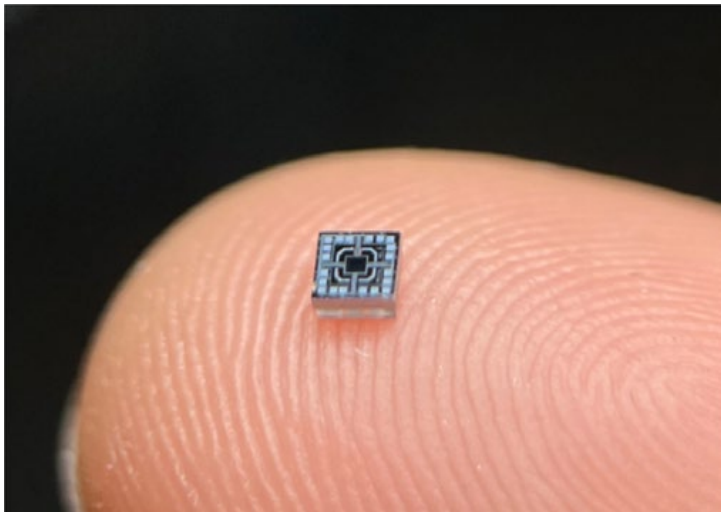
Barry Kok, Geoinventions' Operations Director, said, "Thanks to the support from IMCRC and the research expertise from Griffith, we've developed and successfully patented a sensor capable of revolutionising traditional geotechnical monitoring, managing risks and improving safety in construction."

"We're proud our sensor will be Australian made, with production set to begin this year on the Gold Coast in Queensland. By manufacturing locally, we can offer an alternative to imported sensors, overcoming supply chain delays while providing a cost-effective, high-quality, customisable and more advanced product.

"By facilitating industry-led research and development (R&D), IMCRC has enabled us to create a truly innovative product and contribute to the growth of Australia's sovereign manufacturing capability while doing so."

Professor Dzung Dao, Head of Mechanical Engineering at Griffith University, added, "IMCRC's approach to R&D helped shape a close and collaborative relationship between Griffith and Geoinventions, which will endure into the future as we continue to advance the sensor technology.

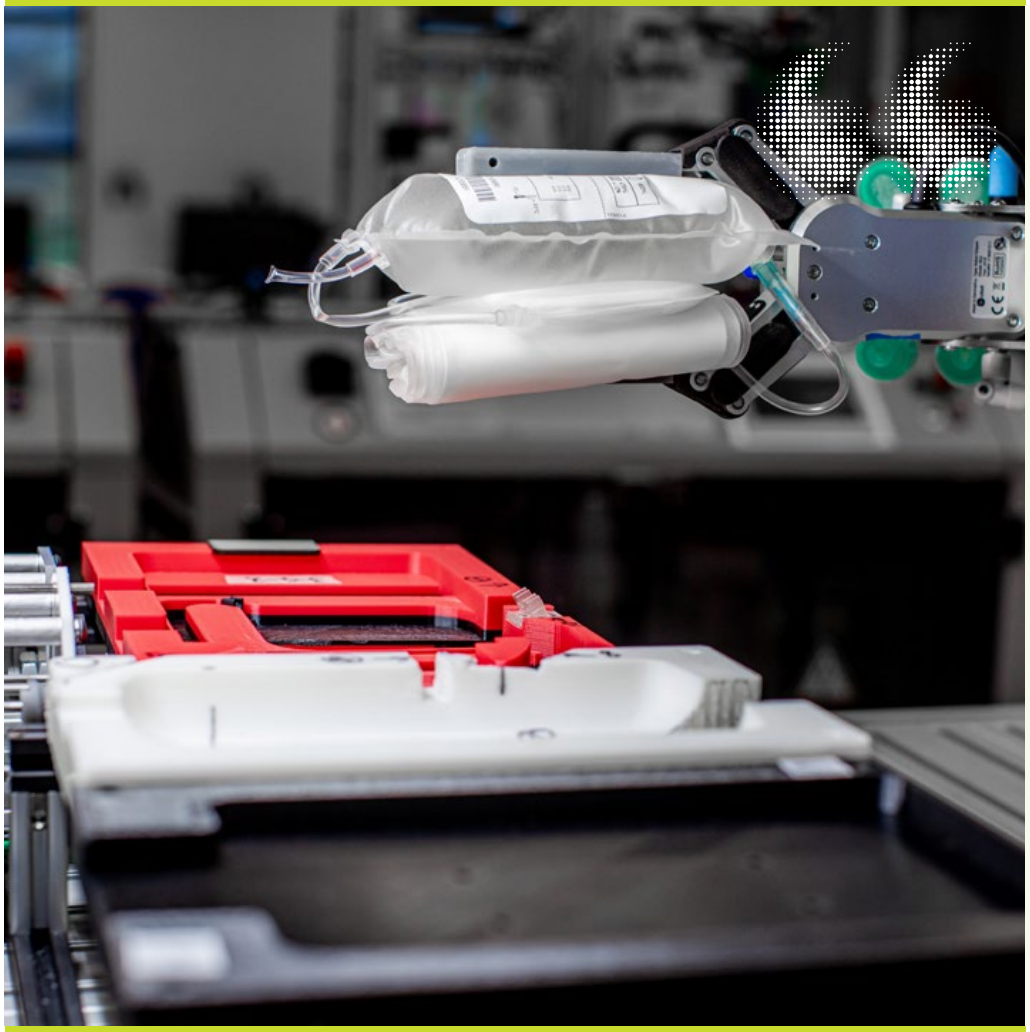
"Through this project, Griffith's research has helped solve a real-world challenge for industry, while also advancing Australia's MEMS manufacturing capabilities and helping to position the nation as a leader in geotechnical sensor technology design and production."



* photo credit: Geoinventions

Australian Red Cross Lifeblood

Design and development of a work cell for robotic folding of whole blood donation packs



* photo credit: Swinburne

IMCRC has been instrumental in bringing this project to life. The team has been with us every step of the way, from helping us refine the initial project proposal to challenging and questioning our approach to ensure it was robust.

DR SHANTI KRISHNAN
DEPUTY DIRECTOR, SWINBURNE FACTORY OF THE FUTURE

Currently, processing blood donations is a complex, manual task. At processing centres, staff fold the blood packs by hand so the blood can be centrifuged and thus separated into its cellular components.

Despite rigorous training, there is the potential for human error throughout this process, and staff face risks including repetitive strain injury and exposure to potentially hazardous biological materials.

That's why in 2021, Swinburne University of Technology partnered with IMCRC on an 18-month research collaboration to develop a world-first system capable of handling and folding blood packs.

In addition to addressing risks to staff, the project sought to minimise disruptions to production, reduce deviations in quality and enable the capture of operational data – which is needed to meet regulatory process monitoring requirements.

By utilising collaborative robots, vision systems, jigs and actuators, the project – which concluded in July 2022 – has successfully delivered a proof-of-concept prototype capable of folding the soft, deformable blood packs.

Project Champion and Scientific Director, Manufacturing and Quality at Australian Red Cross Lifeblood Sue Ismay credits the success of the project to the fact a domain expert from Lifeblood was embedded into the project team at the Factory of the Future at Swinburne's Hawthorn Campus.

"The Lifeblood expert was able to advise the researchers about every aspect of the blood pack handling process, and their presence created an inclusive environment where issues could be addressed on the spot," she said.

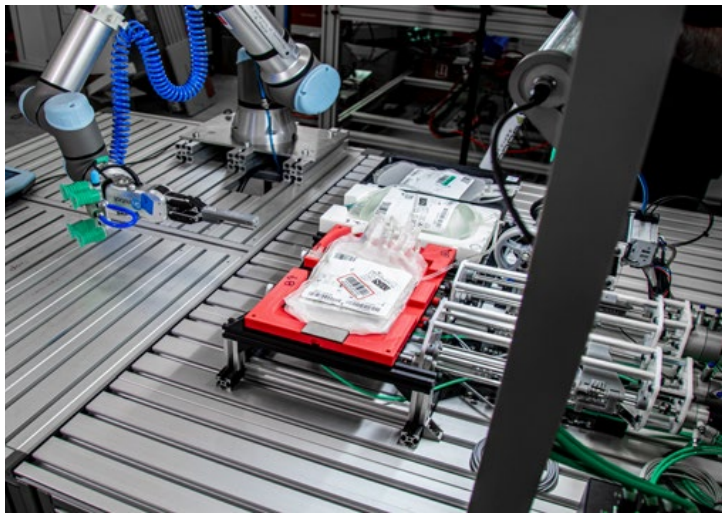
"The research collaboration benefited from this in multiple ways, as there was a shared understanding of core processes and associated risks and obligations. Feedback could also be provided, applied and tested in real-time."

Deputy Director of Swinburne's Factory of the Future Dr Shanti Krishnan said IMCRC's clear processes kept the project on track, especially through delays caused by the pandemic.

"IMCRC's stage-gated approach measured our progress against clear milestones, which helped mitigate the risk of the project and ensured all partners were aligned," said Dr Krishnan.

"As it moves towards commercialisation, our prototype has the potential to transform a critical manufacturing process for the global medical industry. And the effective integration between all partners was key to achieving this outcome.

"IMCRC has been instrumental in bringing this project to life. The team has been with us every step of the way, from helping us refine the initial project proposal to challenging and questioning our approach to ensure it was robust."



* photo credit: Swinburne

The Remediation Group

Miasma Meter – a novel continuous, internet-connected landfill gas monitoring solution

* photo credit: TRG

IMCRC's financial support and Deakin's technical expertise, enabled us to expedite the commercialisation path of our Miasma Meter™, and thus helped us diversify The Remediation Group's business offering.

JON MILLER
MANAGING DIRECTOR, THE REMEDIATION GROUP

Automated monitoring of landfill gases in real-time is critical for understanding a site's impact on its surrounding environment, particularly the risks it poses to human health, infrastructure and adjacent properties. By providing insights into a landfill's dynamic condition, the captured data is used to proactively manage and remediate gas leaks and help determine a site's lifecycle stages including when it is ready for reclamation.

In 2021, The Remediation Group (TRG), which traditionally specialises in large-scale treatment systems for sites with impacted soil and groundwater, partnered with IMCRC and Deakin University to advance the first prototype of the Miasma Meter™ – a unique, continuous passive, low-cost and low-power, standalone and programmable sensing gas monitoring solution.

Designed to measure the risks associated with both landfill gas concentration and flow, the Miasma Meter™ continuously monitors landfill gas pressure and, via telemetry, automatically collects and transmits data in real time.

Over the course of the collaboration, the team progressed the Miasma Meter™ from a manufacturing readiness level (MRL) 5 to MRL8, with Deakin researchers field-testing the 3D printed prototypes, optimising the design and functionality for manufacture in Australia.

At the end of the project TRG was set to commence low-scale production, the next step in its path to commercialisation. The company is currently looking for a local manufacturing partner.

"IMCRC's support over the past 15 months expedited the prototype development process and enabled us to bring our idea to life in a timeframe that met our business' strategic needs," said Jon Miller, TRG's Managing Director.

"We have a fully functional, field-tested prototype that we can demonstrate as we engage with potential stakeholders, drive investment conversations and pursue initial sales opportunities. We are now ready to embark and execute our commercialisation strategy.

"Without Deakin and IMCRC, it would have been far more challenging and time consuming to reach this point. They have been critical to our success."

Recognising the challenges of COVID 19, TRG was pleased with the outcome of the collaboration, and the flexibility and creativity of all involved.

"What we have achieved to date is a great credit to Deakin and IMCRC; their ingenuity and desire to make things happen, their progressive mindset and collaborative culture," Jon concluded.

* photo credit: TRG

Lightning Protection International (LPI)

Smart coatings for the next generation of lightning strike protection devices

* photo credit: LPI

The whole project, and especially the management of it, was straightforward. Swinburne and IMCRC were very supportive of our needs and requirements.

DR FRANCO D'ALESSANDRO
CHIEF TECHNOLOGY OFFICER, LPI

Lightning protection devices, commonly called air terminals, are positioned on the top of buildings and other structures to prevent them from sustaining damage during electrical storms by capturing the lightning stike. But because they are installed outdoors, the devices often get coated in a layer of pollution and dirt that can impact their performance (much like insulators in high voltage facilities).

In 2020, leading manufacturer of protection devices, Lightning Protection International Pty Ltd (LPI), partnered with Swinburne University of Technology to develop a self-cleaning product. With co-funding from IMCRC, the project explored different chemical compositions to create a sprayable coating for the device that repelled surface contaminants.

"Our project had two key goals. We needed to ensure the coating was functional, and we needed it to be something that could be easily and cost-effectively applied by LPI using conventionally available technology," said Dr Hannah King, Postdoctoral Research Fellow at Swinburne University.

"At the start of the project, we were lucky enough to visit LPI's factory in Tasmania. Having insight into how the devices were manufactured ensured we could more seamlessly integrate our science into LPI's production."

For Hannah, another key factor that shaped the project was IMCRC's input.

"IMCRC was more than a financial partner. The team were able to provide their unique insights and expertise in research and manufacturing to help guide the project," she said.

The research was a success, and despite some delays due to COVID-19, delivered a functional coating that is set to optimise the performance of LPI's lightning protection devices.

"We're currently testing the coated device in Europe using simulated lightning. It's early days, but the results look promising, and we're hoping to move onto commercialisation later this year," said Franco.

Franco added that because of its industry-led approach, IMCRC facilitated a project that delivered a commercially viable outcome.

"LPI is competing with companies globally, so cost is a big factor in our decision-making. Because of IMCRC's strong focus on commerciality, we avoided avenues of research that were not cost-competitive, which can be atypical of university research.

"I think that's the key to a successful collaboration. Both the research and industry partners need to consider each other's needs and be 'hands-on' from the outset."

* photo credit: LPI

Energy Renaissance

Renaissance Battery Management Systems (BMS) Development

* photo credit: Energy Renaissance

IMCRC's strategic approach throughout this project helped us identify our priorities and brought us closer to our vision of developing an Australian-designed and made clean energy storage ecosystem.

HOWARD LOVATT
CHIEF TECHNICAL OFFICER, ENERGY RENAISSANCE

With a passion for Australian-made, battery manufacturer Energy Renaissance, in partnership with Australia's national science agency CSIRO, set out to develop a defence-grade Battery Management System (BMS) for its family of batteries. One that could be developed and manufactured locally.

The BMS acts as the "nerve centre" of the battery and is critical to its operating efficiency, monitoring and reporting on its usage, lifespan, and faults through a mobile network. And this addition to its suite of offerings enables Energy Renaissance to provide its customers with a complete battery energy storage solution.

Howard Lovatt, Chief Technology Officer at Energy Renaissance, said they wanted to work with CSIRO due to its battery development experience and its understanding of the unique requirements of the Australian customer.

"Unlike internationally manufactured products, our systems need to withstand temperatures between 10 and 40 degrees Celsius," he said. "Working with partners that understood the technical requirements and shared the same vision as us – building a clean energy supply chain for Australians – was of paramount importance.

"The collaboration with CSIRO and IMCRC was a huge success. With IMCRC's guidance keeping us focused and on track, we worked collectively toward our goal, and we officially launched our BMS in 2022."

The project wasn't without its challenges. In fact, COVID-19 and downstream supply chain issues resulted in considerable obstacles that had to be collaboratively overcome.

The original microprocessor destined for use in this project was no longer available, and a smaller microprocessor had to be sourced. And to make that work, new code was required, which added time and effort to the project.

Commenting on the journey, Dr Adam Best, Principal Research Scientist at CSIRO, said, "IMCRC shouldn't underestimate just how much we appreciate the investment it made in this project. Without its support, we wouldn't have been able to achieve what we have.

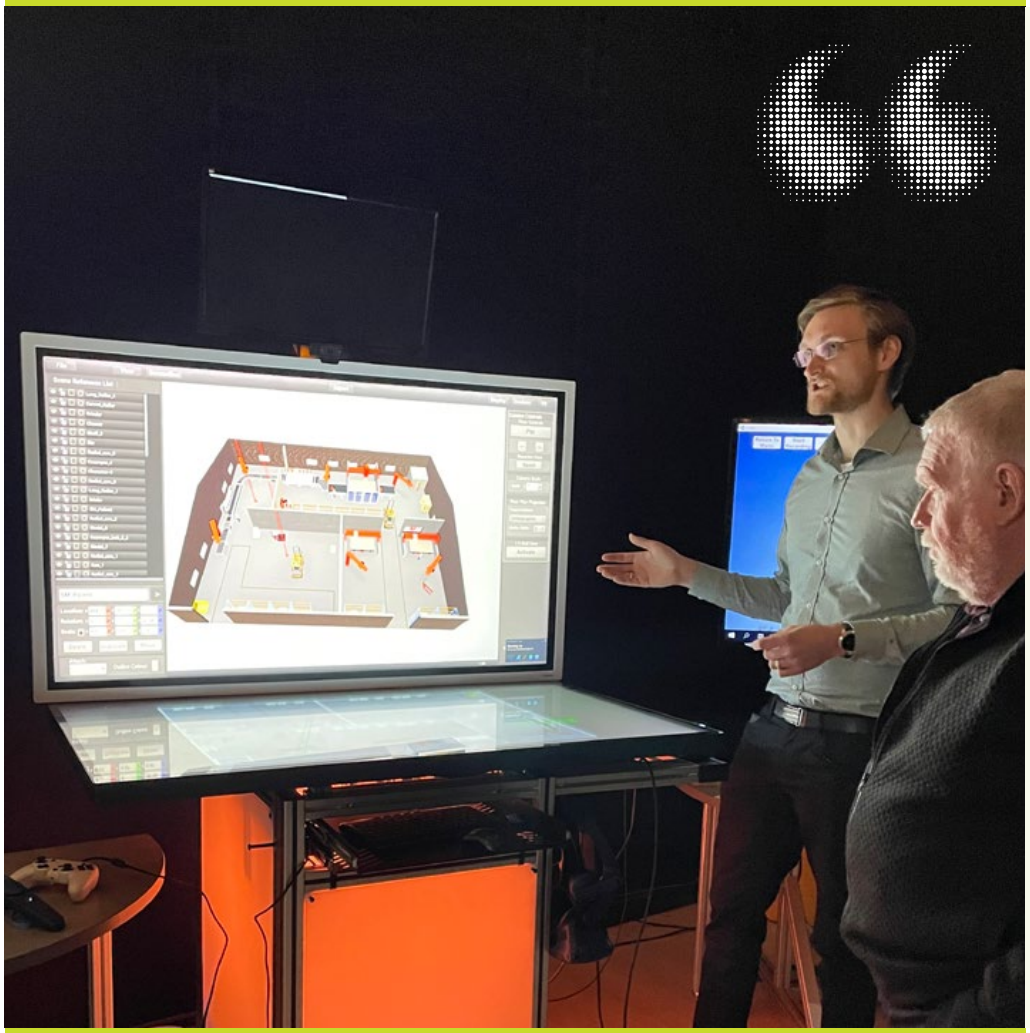
In addition to the delivery of the BMS, the project also created opportunities for research internships, one of which resulted in employment at CSIRO.

"We had six interns supporting various apsects of the project. Two of them designed the switch gear for the BMS, which vastly reduced its size and utilisation of space. I'm proud that we were able to provide these students with practical, real-life opportunities and were eventually be able to hire one of them," said Adam.

* photo credit: Energy Renaissance

CADwalk

CADwalk - XR - Industry 4.0



* photo credit: IMCRC

IMCRC's support was critical to the development of CADwalk Mini. The team shared our vision and understood the requirements for commercial success.

GERHARD (KIM) KIMENKOWSKI
FOUNDER, CADWALK

Five years ago, no one could have predicted what the world would look like today, including the pace at which spatial visualisation would evolve.

Thus, building design company CADwalk and the University of South Australia (UniSA) took an incredible leap of faith when they partnered to develop a technology that allowed CADwalk's customers to visualise the design of high-value infrastructure projects.

With support from IMCRC, CADwalk and UniSA completed five year-long research and development (R&D) sprints that explored the use of technologies such as augmented, virtual and mixed reality.

The R&D resulted in CADwalk Mini – a commercially ready product that visualises paper-based plans and enables users and their collaborators to experience the design using virtual models.

The portable, integrated hardware and software system can showcase the design and layout of a new factory or building, vastly improving users' understanding of the design by enabling immersive interaction with the environment.

"By bringing 2D building plans to life, CADwalk Mini helps our customers make better decisions about their design, ergonomic and workflow requirements," said Gerhard Kimenkowski, CADwalk Founder.

"IMCRC's collaborative and flexible approach to research collaboration enabled us to collectively pursue different ideas and the stage-gate process helped us assess individual research outcomes and adjust future milestones accordingly."

Professor Bruce Thomas, Research Lead and Director of the Australian Research Centre for Interactive and Virtual Environments, said the challenge forced the team to stretch their thinking and adopt a commercially viable mindset.

"As part of the application process, IMCRC required us to think future-state and describe the research and commercial outcomes, and work back from that," he said. "This manufacturing-led approach to innovation enabled us to translate the research into a commercial product, optimising at every phase of the project.

"IMCRC was very accommodating of us throughout the project, providing their unique insights and helping us integrate with and learn from industry."

Gerhard agreed. "We're hugely appreciative of the support that IMCRC provided. The team was the backbone of this project."

* photo credit: IMCRC

INNOVATIVE MANUFACTURING CRC (IMCRC)

* photo credit: IMCRC

ABOUT IMCRC

Who We Are

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

By investing in research-led innovation in manufacturing products, processes and services, we brought 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 innivative, competitive and resilient.

IMCRC worked 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 helped 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 enable expansions 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.

IMCRC purposefully invested $34 million of Commonwealth and other funding to advance Australian manufacturing and catalysed more than $250 million in collaborative research, manufacturing innovation and education across Australia.

With Australian manufacturing being critical to a modern Australian economy, IMCRC helped shift the public perception of a capital- and labour-intensive brand of manufacturing 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 connected and collaborated with industry, research organisations, government and the wider manufacturing community.

DAVID CHUTER
CEO AND MANAGING DIRECTOR

DR JASON COONAN
DEPUTY CEO

DR MATTHEW YOUNG
MANUFACTURING INNOVATION MANAGER

SIMON DAWSON
INDUSTRIAL TRANSFORMATION DIRECTOR

SAMEERA SILVA
FINANCE AND IT MANAGER

LYDIA GUNAWAN
PROJECT RESEARCH AND EDUCATION OFFICER

DR MIN YIN YAP
PROJECT RESEARCH ANDEDUCATION OFFICER

DAVID CHANDLER
PROJECT RESEARCH AND SYSTEMS OFFICER

JANA KUTHE
COMMUNICATIONS, MARKETING AND EVENTS MANAGER

Our Board

IMCRC was governed by an independent Board of Directors that oversaw the organisation's research and worked in creating long-term impact for Australian manufacturing. The Board represented 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 MARRIOTT
INDEPENDENT DIRECTOR

DR JENS GOENNEMANN
INDEPENDENT DIRECTOR
(GROWTH CENTRE)

MR ROBERT COHEN
NON-INDEPENDENT DIRECTOR
(RESEARCH NOMINEE)

PROFESSOR ROY GREEN
NON-INDEPENDENT DIRECTOR
(RESEARCH NOMINEE)

DR JENNI LIGHTOWLERS
ACTS AS IMCRC COMPANY SECRETARY

Our Partners

Thank you to our all industry, research and government partners for collaborating with us, sharing their knowledge and resources to make Australian manufacturing innovative, effective, resilient and relevant.

Industry

SPEE3D
CADwalk
stryker
UAP
BLUGLASS
SCA
TRADIEBOT INDUSTRIES
Corin
RUAG
Mineral Technologies
Whiteley Corporation
CARBON REVOLUTION
Allegra ORTHOPAEDICS
TITOMIC
vaxxas
SLEEPCORP
Codex RESEARCH
monitum
xefco
ESN CLEER
LAVA BLUE
VERTON
HazerGroup
Neometals
BAE SYSTEMS Maritime Australia
Nutromics
TELIX PHARMACEUTICALS
LPI
BORAL
Melbourne Water
LASERBOND
energy renaissance
ROMAR Scalable Manufacturing Solutions
Alcolizer
bnnt TECHNOLOGY LIMITED
QUEST SEMICONDUCTORS
FormFlow
Australian Red Cross Lifeblood
HYDAC
AML3D
The Remediation Group
RUX energy
gTET
BiomeBank
AUSDRILL
CABLEX
Szcut Abrasives
HEIQ
IAS
Callidus
conflux TECHNOLOGY
SPEEDPANEL
DENTROID
entX
singular health
GEOINVENTIONS
REVO GROUP
InfraBuild
THALES Building a future we can all trust
ANCA
MotorOne GROUP
GALE PACIFIC
Humble Bee Bio

Research

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

Other

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

APPENDIX

* photo credit: IMCRC

Manufacturing Readiness Levels

Critical to the success of IMCRC's research projects has been the alignment of industry-focused Manufacturing Readiness Levels (MLRs) with Technology Readiness Levels (TRLs), commonly used to described the maturity of a new technology. With project milestones being described in terms of MRLs, alongside quarterly and annual project stage gate reviews, IMCRC created meaningful and transparent structures that helped build trust and accountability among research and industry partners, and ensured a continued focus on commercial outcomes.

LEVEL	MRL 1	MRL 2	MRL 3	MRL 4	MRL 5	MRL 6	MRL 7	MRL 8	MRL 9	MRL 10
PHASE	Technology assessment and initial proving				Technology development and pre-production		Engineering and manufacturing development		Production and deployment	Operations and support
IMCRC PROJECT RESEARCH FOCUS	Not core focus level	Influencing role		Primary IMCRC Project Research focus				Influencing role	Not core focus level	
INDUSTRIAL TRANSFORMATION FOCUS	Not core focus level				Influencing role		Primary Industrial Transformation focus			
DEFINITION	Basic manufacturing implications identified	Manufacturing concepts identified	Manufacturing proof of concept developed	Capability to produce the technology in a laboratory environment.	Capability to produce prototype components in a production relevant environment.	Capability to produce a prototype system or subsystem in a production relevant environment.	Capability to produce systems, subsystems or components in a production representative environment.	Pilot line capability demonstrated. Ready to begin low rate production.	Low Rate Production demonstrated. Capability in place to begin Full Rate Production.	Full Rate Production demonstrated and lean / six sigma production practices in place.
DESCRIPTION, OUTPUTS AND OUTCOMES	Basic research expands scientific principles that may have manufacturing implications. The focus is on a high level assessment of manufacturing opportunities. The research is not confined or restricted.	Invention begins. Manufacturing science and/or concept described in application context. Identification of material and process approaches are limited to paper studies and analysis. Initial manufacturing feasibility and issues are emerging.	Conduct analytical or laboratory experiments to validate paper studies. Experimental hardware or processes have been created, but are not yet integrated or representative. Materials and/or processes have been characterized for manufacturability and availability but further evaluation and demonstration is required.	Required investments, such as manufacturing technology development identified. Processes to ensure manufacturability, producibility and quality are in place and are sufficient to produce technology demonstrators. Manufacturing risks identified for prototype build. Manufacturing cost drivers identified. IP Utilisation plan developed. Producibility assessments of design concepts have been completed. Key design performance parameters identified. Special needs identified for tooling, facilities, material handling and skills.	Manufacturing strategy refined and integrated with Risk Management Plan. Identification of enabling/critical technologies and components is complete. Prototype materials, tooling and test equipment, as well as personnel skills, have been demonstrated on components in a production relevant environment, but many manufacturing processes and procedures are still in development. Manufacturing technology development efforts initiated or ongoing. Producibility assessments of key technologies and components ongoing. Cost model based upon detailed end-to-end value stream map.	Initial manufacturing approach developed. Majority of manufacturing processes have been defined and characterized, but there are still significant engineering/design changes. Preliminary design of critical components completed. Producibility assessments of key technologies complete. Prototype materials, tooling and test equipment, as well as personnel skills have been demonstrated on subsystems/ systems in a production relevant environment. Detailed cost analysis include design trades. Cost targets allocated. Producibility considerations shape system development plans. Long lead and key supply chain elements identified.	Detailed design is underway. Material specifications are approved. Materials available to meet planned pilot line build schedule. Manufacturing processes and procedures demonstrated in a production representative environment. Detailed producibility trade studies and risk assessments underway. Cost models updated with detailed designs, rolled up to system level and tracked against targets. Unit cost reduction efforts underway. Supply chain and supplier Quality Assurance assessed. Long lead procurement plans in place. Production tooling and test equipment design and development initiated.	Detailed system design essentially complete and sufficiently stable to enter low rate production. All materials are available to meet planned low rate production schedule. Manufacturing and quality processes and procedures proven in a pilot line environment, under control and ready for low rate production. Known producibility risks pose no significant risk for low rate production. Engineering cost model driven by detailed design and validated. Supply chain established and stable.	Major system design features are stable and proven in test and evaluation. Materials are available to meet planned rate production schedules. Manufacturing processes and procedures are established and controlled to three-sigma or some other appropriate quality level to meet design key characteristic tolerances in a low rate production environment. Production risk monitoring ongoing. Low Rate Initial Produciton (LRIP) cost goals met, learning curve validated. Actual cost model developed for Full Rate Production environment, with impact of Continuous improvement.	This is the highest level of production readiness. Engineering/design changes are few and generally limited to quality and cost improvements. System, components or items are in rate production and meet all engineering, performance, quality and reliability requirements. All materials, manufacturing processes and procedures, inspection and test equipment are in production and controlled to six-sigma or some other appropriate quality level. Full Rate Production unit cost meets goal, and funding is sufficient for production at required rates. Lean practices well established and continuous process improvements ongoing.
COMPLEMENTARY TECHNOLOGY READINESS LEVEL	TRL 1	TRL 2	TRL 3	TRL 4	TRL 5	TRL 6	TRL 7	TRL 8	TRL 9	
	Basic research. Principles postulated and observed but no experimental proof available.	Technology formulation. Concept and application have been formulated.	Applied research. First laboratory tests completed; proof of concept.	Small scale prototype build in laboratory environment ("rough and ready" prototype).	Large scale prototype tested in intended environment.	Prototype system tested in intended environment close to expected performance.	Demonstrated system operating in operational environment at pre-commercial scale.	First of a kind commercial system. Manufacturing issues solved.	Full commercial application, technology available for consumers.	

Glossary

IMCRC	Innovative Manufacturing Cooperative Research Centre
APR.Intern	Australian Postgraduate Research Intern
Board	Company Board of Directors
CEO	Chief Executive Officer
CRC	Cooperative Research Centre
CSIRO	The Commonwealth Scientific and Industrial Research Organisation
IIC	Innovation Investment Committee
IP	Intellectual Property
MRL	Manufacturing Readiness Level
R&D	Research and Development
SME	Small and Medium Enterprise
TMI	Tonsley Manufacturing Innovation Hub
TRL	Technology Readiness Level
UTS	University of Technology Sydney
QUT	Queensland University of Technology

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

imcrc | we champion manufacturing innovation

c/o FAL Lawyers
Level 45, 600 Bourke Street
Melbourne, VIC 3000 Australia
imcrc.org

ABN 24 607 527 499