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Innovative Manufacturing CRC (IMCRC)

HIGHLIGHTS REPORT 2021-2022

Australian Government
Department of Industry, Science and Resources

AusIndustry
Cooperative Research Centres Program

Cover image: IMCRC

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

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

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Disclaimer
IMCRC has endeavoured to ensure that the information in this publication is correct. The Highlights Report has been prepared to align with IMCRC's Commonwealth Agreement, referencing the progress, activities, participants and other matters as at 30 June 2022, unless it is otherwise specified in the document.

The Highlights 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.

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HIGHLIGHTS

* photo credit: IMCRC

Achievements

71 projects

OF WHICH 22 COMMENCED IN THE REPORTING PERIOD

28 PhD and Masters students

ACTIVELY ENROLLED IN IMCRC'S RESEARCH COHORT, PLUS 8 MASTERS BY COURSEWORK SCHOLARSHIPS SUPPORTED

24

SUCCESSFULLY COMPLETED PROJECTS, OF WHICH 16 CONCLUDED IN THE REPORTING PERIOD

44 RESEARCH PUBLICATIONS PUBLISHED IN FY2021-22

78 INDUSTRY PARTNERS, WITH 20 NEW JOINING IN FY2021-22

761

MANUFACTURING BUSINESSES COMPLETED FUTUREMAP©, 121 IN THE REPORTING PERIOD

$230 million

CUMULATIVELY INVESTED INTO COLLABORATIVE MANUFACTURING RESEARCH AND INNOVATION

300+

INDUSTRY EVENTS, CONFERENCE AND WORKSHOPS SUPPORTED

22 students

HAVE GAINED HANDS-ON MANUFACTURING EXPERIENCE THROUGH IMCRC'S PARTNERSHIP WITH APR.INTERN

Progress to Date

Since its launch in 2016, IMCRC has purposefully invested **$34 million of Commonwealth and other funding** to advance Australian manufacturing catalysing over **$230 million investment** in collaborative research, manufacturing innovation and education across Australia.

$34m
CRC cash co-invested in projects

71
transformative industry-led R&D projects

78
industry project partners

80%
of projects with Australian owned SMEs

7x
multiplier on Commonwealth funding

$230m
total R&D investment

FOCUS	INDUSTRY FOCUS	RESEARCH COLLABORATION	MANUFACTURING INNOVATION	INDUSTRIAL TRANSFORMATION	ACROSS AUSTRALIA AND BEYOND
APPROACH	• Being industry-led • Driving real-world manufacturing and commercial outcomes • Removing barriers to SME participation • Taking proof of concepts through to pilot readiness and commercial investment (TRL/MRL 4-7) • Taking no CRC share in project IP	• Accessing a network of 11 research organisations, plus CSIRO • Agreed returns on investment for all collaborative parties • In-kind contributions not matched with CRC cash • Fostering talent through PhD stipends, Masters scholarships and industry internships	• Co-investing in emerging manufacturing technologies (Industry 4.0) and new business models to benefit the broader Australian manufacturing industry • Independent Innovation Investment Committee reviewing project applications • Manufacturing projects across multiple key industry growth sectors	• Delivering manufacturing industry SME customised education and awareness programs, centred around futuremap®, IMCRC's unique and proprietary diagnostic • Collaborating with federal, state and local government, industry growth centres and industry associations to advance the adoption of Industry 4.0	• Engaging with industry and research organisations across Australia • Stimulating SME growth and collaboration • International partnerships such as with Germany's Fraunhofer Institutes and New Zealand's Callaghan Innovation
PROGRESS	• **78 industry project participants** • **80% cash co-invested with Australian SMEs**	• **71 projects approved with 24 projects completed** • **Average project investment is 7 multiple on CRC cash** • **28 PhD and Masters students**	• **Projects across the six National Manufacturing Priority areas** • **Investment in all CSIRO defined key enabling manufacturing technologies**	• **futuremap® inspired 750+ manufacturers (90% SMEs) to future-proof their business and invest in Industry 4.0** • **Catalysed the ~$20m ARM Hub establishment in QLD**	• **Industry-led investment across all states and the ACT** • **>80% CRC cash co-invested with Australian owned businesses**

Industry-led Manufacturing Research across Australia and New Zealand

* as at 30 June 2022
projects shown per industry partner location

Innovative Manufacturing Accelerated

Research, development and innovation are the driving forces of modern manufacturing. Together, they are fuelling the creation of revolutionary technologies, products and services that deliver new opportunities for Australian businesses to grow and prosper.

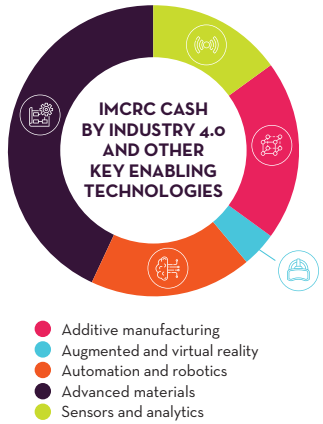
As an independent, not-for-profit and for-impact research centre, IMCRC has been uniquely positioned to offer Australian manufacturers the opportunity and support to rapidly prove, develop and scale their R&D ideas – turning them into real-world products and services. IMCRC's approach has been underpinned by the framework it established to help industry and research partners accelerate innovation by:

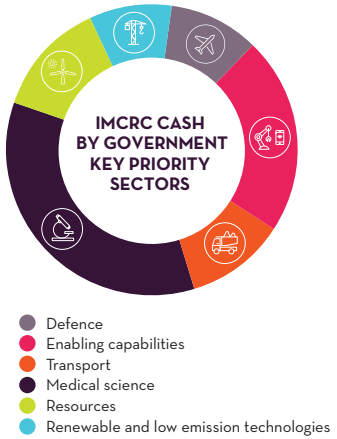
- defining the project success criteria, applying project management principles and evaluating the return on investment
- developing a strong culture of collaboration and innovation
- establishing manufacturing readiness levels
- ensuring market readiness by validating technology, identifying value propositions and understanding market potential
- adapting business models that ensures continuous innovation.

With a deep understanding of Australian manufacturing, IMCRC has also provided its partners with fresh insights and perspectives. By developing trusting and respectful relationships, the team was able to ask difficult questions and identify areas where extra dedication or investment could spur a transformative step change in the project outcome.

Although the process has not always been straightforward, it has resulted in greater ambition and outcomes. "It has been about challenging the mindset of leaders of both industry and researchto ensure no stone goes unturned. Often, our partners suspected they were not quite on the right track and needed to shift direction - they just had to hear it echoed by someone slightly removed who they could trust," says David Chuter.

By engaging and working closely with leadership in this way, IMCRC created the conditions for each project to succeed. And by providing actionable advice, access to vital resources and opportunities to enhance their abilities, IMCRC has empowered Australian manufacturers to grow and scale their businesses and helped them maximise the commercial outcomes of their research.





Message from the Chair

In 2016, IMCRC set out to help catalyse the transformation of Australian manufacturing through collaborative investment, research impact and innovation.

Since then, and despite significant economic, social and environmental challenges and change, IMCRC has remained committed to our vision for Australian manufacturing to be thriving, relevant and globally integrated.

From the outset, IMCRC was determined to be industry-led, to grow Australia's manufacturing capability and capacity, and to drive real-world commercial outcomes. By catalysing investment in collaborative research and development (R&D), we have supported start-ups, small and medium enterprises (SMEs) and global multinationals to exploit innovative technologies and deliver transformative business models, products, processes, services, and platforms. Over the past six years, IMCRC's efforts have helped our industry and research partners achieve outcomes that strengthen their competitiveness and resilience – two critical enablers of future prosperity.

A robust portfolio of 71 manufacturing R&D projects is a testament to the success of IMCRC's business model for establishing effective and focused partnerships. With the support of an independent Innovation Investment Committee, IMCRC assessed the commercial potential of each project application. By requesting that project participants clearly state their research and business objectives, IMCRC created a framework that helped them define and set R&D milestones and build transparent structures to support the research collaboration from the outset. Regular project reviews, including stage-gates, ensured the project research and commercial outcomes were aligned and delivered the intended outcome. And by establishing an open approach to ownership of intellectual property (IP) and by encouraging our participants to enter mutually beneficial partnerships, we removed an underlying barrier to industry-university collaboration, particularly for Australian-owned SMEs.

It's pleasing to see IMCRC's business model has already delivered a number of research commercialisations. One example (and a launch I attended during the year) is Monitum's automated surface displacement monitoring service, Kurloo. Monitum's outcome is proof positive of the power of collaborative R&D and serves as an excellent example of the capabilities of Australia's manufacturing industry.

The value of IMCRC's industry-led, collaborative approach has been recognised by many of its participants, who continued to remain committed to their research investment despite growing uncertainty. In several cases, this led to an increase in scope, as well as investment in additional projects.

Through initiatives such as IMCRC activate, IMCRC delivered new research opportunities that helped Australian manufacturing businesses navigate COVID-19 setbacks. The team worked hard to deliver the program during the worst of the pandemic, providing 35 manufacturers access to shorter-term R&D funding to leverage emerging technologies and create new business opportunities and manufacturing outcomes.

The scale and breadth of the IMCRC research collaborations across Australia's core industries has meant that IMCRC is directly and uniquely connected to many of the trends shaping Australia's manufacturing sector.

Utilising that knowledge as part of its Industrial Transformation Program, IMCRC has encouraged over 750 Australian manufacturing SMEs, as well as many larger manufacturers, to accelerate their digital transformation journey. At its core sits futuremap®, a unique diagnostic platform that has enabled manufacturers to assess their capabilities across industrial and manufacturing competitiveness and identify opportunities for growth and investment. Pleasingly, many of IMCRC's industry partners have credited futuremap® as the catalyst for their manufacturing innovation journeys.

IMCRC's business model and focus on building effective and sustainable partnerships, combined with our strong commitment to governance, has allowed the CRC to purposefully invest more than $34 million of Commonwealth and other project funding. In turn, this has catalysed a $230 million portfolio investment in transformative manufacturing R&D.

All our projects and CRC activities are due to be completed before or during December 2022. As this concludes IMCRC's term, we leave behind a proven and exemplary framework for manufacturing innovation. IMCRC has emerged as one of the key success stories of Australia's CRC Program. It is my hope this successful business model can continue to shape Australia's manufacturing and innovation ecosystem into the future.

It has been an immense privilege to support the transformation of Australia's manufacturing industry as IMCRC's Chair. On behalf of the Board, I would like to congratulate CEO and Managing Director David Chuter and his team, as well as our industry and research partners, for their remarkable passion and commitment over the past six years.

The Hon Ian Macfarlane
Chair

Message from the CEO and Managing Director

Manufacturing is a cornerstone of Australia's economy, and the past 12 months have proven once more the importance of building a resilient and agile manufacturing ecosystem.

Through the uncertainties created by COVID-19 and recent geopolitical tensions, IMCRC's focus has remained on supporting our project partners in their collaborative research and innovation endeavours.

Thanks to the dedication of IMCRC's staff and Board and the strong commitment of our industry and research partners, we have generated a $230 million investment portfolio of 71 research projects, 22 of which commenced in the fiscal year.

IMCRC's ambition to help catalyse the transformation of Australian manufacturing has inspired the wider industrial community to go beyond traditional operations, invest in new and digital technologies and future-proof their business models. Backed by a transparent governance framework, we invested in innovative, industry-led projects that leveraged Australia's research strength, right from the start. By assessing the risks, readiness and potential of each project, and requesting our partners to be clear about their research and commercial objectives, we have ensured that everyone was committed to the milestones that drive the translation of research from proof of concept through to commercialisation. Importantly, we decided not to own any intellectual property created through the projects to encourage our partners to form mutually beneficial agreements that would allow them to effectively commercialise.

By doing so, we removed a common barrier for SME participation in collaborative R&D. And with 80% of our industry partners being Australian-owned SMEs, this approach has proven to be incredibly effective. Because these project investments have been strategically important to our partners, they have remained relevant through the worst of the pandemic, with IMCRC's portfolio remaining largely intact.

This financial year we have again seen what is possible when Australian manufacturers and universities collaborate, with 16 projects completed and already delivering real-world commercial outcomes.

Supercool is one example. In collaboration with Griffith University, they developed a smart electric compressor for mobile air-conditioning and refrigeration technology. Launched in late 2021, the Internet of Things enabled compressor delivers real-time access to performance data which offers equipment operators around the world new insights and Supercool a real competitive advantage. There are many more, and I strongly recommend reading through this Annual Report to be inspired.

To accelerate the commercialisation of research, we have also encouraged our industry partners to engage with universities on a much broader level – including with business schools and faculties such as IT and

law. By tapping into these areas of expertise to assess competitor landscapes, regulatory requirements and costing models in parallel with the R&D, our partners have been able to fast-track market readiness.

One exemplar is IMCRC's collaboration with global medical technology company Stryker, four leading universities and St Vincent's Hospital. The five-year project is developing a revolutionary, patient-specific treatment for bone cancers and tumors. By engaging researchers from different schools and disciplines, Stryker embraced the breadth and complexity required to deliver commercial success, from technology to treatment integration. As a result, the innovation process has accelerated far beyond initial expectations and catalysed further R&D investment by Stryker in Australia through their new R&D Lab.

We have continued to see wider impact through futuremap®, IMCRC's education and industrial transformation platform for manufacturing SMEs, which was selected to support new initiatives such as the NSW Government's 'Driving Digital Skills Pilot Program'. Additionally, we have facilitated multiple workshops that deepened manufacturers' understanding of their business capabilities by sharing insights into how Industry 4.0 can improve productivity and create new manufacturing opportunities. Work is also underway to develop an additional 'journey to Net Zero' futuremap® module for manufacturing SMEs.

In March 2022, we celebrated the 30th anniversary of the CRC Program at Parliament House in Canberra. As part of the CRC Showcase, we demonstrated the depth and breadth of our industry-research collaborations and engaged in conversations about how research-led innovations create opportunities for Australian manufacturing. In June 2022, after a three-year hiatus, wwe welcomed our partners at IMCRC's 'Innovative Manufacturing Accelerated' conference in Sydney. Hosted alongside Australian Manufacturing Week, and in partnership with UTS Tech Lab, the conference focused on research translation and commercialisation, capturing diverse views on innovation, collaboration and investment from across Australia's manufacturing ecosystem.

Over the past six years, IMCRC has strategically invested $34 million in Commonwealth and other cash funding into R&D projects designed to help rebuild a thriving and globally relevant manufacturing industry. This has catalysed a 7x multiplier on Commonwealth cash investment, with outcomes set to deliver significant high value jobs and substantial net economic benefit to CRC partners and to Australia more generally through commercial pathways, technology investment, new business models and international collaborations.

While these returns and impact highlight the critical importance of strong commercial and governance frameworks, I cannot ignore that, especially through the challenges of COVID-19, strong relationships emerged as a key driver of effective collaboration. With mutual respect and trust between industry and research institutions has come a willingness to think differently and collectively drive manufacturing forward in Australia.

It is exciting to see that IMCRC's collaborative ecoswystem facilitates enduring partnerships – both with research organisations working together on new projects, and industry partners collaborating through complementary technologies and business models.

To IMCRC's team and project partners, thank you for your trust through these unprecedented times. I want to acknowledge the unwavering commitment of our team. I am extremely proud to work alongside a group of people so dedicated and invested in the success of every project and to the industry as a whole. Thank you also to our Chair, the Hon Ian Macfarlane, and our Board of Directors, for their invaluable support and counsel over the past year.

Although IMCRC concludes CRC activities at the end of 2022, it leaves behind a strong legacy and a clear framework for commercialising research innovation. It has been a responsibility and a 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 for the future.

Thank you.

David Chuter
CEO and Managing Director

CASE STUDIES

* photo credit: IMCRC

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."

INNOVATIVE MANUFACTURING CRC (IMCRC)

* photo credit: IMCRC

ABOUT IMCRC

Who We Are

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

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

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

- invest in new ideas, emerging technologies, research and development (R&D) and innovative business models
- connect and collaborate with scientists and researchers to solve industry-specific problems and identify solutions that translate into commercial outcomes
- improve manufacturing expertise and capabilities to move up the value chain
- discover new business opportunities that strengthen partnerships and 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.

To date, we have purposefully invested $34 million of Commonwealth and other funding to advance Australian manufacturing, catalysing more than $230 million in collaborative research, manufacturing innovation and education across Australia.

With Australian manufacturing being critical to a modern Australian economy, we want the public perception of a capital- and labour-intensive brand of manufacturing shift to one that embraces industrial transformation, in which companies leverage digital technologies, including Industry 4.0, to deliver innovative business models and design, make and sell new products, services and solutions to a global market.

What We Do

Our Vision

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

Our Mission

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

What We Value

Purposeful investment

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

Industry-led focus and collaboration

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

Bold entrepreneurship

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

Inspirational yet humble leadership

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

Passionate advocacy

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

Our Team

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

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

In FY2021-22, Dr Min Yin Yap left the organisation to pursue a new career opportunity. As Project Research and Education Officer she worked with IMCRC's industry and research participants to successfully progress their manufacturing research collaborations.

IMCRC also engaged Mr Rohann Chapman from 6Step as project manager (part-time) to support the Industrial Transformation Program.

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

DAVID CHANDLER
PROJECT RESEARCH AND SYSTEMS OFFICER

JANA KUTHE
COMMUNICATIONS, MARKETING AND EVENTS MANAGER

Our Board

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

HON IAN MACFARLANE
INDEPENDENT DIRECTOR, CHAIR

MR DAVID CHUTER
MANAGING DIRECTOR (AND CEO)

PROFESSOR MARY O'KANE, AC
INDEPENDENT DIRECTOR

DR ALEXANDER GOSLING, AM
INDEPENDENT DIRECTOR

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

MR SIMON 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

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

Industry

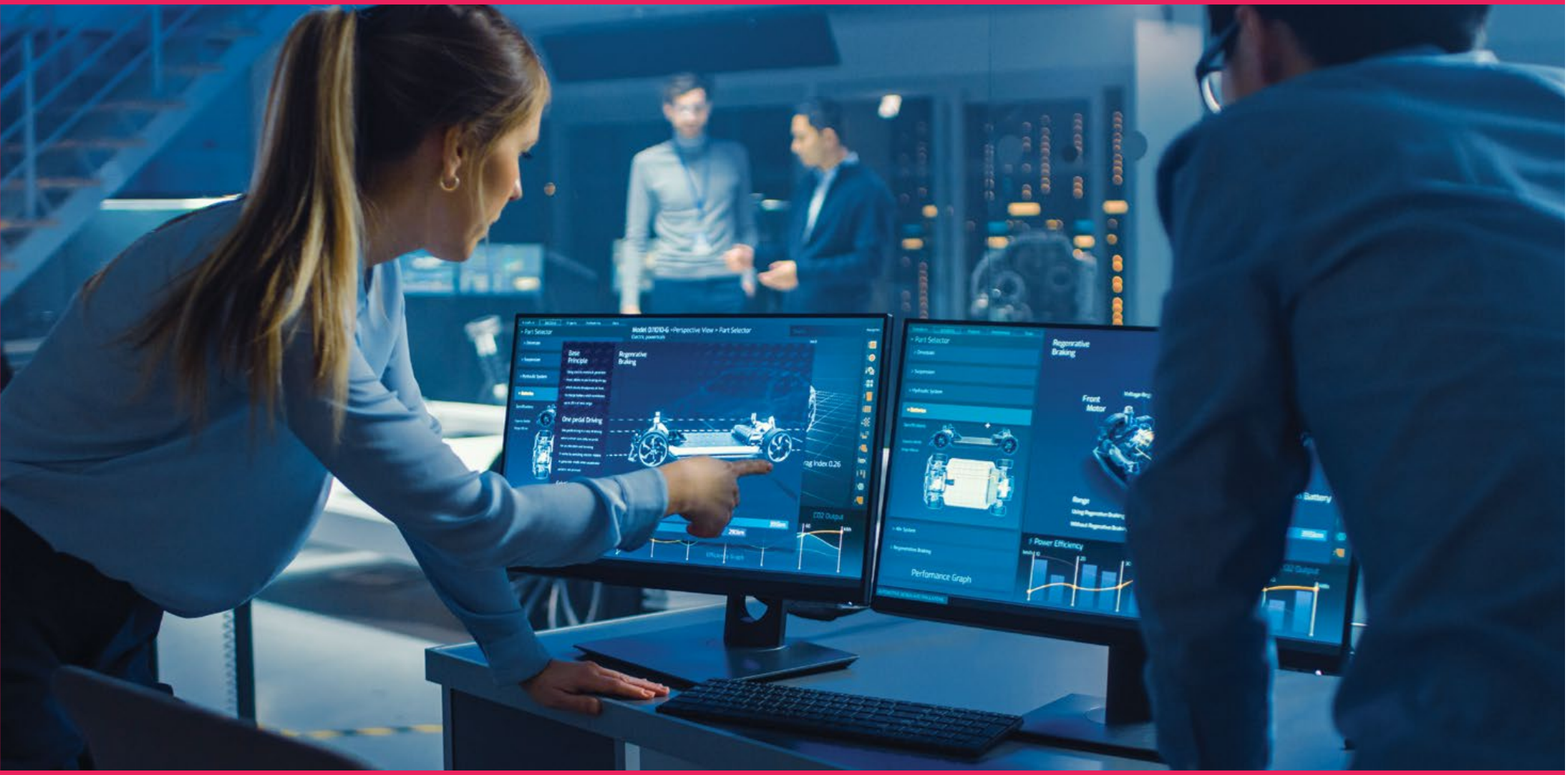
Research

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 Hub
MTP Connect
prefabAUS
AMGC Advanced Manufacturing Growth Centre Ltd
AMTIL
South Australia
Government of South Australia Department of State Development
Fraunhofer
Callaghan Innovation

CHAMPIONING MANUFACTURING INNOVATION



* photo credit: IMCRC

Executive Summary

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

As a critical enabler of Australia's prosperity, the importance of a strong, resilient and capable manufacturing sector has never been clearer. The pandemic, together with global supply chain and geopolitical issues, has shone a spotlight on what we could and should be designing and manufacturing locally, and what we can do to stimulate investment in new products, processes, services and business models.

Accelerating innovation

Since 2016, IMCRC has purposely invested in a broad range of R&D projects designed to lift Australian Manufacturing capability and capacity. This strategy has delivered 71 industry-led manufacturing projects,spanning four multidisciplinary research programs:

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

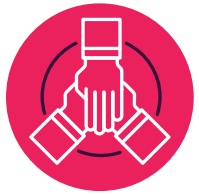
Carefully crafted and executed, all IMCRC projects explore emerging technologies and develop ground-breaking manufacturing solutions that deliver real-world outcomes and help those involved transform, become more competitive and grow.

In FY2021-22, IMCRC managed a portfolio of 59 projects, of which 17 were successfully completed during the reporting period, taking the total completed IMCRC projects to 25. With IMCRC activate, IMCRC created a new funding program to help manufacturing businesses, particularly SMEs, collaborate with research organisations and accelerate their COVID-19 recovery through shorter-term, high-impact R&D. Since launching the program in June 2020, IMCRC has invested more than $3.5 million in 36 activate collaborations spanning multiple sectors, 22 of which commenced during the reporting period.

Safeguarded by IMCRC's proven governance framework, which aligns industry, research and other supporting partners at each step of the innovation journey, the majority of IMCRC's projects have progressed without any significant technical or scientific impediments. In fact, several businesses such as SuperCool, Monitum and HYDAC Australia have successfully commercialised the technology, product or service they developed with the support of IMCRC.

ADDITIVE MANUFACTURING PROCESSES

AUTOMATED AND ASSISTIVE TECHNOLOGIES



HIGH-VALUE PRODUCT DEVELOPMENT

INDUSTRIAL TRANSFORMATION

Supporting the next generation of manufacturers

In FY2021-22, IMCRC welcomed two new students to its cohort of 28 PhD and Masters students. With the majority in the final stages of their research, IMCRC hosted a 'Take Charge of Your Career' workshop in August 2021, offering 25 students the opportunity to develop a tailored career plan and expand their network of contacts. Since then, five PhD students and one Masters student have completed their candidature.

To spark more interest in a career in manufacturing, IMCRC extended its "Masters by Coursework" scholarship, offering five students a $5,000 incentive to engage in an industry-led research project over the course of one semester.

Through the Australian Postgraduate Research Intern (APR.Intern) Program, IMCRC has helped PhD students gain real industry experience. In FY2021-22, three PhD students were matched with manufacturing SMEs, helping them assess and explore emerging technologies through a three to six-month internship. Since launching the partnership in 2019, IMCRC has fostered 22 internships, with nine leading to full-time employment.

Engaging with the manufacturing and innovation ecosystem

After a three-year hiatus, IMCRC enjoyed reconnecting with industry, research and government partners, and the wider Australian manufacturing community. In FY2021-22, IMCRC sponsored InnovationAus' inaugural 'Excellence in Innovation Awards' and the Cooperative Research Australia's (CRA) 'Collaborate Innovate' Conference. This helped demonstrate the depth and breadth of IMCRC's industry-research collaborations and drove new conversations about how research-led innovations create opportunities for Australian manufacturing. At the CRA conference, IMCRC PhD student, Dylan Ashton, was recognised for his presentation "Kangaroo tendons as substitute for ALC replacement", winning the 2021 Early Career Researchers Competition.

In June 2022, at IMCRC's 'Innovative Manufacturing Accelerated' Conference, around 100 industry and research partners were encouraged to take the next steps on their manufacturing innovation journey. Hosted alongside Australian Manufacturing Week and in partnership with UTS' Tech Lab, the Conference captured diverse views on innovation, collaboration and investment, while an engaging industry panel discussion, led by Professor Roy Green, explored pathways for industrial transformation.

Over FY21-22, IMCRC engaged in a total of 65 industry events, including webinars and workshops. futuremap® – IMCRC's SME engagement and education platform – has been the core driver of IMCRC's industry engagement. In collaboration with its deployment partners – Swinburne University of Technology, University Technology Sydney (UTS), Flinders University, and the Advanced Robotic for Manufacturing (ARM) Hub– IMCRC has now connected with over 1,000 manufacturing businesses across Australia.

Icon Reference

Primary Industry Sector

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

Key Enabling Technology

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

Project Status

- Start
- Completed
- In Progress
- Withdrawn
- Media

Dr. Matthew Young
Manufacturing Innovation Manager

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

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

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

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

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

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

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

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

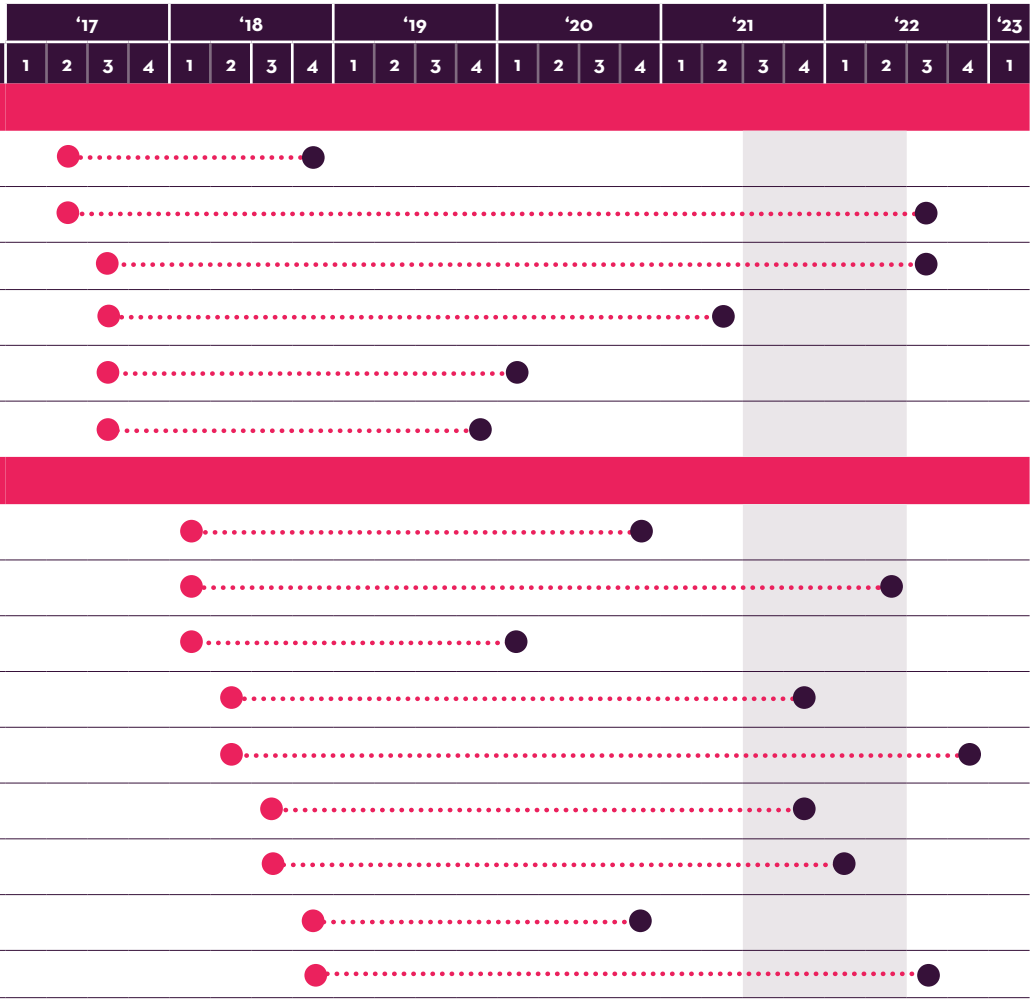
"Undoubtedly what we have achieved for, and with, our partners, but it would be impossible for me to choose between projects. Therefore, my proudest achievement is how we at the IMCRC have worked together as a very lean, close-knit team playing to each other's respective strengths to achieve our collective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

Areas of focus:

- Commercialisation
- Business development
- Project management
- Stakeholders

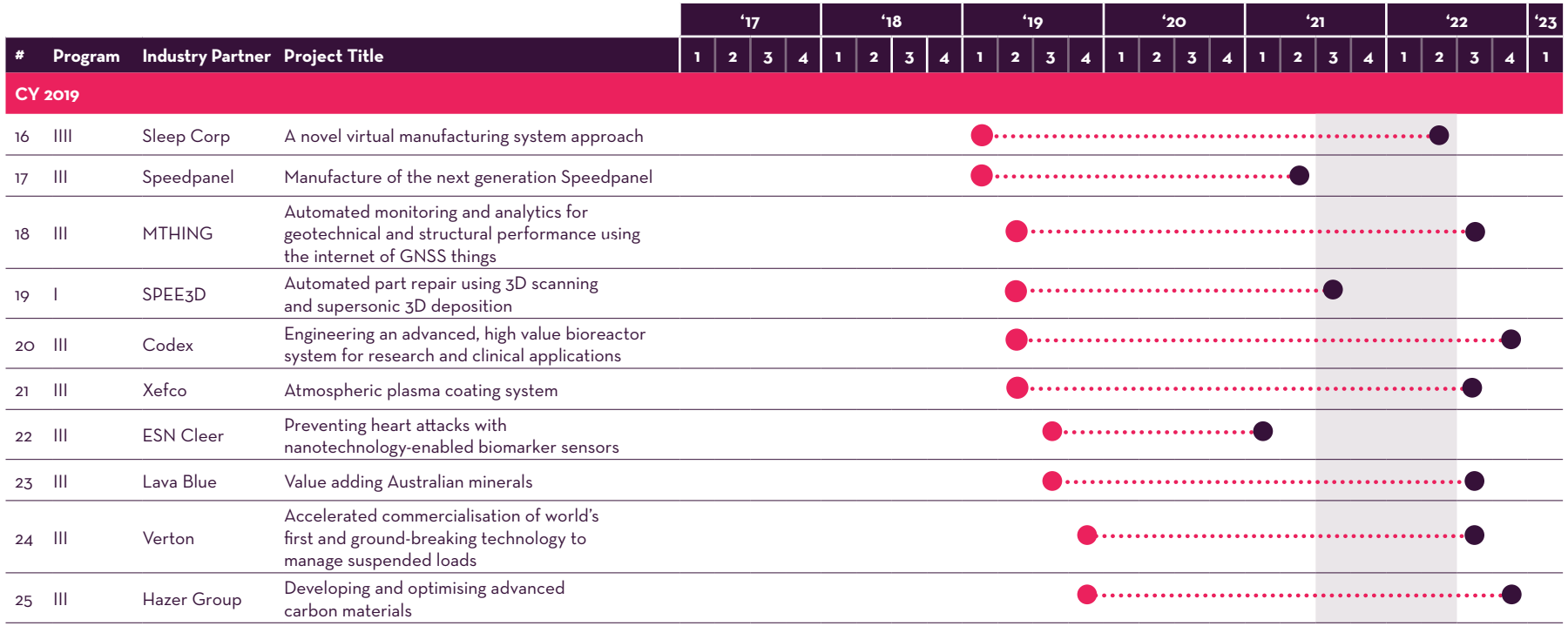
Research Projects from 2017-2022

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



FY2021-22 IMCRC activate Project commenced Project completion

#	Program	Industry Partner	Project Title
CY 2019			
16	IIII	Sleep Corp	A novel virtual manufacturing system approach
17	III	Speedpanel	Manufacture of the next generation Speedpanel
18	III	MTHING	Automated monitoring and analytics for geotechnical and structural performance using the internet of GNSS things
19	I	SPEE3D	Automated part repair using 3D scanning and supersonic 3D deposition
20	III	Codex	Engineering an advanced, high value bioreactor system for research and clinical applications
21	III	Xefco	Atmospheric plasma coating system
22	III	ESN Cleer	Preventing heart attacks with nanotechnology-enabled biomarker sensors
23	III	Lava Blue	Value adding Australian minerals
24	III	Verton	Accelerated commercialisation of world's first and ground-breaking technology to manage suspended loads
25	III	Hazer Group	Developing and optimising advanced carbon materials



#	Program	Industry Partner	Project Title	'17 1	'17 2	'17 3	'17 4	'18 1	'18 2	'18 3	'18 4	'19 1	'19 2	'19 3	'19 4	'20 1	'20 2	'20 3	'20 4	'21 1	'21 2	'21 3	'21 4	'22 1	'22 2	'22 3	'22 4	'23 1
CY 2020																												
26	III	Neometals	Value adding the Australian lithium mining sector: cutting-edge manufacturing proces to convert aluminosilicate mining wast to zeolites													●	·····	●										
27	IIII	BAE Systems Australia	Accelerating the uptake and diffusion of innovative manufacturing technologies in Australian shipbuilding and supply chain: the human factor													●	·····	·····	·····	·····	·····	·····	·····	·····	·····	·····	●	
28	IIII	Nutromics	R2R printing for cost effective manufacturing of a smart patch for health monitoring													●	·····	·····	·····	·····	·····	·····	●					
29	III	Telix	Centralised manufacture of Molecularly-targeted Radiation (MTR) drugs for cancer treatment													●	·····	·····	·····	·····	·····	·····	·····	·····	·····	●		
30	III	LPI	Smart coatings for the next generation of lightning strike protection devices														●	·····	·····	·····	·····	·····	·····	·····	·····	●		
31	III	Boral	Ultra sustainable concrete with high SCM content															●	·····	·····	·····	·····	·····	·····	●			
32	IIII	BAE Systems Australia	The application of interactive narrative visualisation and big data to improve high-value manufacturing															●	·····	·····	·····	·····	·····	·····	·····	●		
33	III	Alcolizer	Rapid point of care SARS-CoV2 detection, using a sensitive antigen screening test															●	·····	●								
34	IIII	Melbourne Water	Investigating Virtual Reality (VR) Low Voltage (LV) electrical safety rescue simulation for utilities and manufacturing sectors																●	·····	·····	·····	·····	·····	·····	·····	●	
35	III	LaserBond	Delivery of high-quality laser clad coatings for heavy wear and corrosion protection in slurry pumps																●	·····	·····	·····	·····	·····	·····	·····	●	
36	III	3D Dental	Development of novel 3D BNNT ceramic composite for advanced dental applications																●	·····	·····	·····	·····	●				
37	III	Questsemi	SiC diode manufacturability and characterisation for commercialisation by Questsemi Australia																●	·····	·····	·····	·····	●				
38	IIII	FormFlow	High volume, scalable manufacturing cell for enhanced building products																●	·····	·····	·····	·····	●				

FY2021-22 IMCRC activate ● Project commenced ● Project completion

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

FY2021-22 IMCRC activate ● Project commenced ● Project completion

#	Program	Industry Partner	Project Title	'17 1	'17 2	'17 3	'17 4	'18 1	'18 2	'18 3	'18 4	'19 1	'19 2	'19 3	'19 4	'20 1	'20 2	'20 3	'20 4	'21 1	'21 2	'21 3	'21 4	'22 1	'22 2	'22 3	'22 4	'23 1
CY 2022																												
50	I	Allegra Orthopaedics	Improving manufacturability of Sr-HT coated orthopaedic implants																			●				●		
51	I	TFM	Upscaling and optimisation of titanium swarf ECAP process																			●				●		
52	III	Ozcut Abrasive	Surface functionalization of ceramic alumina abrasive																			●				●		
53	III	SuperCool	Smart voltage regulators and control module for refrigeration compressors on heavy vehicles																			●				●		
54	IIII	Revo Group	PoleWatch																			●				●		
55	III	Callidus Welding	Advanced engineered surfaces for hydrometallurgy ball valves																			●				●		
56	III	HeiQ	Bio-based materials for next generation textile treatments																			●				●		
57	I	InfraBuild	Cold spray deposition of titanium on a complex metal substrate																			●				●		
58	III	Xefco	Textile dyeing via atmospheric plasma coating																			●				●		
59	III	Impact Absorbing Systems	Energy absorbing traffic lights																				●			●		
60	II	Dentroid	Development of a miniaturised robotic laser device for ultra-precise and pain-free dentistry																				●			●		
61	III	Speedpanel	A new advanced manufacturing technology to manufactur fire rated and acoustic panel systems																				●			●		
62	I	ANCA	Additively manufactured cutting tools																				●			●		
63	III	entX	Development of a novel, prototype thermovoltaic energy device																				●			●		

FY2021-22 IMCRC activate ● Project commenced ● Project completion

#	Program	Industry Partner	Project Title	'17 1	'17 2	'17 3	'17 4	'18 1	'18 2	'18 3	'18 4	'19 1	'19 2	'19 3	'19 4	'20 1	'20 2	'20 3	'20 4	'21 1	'21 2	'21 3	'21 4	'22 1	'22 2	'22 3	'22 4	'23 1
CY 2022																												
64	I	Singular Health	Rapid prototyping and point of care 3D-print manufacture of patient specific ostomy seal device																				●			●		
65	III	GeoInventions	Development of smart sensor system for soft soil engineering and construction safety																				●			●		
66	III	Xefco/Survivon	Sustainable functional metallised textiles																				●			●		
67	I	Conflux	Alloy development for additively manufactured heat exchangers																					●		●		
68	III	Humble Bee Bio	Sustainable DWR textile coatings inspired by Australian bee biopolymers																					●		●		
69	III	Thales Australia	Development of lightweight Australian composite overwrapped gun barrels																					●		●		
70	IIII	MotorOne Group	Industrial internet-of-things solution for real-time assessment of product quality																					●		●		
71	III	Gale Pacific	Non-combustible fabric development																					●			●	

FY2021-22 IMCRC activate ● Project commenced ● Project completion

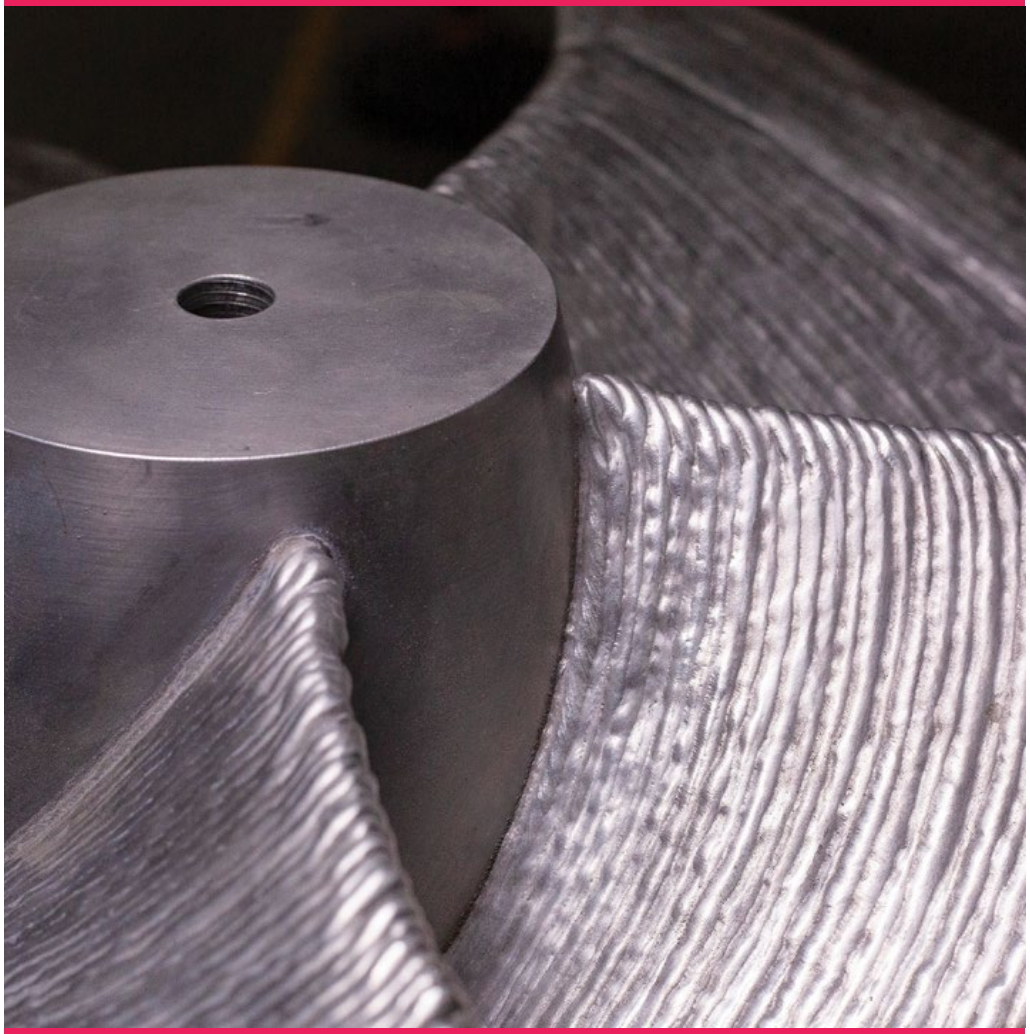
Program 1: Additive Manufacturing Processes

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

As the technology matures into production ready applications, industry research and development requirements shift. IMCRC's research program focuses on:

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

To date IMCRC has invested in **14 'Additive Manufacturing Processes' research projects**, with **five projects** since being successfully completed.



* photo credit: AML3D

Six new projects were funded under IMCRC's activate program.

IMCRC activate

3D printed heat exchanger

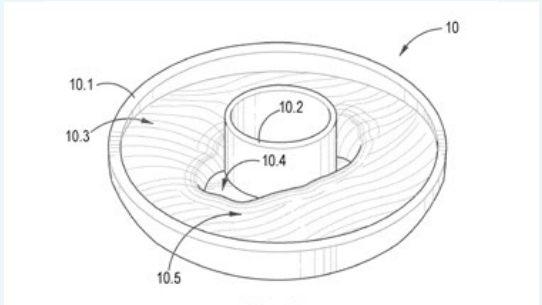
* photo credit: Conflux

Alloy development for additively manufactured heat exchangers					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Conflux	Deakin	$701,703	$138,232	07/01/22	9 months

Objective

- to develop novel aluminium alloy compositions that improve the overall thermal conductivity performance of additively manufactured heat exchangers

IMCRC activate



Render of ostomy seal

* photo credit: Singluar Health

Rapid prototyping and point of care 3D-print manufacture of patient specific ostomy seal devices					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Singular Health	CSIRO	$538,985	$99,936	01/11/21	11 months

Objective

- to advance Singular Health's 3Dicom software application by developing a 'surface scan to model' extension that will add 3D visualisation capability to the software

Additively manufactured cutting tools					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
ANCA	CSIRO	$928,571	$150,000	01/10/21	1

Objective

- to develop novel 3D printing technology to manufacture tungsten-carbide tools with the aim of replacing the current production process of mould pressing, sintering, brazing and grinding

Cold spray deposition of titanium on a complex metal substrate					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
InfraBuild	CSIRO	$904,512	$106,043	01/09/21	1

Objective

- to validate the potential of cold spray metal and metal composite coatings using recycled titanium waste powder as a viable coating for highly corrosive soils using CSIRO's patented Cold Spray ZAPTM technology

IMCRC activate

Grinding tools

* photo credit: ANCA

IMCRC activate

InfraBuild manufacturing plant

* photo credit: InfraBuild

IMCRC activate

Titanium swarf

* photo credit: IMCRC

Upscaling and optimisation of titanium swarf ECAP process					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
TFM	Deakin	$878,897	$149,576	01/07/21	15 months

Objective

- to optimise and scale up an ECAP process of converting titanium swarf into a high value product with better material properties while consuming less energy

IMCRC activate

Novel coating process

* photo credit: Swinburne

Improving manufacturability of Sr-HT coated orthopaedic implants					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Allegra Orthopaedics	Swinburne, RMIT	$394,071	$59,169	01/07/21	15 months

Objective

- to prototype a new coating manufacturing process using a liquid suspension plasma spray system to deposit Allegra's proprietary bioceramic material onto orthopaedic implants

In FY 2021-22, the following **three projects** continued their research journey.

IMCRC activate

New Al-Sc welding wires for the emerging Australian arc additive manufacturing sector					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
AML3D	Deakin	$759,564	$113,212	01/03/21	1.5

Objective

- to develop new commercially viable aluminium-alloy welding wire tailored for a new emerging technology – wire additive manufacturing (WAM) to replace existing welding wire solutions

Aluminium-alloy welding wire

* photo credit: AML3D

Revolutionising mineral separation using additive manufacturing

Industry Partner
Mineral Technologies

Research Partner
UTS

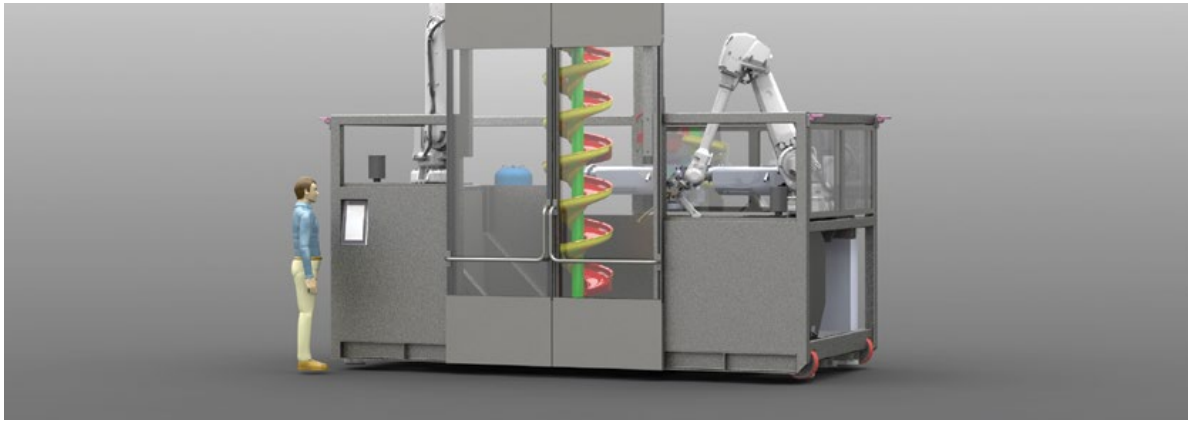
Total Project Value (AUD)
$9,126,869

IMCRC Funding (AUD)
$1,800,000

Start Date
01/04/18

Duration (Years)
4.5

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



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

* photo credit: UTS

Objectives

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

Just in time patient specific tumour implants

Prototypes of 3D printed musculoskeletal tumour implants

* photo credit: RMIT

Objectives

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

Industry Partner
Stryker Australia

Research Partner
RMIT, UTS, St Vincent's Hospital Melbourne, Melbourne University, Sydney University

Total Project Value (AUD)
$17,821,197

IMCRC Funding (AUD)
$3,000,000

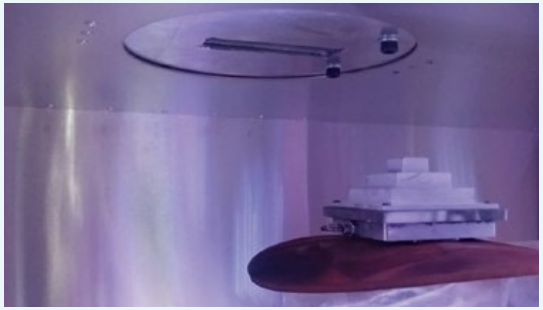
Start Date
01/07/17

Duration (Years)
5.2

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

In FY2021-22, a further **two 'Additive Manufacturing Process'** projects were completed, bringing the total of completed research projects to **five**.

IMCRC activate



SPEE3D calibration scan

* photo credit: SPEE3D

Cold Spray Additive Manufacturing product development via material dataset					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
SPEE3D	Swinburne	$420,992	$50,005	01/05/21	1

Outcome

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

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

David Chandler
Project Research and Systems Officer

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

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

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

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

What has interested you most during your time at IMCRC?

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

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

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

Areas of focus:

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

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

Industry Partner
SPEE3D

Research Partner
UTS

Total Project Value (AUD)
$915,860

IMCRC Funding (AUD)
$175,196

Start Date
01/04/19

Duration (Years)
2.5

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

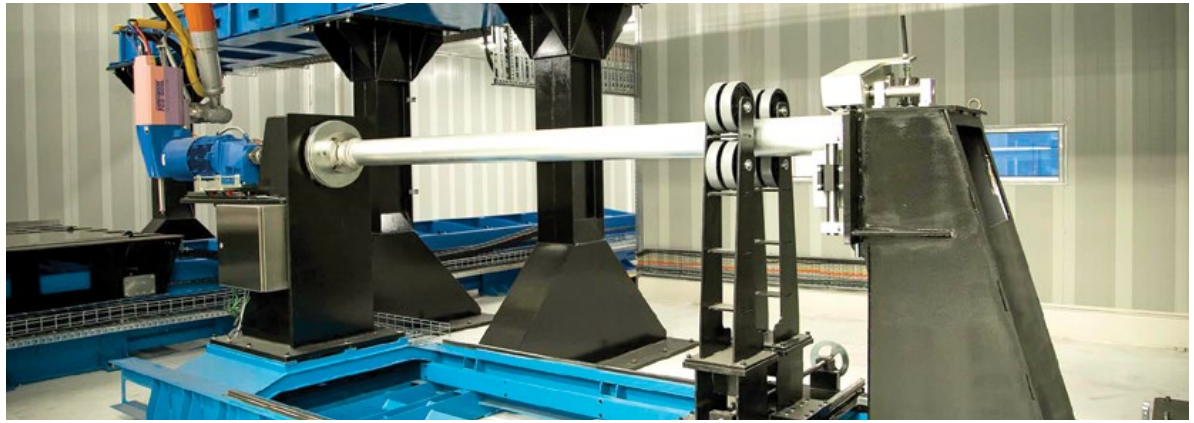
Automated part repair using 3D scanning and supersonic 3D deposition

* photo credit: SPEE3D

Outcomes

- developed automated supersonic 3D deposition technology for maintenance
- upsized and integrated the scanning technology developed in the IMCRC project "Machine vision for Industry 4.0 high speed printing" in SPEE3D's next generation WarpSPEE3D machine
- demonstrated technologies required to automate and digitalise the repair process enabling and expanding the application of SPEE3D technology

Additively manufactured titanium complex structures



Additively manufactured titanium complex structures

* photo credit: Titomic

Outcomes

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

Industry Partner
Titomic

Research Partner
CSIRO, RMIT

Total Project Value (AUD)
$2,612,762

IMCRC Funding (AUD)
$470,303

Start Date
01/11/18

Duration (Years)
2

David Chuter
Chief Executive Officer and Managing Director

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

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

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

David's unwavering focus on achieving transformation is the fundamental principle that sets IMCRC apart, both operationally and in its approach to inspiring that same drive and ambition in industry participants. He relentlessly pursues 'what could be done' and not just 'what should be done'.

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

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

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

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

Areas of focus

- Advocacy and a catalyst for positive change
- Manufacturing industry transformation
- Governance and operations
- Stakeholder engagement and investment

Application of additive metal technology to operational aircraft

Application of additive metal technology to operational aircraft

* photo credit: RUAG Australia

Outcomes

- developed an additive manufacturing process that addresses corrosion and stress-corrosion damage affecting the structural integrity of components in operational aircraft
- explored geometry restoration using laser deposition technology to solve problems associated with corrosion/cracks in wing planks without the need for traditional major structural repair or component replacement

Industry Partner
RUAG Australia

Research Partner
RMIT

Total Project Value (AUD)
$1,150,781

IMCRC Funding (AUD)
$124,263

Start Date
01/03/18

Duration (Years)
2

Machine vision for Industry 4.0 high-speed printing

Industry Partner
SPEE3D

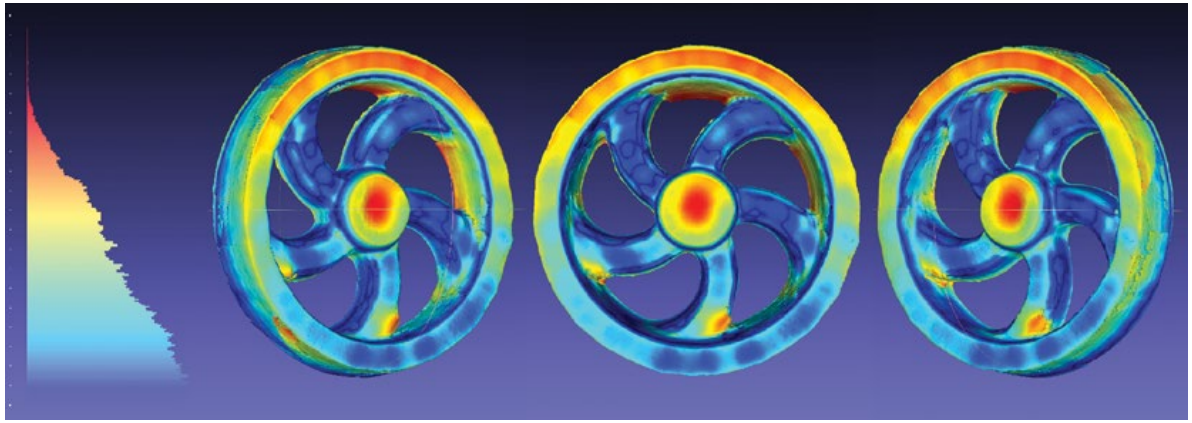
Research Partner
UTS

Total Project Value (AUD)
$1,315,845

IMCRC Funding (AUD)
$349,797

Start Date
01/03/17

Duration (Years)
1.4



Machine vision for Industry 4.0 high-speed printing

* photo credit: UTS

Outcomes

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

Program 2: Automated and Assistive Technologies

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

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

Under Program 2 – Automated and assistive technologies – IMCRC engages in the research and development of agile manufacturing technologies that improve the performance and operational effectiveness of short run and personalised production systems. The program aims to help industry develop:

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

MCRC has supported **ten research projects** under the 'Automated and Assistive Technologies' program, with **four projects** being successfully completed.

* photo credit: IMCRC

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

Dr. Jason Coonan
Deputy CEO

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

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

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

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

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

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

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

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

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

Areas of focus:

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

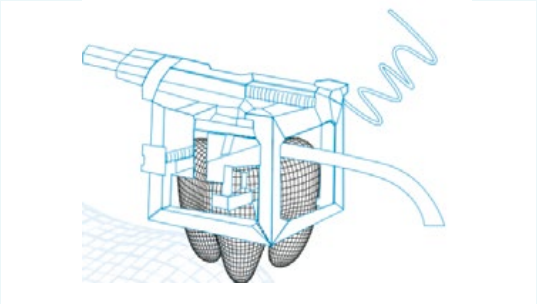
In FY2021-22, **one new IMCRC activate project** commenced under the program.

IMCRC activate

Development of a miniaturised robotic laser device for ultra-precise and pain-free dentistry					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Dentroid	Griffith	$656,368	$100,000	23/09/21	1

Objective

- to design and develop a high-power laser micro-electro-mechanical systems (MEMS) mirror to control the laser within the -mouth robotic assistive device



Micro-mechanical systems (MEMS)

* photo credit: Dentroid

IMCRC activate

Common land fill site

* photo credit: IMCRC

In FY2021-22, the following **five projects** continued their research into automated and assistive technologies to support their organisation.

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

Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
The Remediation Group	Deakin	$765,266	$150,000	01/03/21	1.6

Objective

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

Renaissance Battery Management Systems (BMS) Development

SuperCube

* photo credit: Energy Renaissance

Objectives

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

Industry Partner
Energy Renaissance

Research Partner
CSIRO

Total Project Value (AUD)
$2,524,829

IMCRC Funding (AUD)
$563,210

Start Date
01/02/21

Duration (Years)
1.7

Industry Partner
Verton

Research Partner
QUT

Total Project Value (AUD)
$3,970,221

IMCRC Funding (AUD)
$412,118

Start Date
10/10/19

Duration (Years)
3

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

A remote-controlled load-management system for suspended loads

* photo credit: Verton

Objectives

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

Automated monitoring and analytics for geotechnical and structural performance using the Internet of GNSS Things

Kurloo: automated monitoring system for geotechnical and structural performance

* photo credit: QUT

Industry Partner
MTHING

Research Partner
QUT

Total Project Value (AUD)
$4,502,248

IMCRC Funding (AUD)
$875,305

Start Date
01/04/19

Duration (Years)
3.4

Objectives

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

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

Industry Partner
CADwalk

Research Partner
UniSA

Total Project Value (AUD)
$6,602,962

IMCRC Funding (AUD)
$1,060,626

Start Date
01/04/17

Duration (Years)
5.5

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

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

* photo credit: CADwalk

Objectives

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

Under the 'Automated and assistive technologies' research program, **two projects** were completed in the FY2021-22, bringing total completed projects to **four**.

High Access Localised Operations (HALO)					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Ausdrill	UTS	$466,547	$75,314	15/04/21	1

Outcome

- advanced a high access localised operations (HALO) platform by integrating robotic and virtual reality (VR) technologies with the aim to improve the efficiency and safety of traditional rock scaling operations

IMCRC activate

Robotic and Virtual Reality (VR) technologies

* photo credit: UTS

Explosion diagram based virtual and augmented reality maintenance training for industrial machines					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
HYDAC Australia	Deakin	$486,627	$78,358	25/02/20	1.1

Outcome

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

IMCRC activate

HYDAC's hydraulics components

* photo credit: HYDAC

Design robotics for mass customisation manufacturing

Industry Partner
UAP

Research Partner
QUT, RMIT

Total Project Value (AUD)
$6,560,238

IMCRC Funding (AUD)
$1,202,066

Start Date
01/07/17

Duration (Years)
4

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

The Design Robotics team at UAP in Brisbane

* photo credit: UAP

Outcomes

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

Tradiebot

Tradiebot

* photo credit: Tradiebot

Outcomes

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

Industry Partner
Tradiebot Industries

Research Partner
Swinburne

Total Project Value (AUD)
$1,881,498

IMCRC Funding (AUD)
$390,247

Start Date
18/01/18

Duration (Years)
2

Program 3: High Value Product Development

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

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

IMCRC has co-funded **39 'High Value Product Development' research projects**, with **ten projects** being completed in the FY2021-22.

* photo credit: IMCRC

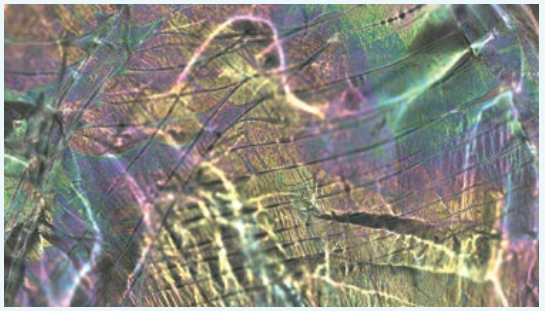
In FY2021-22, **13 research projects commenced** in the reporting period, with **one being completed.**

Sustainable DWR textile coatings inspired by Australian bee biopolymers					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Humble Bee Bio	Deakin	$566,248	$70,000	28/02/22	7 months

Objective

- to develop a formulation and production method for suitable durable water repellent (DWR) coatings using Humble Bee Bio's novel biopolymer

IMCRC activate



Durable water repellent (DWR) coatings

* photo credit: Humble Bee Bio

Development of lightweight Australian composite overwrapped gun barrels					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Thales Australia	Deakin	$234,023	$51,567	07/02/22	7 months

Objective

- to specify and source suitable carbon fibres, select appropriate resin and develop a new sizing agent to create new composite-metal interface for overwrap gun barrels and other civil applications

IMCRC activate

Composite-metal interface

* photo credit: Thales Australia

IMCRC activate

Fabric production

* photo credit: Gale Pacific

Non-combustible fabric development					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Gale Pacific	Deakin	$424,501	$70,044	01/02/22	8 months

Objective

- to develop a lightweight, flexible and formable fabric with commercial applications across different industry sectors including construction, defence, mining and agriculture

IMCRC activate

Metalic coating

* photo credit: Xefco

Sustainable functional metallised textiles					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Xefco and Survivon	Deakin	$518,942	$99,448	01/12/21	9 months

Objective

- to improve the durability of already-developed antiviral and heat-reflective metallic coatings for textiles

IMCRC activate

Development of a smart sensor system for soft soil engineering and construction safety					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
GeoInventions	Griffith	$421,147	$50,000	25/11/21	11 months

Objective

- to develop smart geotechnical sensors to monitor the safety of Australian coastal roadways using micro-electro-mechanical systems (MEMS) technology

Geotechnical sensors on roadways

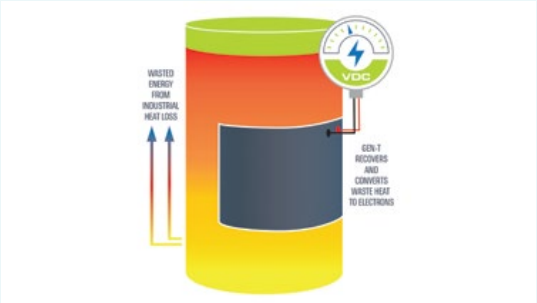
* photo credit: GeoInventions

IMCRC activate

Development of a novel prototype thermovoltaic energy device					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
entX	UniSA	$404,642	$76,620	01/11/21	9 months

Objective

- to advance entX beta-voltaic technology and build a set of prototypes that will convert infrared energy from waste heat sources into electicity



Beta-voltaic technology

* photo credit: entX

IMCRC activate

Speedpanel team at Deakin

* photo credit: Speedpanel

IMCRC activate

Atmosheric plasma coating

* photo credit: Xefco

A new advanced manufacturing technology to manufacture fire rated acoustic panel systems

Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Speedpanel	Deakin	$612,629	$99,560	01/10/21	1

Objective

- to establish a continuous manufacturing process for high volume production of the outer steel shell component of Speedpanel's acoustic and fire rated panel system

Textile dyeing via atmospheric plasma coating

Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Xefco	Deakin	$702,152	$99,828	01/09/21	1

Objective

- to evaluate atmospheric plasma pre-treatment processes as an alternative to conventional textile dyeing to improve dye absorption and diffusion in textiles, and immobilise dyes aimed to enhance colour fastness

Bio-based materials for next generation textile treatments					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
HeiQ	Deakin	$571,656	$99,560	01/09/21	1

Objective

- to develop innovative technologies and treatment option to use bioderived biodegradable sources such as natural waxes and oils for functional fibre coatings

IMCRC activate

Natural waxes and oils

* photo credit: IMCRC

Advanced engineered surfaces for hydrometallurgy ball valves					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Callidus Welding	Deakin	$586,595	$99,921	01/09/21	1

Objective

- to develop a surface engineering solution that delivers a “fused” coating system that has a complete metallurgical bond with the substrate by modifying, in this case, the two dominate alloys in hydrometallurgical reactors – titanium alloys and super duplex stainless steel

IMCRC activate

Welding

* photo credit: IMCRC

IMCRC activate

Test of energy absorbing bollard (EAB) concept

* photo credit: UnisSA

Energy absorbing traffic lights					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Impact Absorbing Systems	UniSA	$698,276	$99,989	15/08/21	1

Objective

- to modify an existing energy absorbing bollard (EAB) concept to suit the shape, length, size and location of common traffic lights

IMCRC activate

SuperCool's smart compressor

* photo credit: SuperCool

Smart voltage regulators and control modules for refrigeration compressors on heavy vehicles					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
SuperCool	Griffin	$488,097	$80,000	01/08/21	1

Objective

- to develop a range of smart voltage regulators and control modules tailored for SuperCool's 600V electric swashplate compressor, making it accessible for other vehicle and industrial applications

In FY2021-22, the following **eleven research projects** continued:

Scaling up high-performance hydrogen storage metal organic framework (MOF) materials manufacture for field trial prototypes of Hydrogen (H2) Storage systems in heavy trucking and hydrogen hubs					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
RUX Energy	University of Sydney	$723,132	$99,775	01/03/21	1.75

Objective

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

IMCRC activate

Hydrogen storage

* photo credit: IMCRC

High-speed permanent magnet rotor post assembly magnetisation and power conversion systems manufacture					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
gTET	RMIT	$373,615	$50,237	01/03/21	1.45

Objective

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

IMCRC activate

High-speed permanent magnet (PM)

* photo credit: gTET

Industry Partner
LaserBond

Research Partner
UniSA

Total Project Value (AUD)
$3,203,203

IMCRC Funding (AUD)
$486,594

Start Date
15/10/20

Duration (Years)
2

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

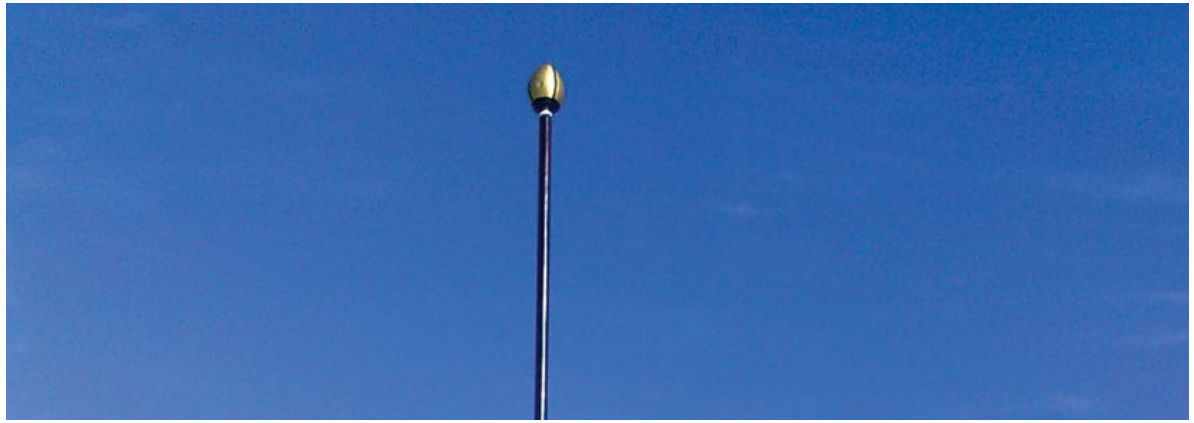
LaserBond's laser cladding technology

* photo credit: LaserBond

Objectives

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

Smart coatings for the next generation of lightning strike protection devices



LPI air terminal

* photo credit: LPI

Objectives

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

Industry Partner
Lightning Protection International

Research Partner
Swinburne

Total Project Value (AUD)
$1,136,428

IMCRC Funding (AUD)
$189,230

Start Date
01/06/20

Duration (Years)
2.3

Industry Partner
Telix
Cyclotek
iPhase Technologies
Genesis Care

Research Partner
University of Melbourne

Total Project Value (AUD)
$2,732,219

IMCRC Funding (AUD)
$499,215

Start Date
03/02/20

Duration (Years)
2.7

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

Manufacture of Molecularly-Targeted Radiation (MTR) drugs

* photo credit: Telix

Objectives

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

Developing and optimising advanced carbon materials

Developing and optimising advanced carbon materials

* photo credit: Hazer

Industry Partner
Hazer

Research Partner
University of Sydney

Total Project Value (AUD)
$5,888,068

IMCRC Funding (AUD)
$1,166,459

Start Date
01/11/19

Duration (Years)
2.5

Objectives

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

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

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

Industry Partner
Lava Blue

Research Partner
QUT

Total Project Value (AUD)
$10,461,003

IMCRC Funding (AUD)
$1,454,785

Start Date
23/09/19

Duration (Years)
3

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

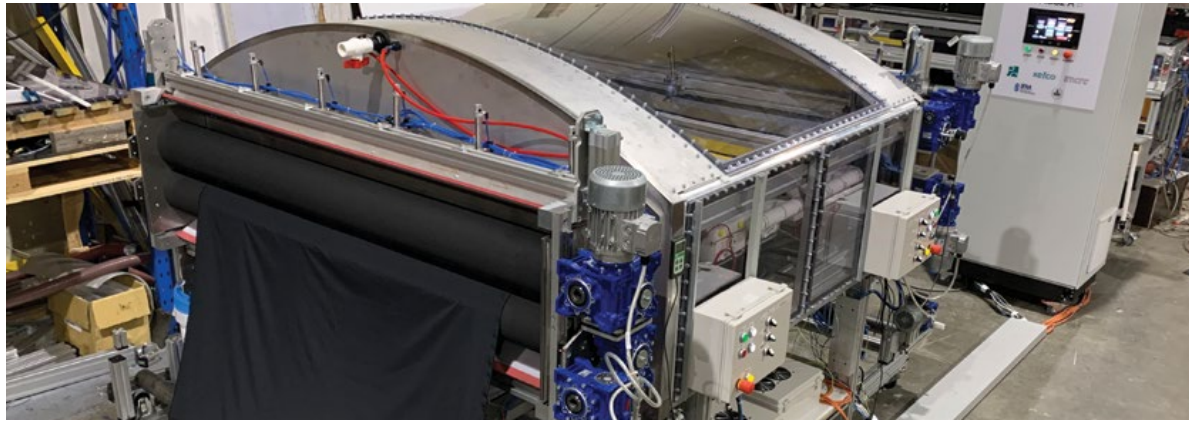
Advanced manufacturing of minerals

* photo credit: QUT

Objectives

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

Atmospheric plasma coating system



Atmospheric plasma coating system

* photo credit: Xefco

Objectives

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

Industry Partner
Xefco and
Proficiency Contracting

Research Partner
Deakin

Total Project Value (AUD)
$4,570,898

IMCRC Funding (AUD)
$825,006

Start Date
01/06/19

Duration (Years)
3.3

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

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

Industry Partner
Codex Research

Research Partner
University of Sydney

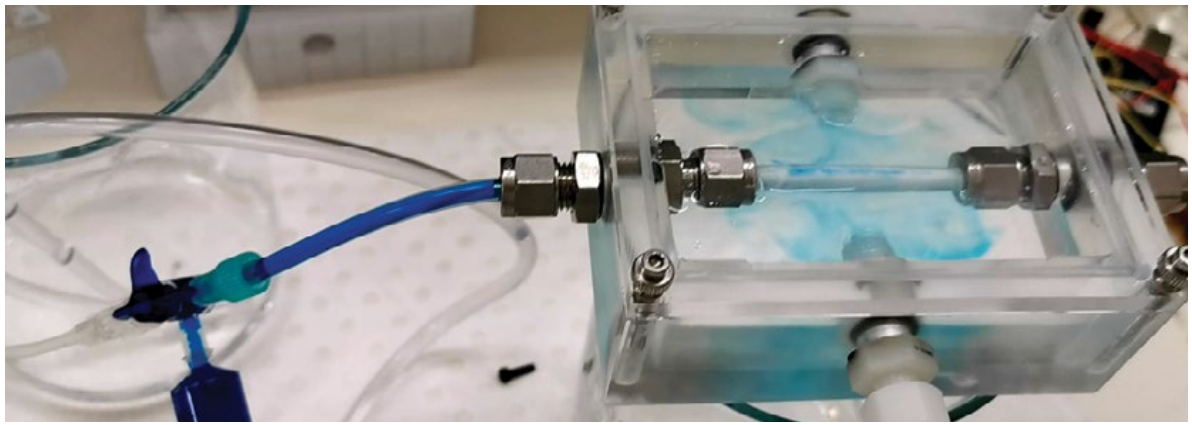
Total Project Value (AUD)
$5,376,676

IMCRC Funding (AUD)
$1,069,858

Start Date
01/04/19

Duration (Years)
3.4

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



Codex blood vessel pump

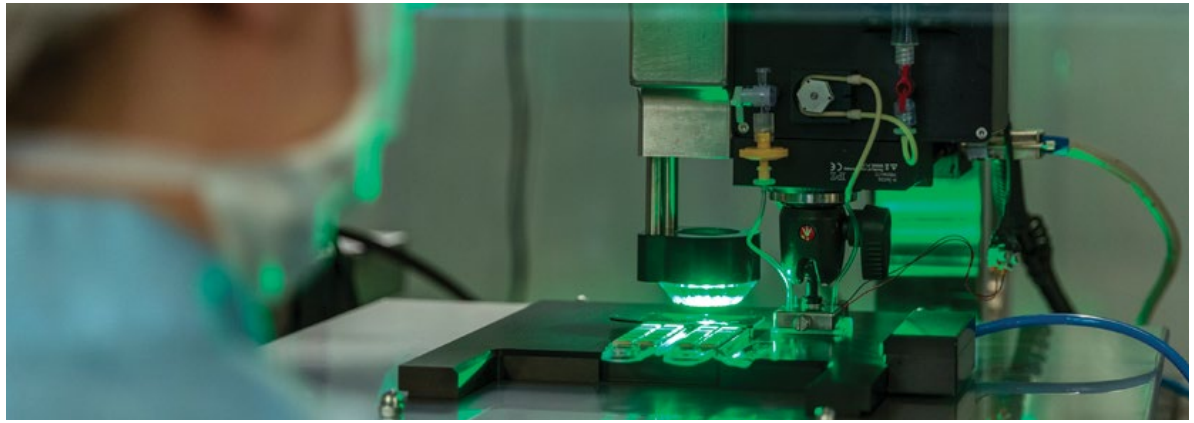
* photo credit: Codex

Objectives

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

Innovative vaccine delivery technology

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



Innovative vaccine delivery technology

* photo credit: Vaxxas

Industry Partner
Vaxxas

Research Partner
University of Sydney

Total Project Value (AUD)
$3,806,996

IMCRC Funding (AUD)
$556,231

Start Date
01/11/18

Duration (Years)
3.8

Objectives

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

A novel approach to biofilm disruption and removal

Industry Partner
Whiteley Corporation

Research Partner
University of Sydney,
UNSW

Total Project Value (AUD)
$5,271,285

IMCRC Funding (AUD)
$975,504

Start Date
01/04/18

Duration (Years)
4.7

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

IMCRC meeting the Whiteley research team

* photo credit: Whiteley

Objectives

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

In FY2021-22, **ten projects finished** under the 'High Value Product Development' stream, bringing the total of completed projects to **thirteen**.

Surface functionalisation of ceramic alumina abrasive					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Ozcut Abrasive	Swinburne	$333,636	$39,418	01/08/21	10 months

Outcome

- developed a stable surface functionalisation process that treats ceramic alumina and is compatible with phenolic thermoset resin systems

IMCRC activate

Metal cutting wheel

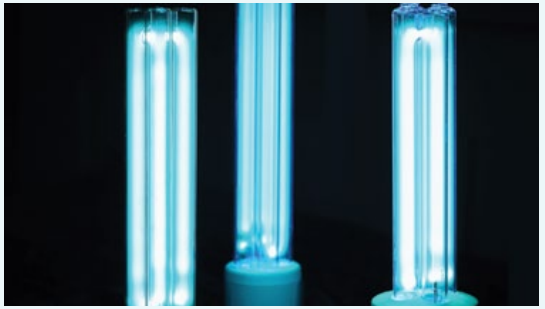
* photo credit: Swinburne

Automated closed loop verification of UV-C disinfection of COVID-19 using commercial off the shelf pulsed xenon source and detectors, certified by COVID testing on a range of surfaces					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Cablex	Swinburne	$614,649	$28,912	01/06/21	9 months

Outcome

- developed a sensor array to capture the energy distribution of a miniaturised pulsed xenon UV disinfection system and characterisation of the ability of the system to disinfect pathogens based on the energy distribution

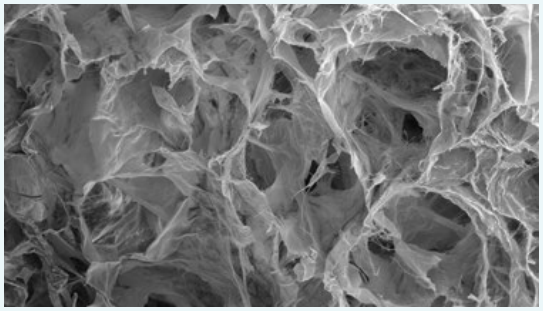
IMCRC activate



Senor array

* photo credit: IMCRC

IMCRC activate



Hydrogel

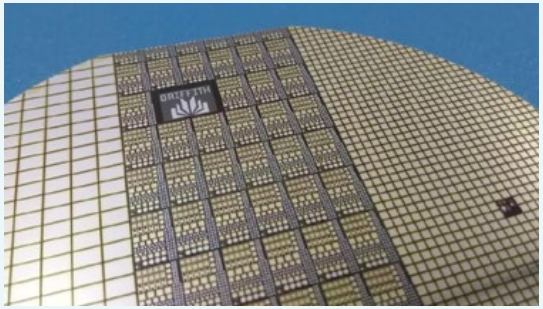
* photo credit: RMIT

Hydrogel-based perfusion bioreactor to engineer stable gut microbial composition					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
BiomeBank	RMIT	$603,544	$101,171	15/03/21	1.3

Outcome

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

IMCRC activate



SiC Schottky Diodes

* photo credit: Griffith

SiC diode manufacturability and characterisation for commercialisation by Questsemi Australia					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Questsemi	Griffith	$1,297,549	$143,710	1/11/20	1.1

Outcome

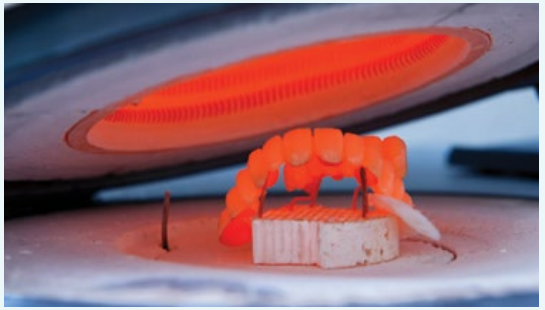
- established a simple and cost-effective manufacturing process of SiC Schottky Diodes, with the performance of the technology being tested in a pilot production facility that also supports early production runs

IMCRC activate

Development of novel 3D BNNT ceramic composite for advanced dental applications					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
3D Dental Technology	Deakin	$1,047,998	$149,992	15/10/20	1.4

Outcome

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



Dental ceramic oven

* photo credit: IMCRC

Ultra-sustainable concrete with high SCM content

Industry Partner
Boral

Research Partner
UTS

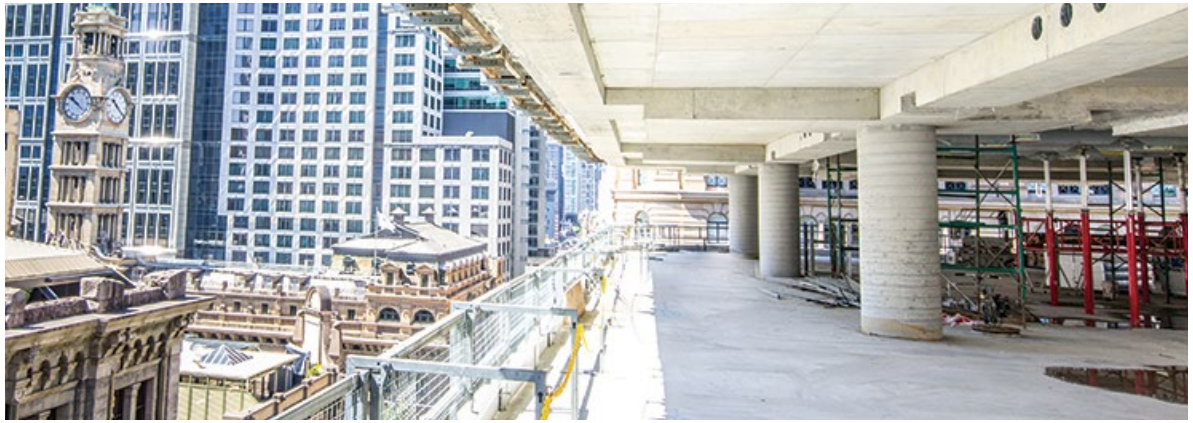
Total Project Value (AUD)
$6,880,822

IMCRC Funding (AUD)
$846,715

Start Date
01/07/20

Duration (Years)
2.5

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



Boral ultra-sustainable concrete, placed in St George Street, Sydney

* photo credit: Boral

Outcomes

- developed advanced technology for manufacturing, placing, and curing new ultra-sustainable concrete with an increased binder content of 70% supplementary cementitious materials (SMCs)
- mastered strength development and improved surface finishing techniques

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

Dr Summeet Walia working in the Nutromics laboratory

* photo credit: RMIT

Outcomes

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

Industry Partner
Nutromics
Romar Engineering

Research Partner
RMIT, Griffith

Total Project Value (AUD)
$6,602,894

IMCRC Funding (AUD)
$929,023

Start Date
01/02/20

Duration (Years)
1.75

Industry Partner
BLT
Allegra Orthopaedics

Research Partner
University of Sydney

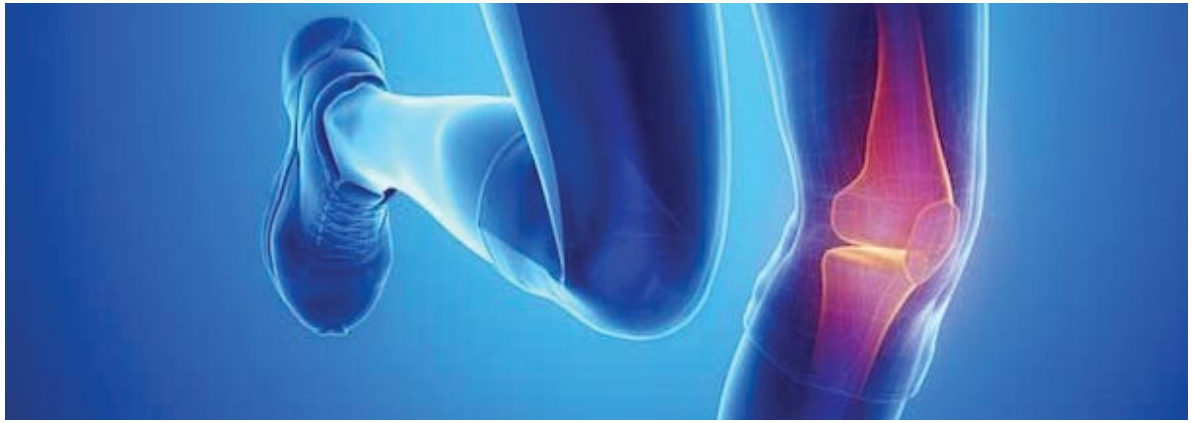
Total Project Value (AUD)
$7,504,204

IMCRC Funding (AUD)
$1,349,544

Start Date
01/09/18

Duration (Years)
3.6

Xenograft using Kangaroo tendon as substitute for ligament reconstruction



Using kangaroo tendon as substitute for ligament reconstruction

* photo credit: IMCRC

Outcomes

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

Industrialisation of composite wheel technology

Industrialisation of composite wheel technology

* photo credit: Carbon Revolution

Outcomes

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

Industry Partner
Carbon Revolution

Research Partner
Deakin

Total Project Value (AUD)
$16,513,992

IMCRC Funding (AUD)
$2,998,627

Start Date
01/07/18

Duration (Years)
3.5

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

Industry Partner
Corin

Research Partner
UniSA

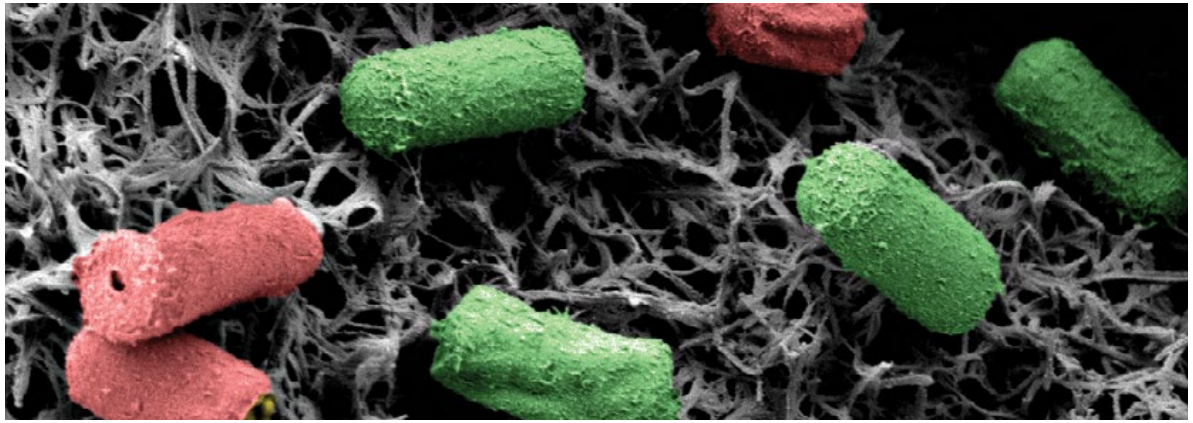
Total Project Value (AUD)
$13,831,236

IMCRC Funding (AUD)
$2,433,145

Start Date
28/02/18

Duration (Years)
4.3

Antimicrobial nanosurface for orthopaedic implants



Antibacterial surface modification

* photo credit: Corin

Outcomes

- explored nano-modification technology based on the structure of the dragonfly wing to create antimicrobial surface for orthopaedic implants
- proofed the safety of medical implants with the antimicrobial surface – “smart surface” - and tested their bacteria-killing properties
- developed a manufacturing infrastructure that allows the antimicrobial nano-surface to be engineered onto existing medical devices

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

Outcomes

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

IMCRC activate

Virulizer: rapid COVID-19 testing

* photo credit: Alcolizer

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

Industry Partner
BluGlass

Research Partner
Griffith

Total Project Value (AUD)
$2,096,662

IMCRC Funding (AUD)
$330,001

Start Date
01/09/17

Duration (Years)
2.2

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

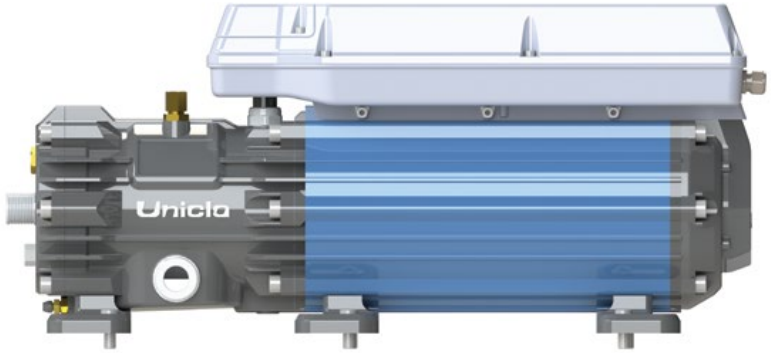
BluGlass laboratory

* photo credit: BluGlass

Outcomes

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

Smart electric compressor for refrigeration and air conditioning on electric vehicles



Smart electric compressor for refrigeration and air conditioning on electric vehicles

* photo credit: SuperCool

Industry Partner
SuperCool

Research Partner
Griffin

Total Project Value (AUD)
$2,370,366

IMCRC Funding (AUD)
$ 296,325

Start Date
01/09/17

Duration (Years)
2.5

Outcomes

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

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

The following three industry partners withdrew their research projects from the program due to COVID-19 disruptions and a change in industry partner strategic priorities in FY2020-21.

Lithium mining sector

* photo credit: Neometals

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

Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Neometals	QUT	$898,886	$62,552	01/01/20	1

ESN product

* photo credit: ESN Cleer

Preventing heart attacks with nanotechnology-enabled biomarker sensors

Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
ESN Cleer	RMIT	$1,582,082	$252,709	15/09/19	1

Speedpanel lab

* photo credit: Speedpanel

Manufacture of the next generation Speedpanel

Industry Partner	Research Partner	Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)
Speedpanel	Swinburne	$2,919,450	$397,998	01/02/19	2.5

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

Sameera Silva
Finance and IT Manager

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

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

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

What has inspired you most during your time at IMCRC?

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

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

Areas of focus:

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

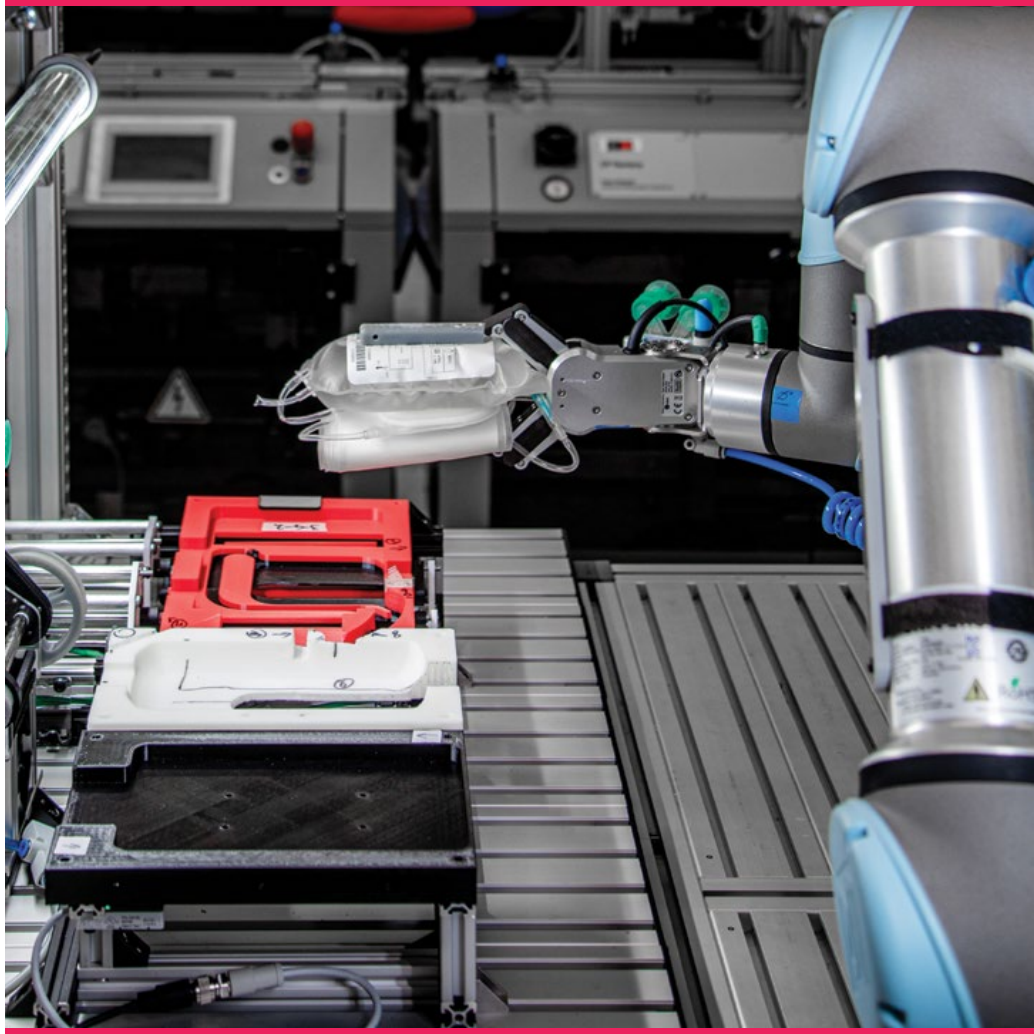
Program 4: Industrial Transformation

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

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

In FY2021-22, the **Industrial Transformation Program** has successfully:

- delivered 26 futuremap® workshops – virtually and in person – across Australia, encouraging 121 Australian manufacturing SMEs to commence or accelerate their Industry 4.0 and innovation journey
- empowered IMCRC's futuremap delivery partners – Swinburne University of Technology in Victoria, University Technology Sydney (UTS) in New South Wales, Flinders University in South Australia, and the Advanced Robotic for Manufacturing (ARM) Hub in Queensland – to lead and manage SME engagements within their respective states, with IMCRC stepping into a futuremap advisory and facilitator role



* photo credit: Swinburne

- collaborated with Investment NSW and the Department of Education – Training Services NSW on the 'Driving Digital Skills Pilot Program', providing conceptual guidance on how to develop NSW manufacturers' digital skills and broaden their understanding of Industry 4.0. All twelve participating organisations used futuremap® to assess and then build on their current digital capabilities
- adjusted the futuremap® delivery style, recognising the benefits of futuremap participants completing the diagnostic in their own time and using shorter-form workshops to discuss their results and possible pathways to Industry 4.0
- conducted four Industry 4.0 assessments in collaboration with Swinburne University's Factory of the Future (enabled by IMCRC's Industry 4.0 license agreement with Fraunhofer). Each assessment delivered comprehensive insights into the business maturity of each company and made recommendations for a successful implementation of Industry 4.0
- reported on the importance and progress of the adoption of Industry 4.0 across Australia, using the aggregated futuremap® data of 761 manufacturing SMEs that have completed the business diagnostic since its launch in 2018. Through thought and action leadership articles and speaking engagements at industry events such as the MedTech Industry 4.0 Forum and AusPack, IMCRC communicated where Australian manufacturing SMEs sit on the Industry 4.0 adoption scale and how they, by making small investments into technologies, processes and people, can get set for the future
- launched IMCRC's interactive project map in March 2022 to highlight where manufacturing businesses across Australia invest, develop and benefits from Industry 4.0 and advanced manufacturing technologies. This supports the demonstration of technology application and digital business model use cases as part of IMCRC's leadership of these workstreams within Australia's Industry 4.0 Advanced Manufacturing Forum

In FY2021-22, IMCRC invested in **eight research projects** as part of the Industrial Transformation Program, of which **three project**s have been successfully completed.

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

IMCRC activate

MotorOne Group team at the new factory

* photo credit: Swinburne

Industrial Internet-of-Things solution for real-time assessment of product quality					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
MotorOne Group	Swinburne	$295,635	$63,552	15/02/22	6 months

Objective

- to design and build an Industrial Internet-of-Things solution that seamlessly integrates sensing, communications and data analytics to assess and support the production processes in real time

IMCRC activate

Power line poles

* photo credit: Revo Group

PoleWatch					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Revo Group	Deakin	$639,158	$99,984	15/08/21	1

Objective

- to advance PoleWatch, a prototype of a pole monitoring device, to continuously capture and analyse data affecting the health of utility poles and provide information for predictive and preventative maintenance

In FY2021-22, the following **three projects** continued.

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

Investigating Virtual Reality (VR)

* photo credit: Deakin

Industry Partner
Melbourne Water

Research Partner
Deakin

Total Project Value (AUD)
$1,396,905

IMCRC Funding (AUD)
$200,000

Start Date
01/10/20

Duration (Years)
2

Objectives

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

Industry Partner
BAE Systems
Maritime Australia

Research Partner
UniSA

Total Project Value (AUD)
$4,410,208

IMCRC Funding (AUD)
$897,039

Start Date
1/07/20

Duration (Years)
2.4

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

Hunter Class Frigate Program

* photo credit: UniSA

Objectives

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

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

Hunter Class Frigate Program

* photo credit: ASC Shipbuilding, BAE Systems Australia

Objectives

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

Industry Partner
BAE Systems
Maritime Australia

Research Partner
Flinders

Total Project Value (AUD)
$10,179,419

IMCRC Funding (AUD)
$1,472,893

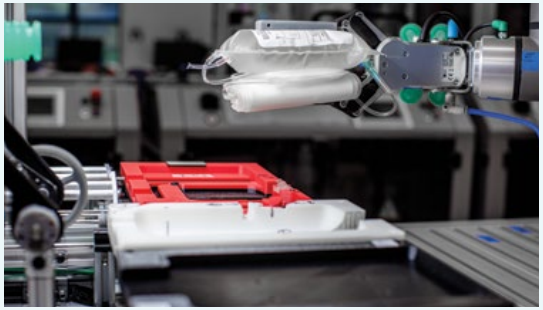
Start Date
17/02/20

Duration (Years)
2.7

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

In FY2021-22, the following **three projects** were completed.

IMCRC activate



Automated folding process of donation packs

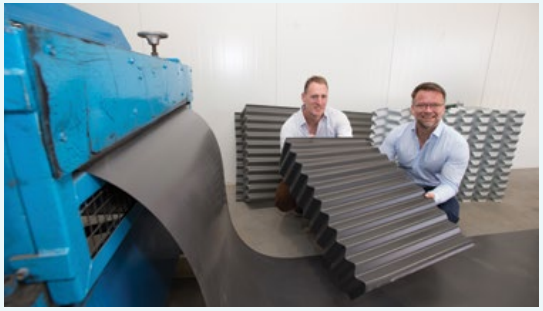
* photo credit: Swinburne

Design and development of a work cell for robotic folding of whole blood donation packsw					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
Australian Red Cross Lifeblood	Swinburne	$423,878	$79,104	01/02/21	1.4

Outcome

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

IMCRC activate



Corrugated steel strips

* photo credit: FormFlow

High volume, scalable manufacturing cell for enhanced building products					
Industry Partner	**Research Partner**	**Total Project Value (AUD)**	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**
FormFlow	Deakin	$830,637	$103,497	01/11/20	1.3

Outcome

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

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

SleepCorp virtual design

* photo credit: SleepCorp

Outcomes

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

Industry Partner
SleepCorp

Research Partner
Swinburne

Total Project Value (AUD)
$3,397,959

IMCRC Funding (AUD)
$406,519

Start Date
01/01/19

Duration (Years)
3.5

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

Simon Dawson
Industrial Transformation Director

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

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

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

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

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

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

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

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

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

Areas of focus:

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

futuremap®

When the term 'Industry 4.0' was first coined in the early 2010s, much hype ensued around the concepts of automation, digitalisation and the Internet of Things (IoT).

Twelve years on, the latest, aggregated futuremap® data reveals that Australian manufacturers clearly understand the benefits of Industry 4.0, yet many are still reticent about getting involved.

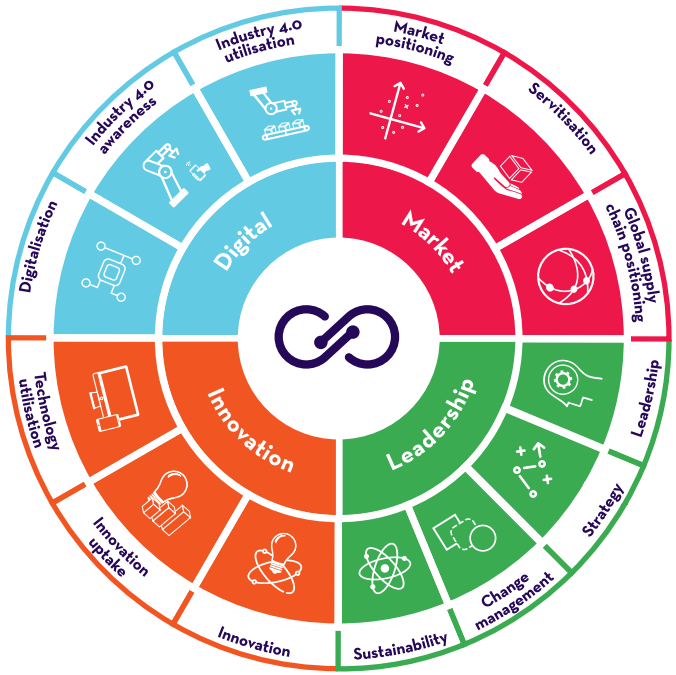
While most SME manufacturers state that they will be increasing their investment in Industry 4.0 and key enabling technologies, their main reason for adopting new technologies is to improve traditional manufacturing processes, increase productivity and reduce costs.

However, the most successful companies have been able to look beyond these cost reduction opportunities and realise bigger benefits by integrating Industry 4.0 across their entire value chain and making it part of their innovation culture.

With futuremap® IMCRC has designed a business diagnostic and education platform specifically targeting the challenges and inertias of Australian manufacturing, particularly for SMEs. 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 hence areas of potential focus. 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 its launch in 2018, over 750 Australian manufacturing SMEs have participated in futuremap® and outlined their first or next step in their digital transformation journey.

Building on the positive contribution futuremap® has made to the Industry 4.0 journey for SMEs, IMCRC has now commenced work expanding the futuremap® engagement and education model to help manufacturers understand their role in supporting Australia's vision of "Net Zero" by 2050.



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

Helping Australian SMEs innovate and grow

Most Australian businesses are defined as small and medium enterprises (SMEs). They employ 68% of the workforce and contribute more than 50% to Australia's GDP*.

Recognising the potential for research collaboration in Australian SMEs, the University of Technology Sydney (UTS) established SME@UTS, a tailored program that helps SMEs access to UTS' innovation expertise, research capabilities and technology facilities to turn their business ideas into reality – whether being a product, service or technology platform.

To connect with manufacturing SMEs, to better understand their research and development requirements and to set up pathways for collaboration, SME@UTS partnered with IMCRC. Utilising futuremap® – IMCRC's proprietary business diagnostic and education platform – UTS offers manufacturers a unique opportunity to assess their manufacturing capabilities and identify what is needed to advance their business operation.

Since hosting the first futuremap® workshop in 2021, SME@UTS and IMCRC have engaged with over 200 manufacturing businesses, helping them, in the first instance, demystify the concept of Industry 4.0 and recognise the transformational power of marrying their manufacturing processes with digital technologies. Once SMEs have completed futuremap®, the SME@UTS team discusses the results with them and advises possible next steps, which could be an in-depth conversation with an industry expert to define the problem they seek to address or a masterclass to obtain better understanding of how to accelerate innovation within their organisation. The aim is to outline different options – steppingstones - that help organisations advance their innovation and digital transformation journey.

To date, SME@UTS has hosted 15 futuremap® workshops, collaborating with the State Government, local councils, industry associations and other universities to broaden the reach and connect with manufactures across New South Wales. Six research collaborations have emerged from the program so far, tapping into the expertise of UTS Rapido, the Faculty of Engineering and IT and UTS Business School. Each collaboration integrates emerging student talent to explore, develop and apply advance technologies such as robotics, automation, data analytics and design to find the best solution to support the manufacturing partners needs.

*Australian Bureau of Statistics (ABS)

> It is really important that programs like these collaborate across the ecosystems, so that we can bring the best value to SMEs in a timeframe that suits them.
>
> **ANNETTE DOCKERTY**
> PROGRAM LEAD, SME ENGAGEMENT
> UNIVERSITY OF TECHNOLOGY SYDNEY

UTS facilitatd futuremap® workshop

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

Jana Kuthe

Communications, Marketing and Events Manager

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

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

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

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

What has inspired you most during your time at IMCRC?

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

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

Areas of focus:

- Brand
- Marketing Communications
- Public Relations
- Events

SME Engagement

Australian manufacturing SMEs are the backbone of Australia's economy. However, economic uncertainty, disruptive technologies and new business models are changing the business landscape, putting increased pressure on businesses to develop new ideas, new products and services to maintain their competitive advantage.

For SMEs this presents futher challenges as they are often limited by access to the funding, facilities and expertise that is needed to assist their business in adapting for growth and transformation.

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

In FY2021-22, IMCRC:

- co-funded 22 new industry-led manufacturing research projects involving small and medium sized businesses from a diverse cross section of industries and location, all observing IMCRC's SME collaboration requirement
- granted 17 SME manufacturers $1.57 million in matched cash funding and access to R&D expertise though IMCRC activate, a funding initiative designed by IMCRC to support shorter-term, industry-led research projects in innovative manufacturing and digital technologies
- supported manufacturing SMEs such as HYDAC Australia and Monitum with the Australian launch of new products and services developed as part of their IMCRC research collaboration
- inspired 121 SME manufacturers via futuremap® – IMCRC's education platform and business diagnostic that helps them assess and map their business capabilities across thirteen key areas of industrial and manufacturing maturity – to commence or take the next step in their Industry 4.0 transformation journey
- collaborated with four Industry 4.0 hubs - SME@UTS, the Advanced Robotics in Manufacturing (ARM) Hub, Swinburne's Factory of the Future and the Tonsley Manufacturing Innovation (TMI) Hub – and supported them in their quest to accelerate the uptake and diffusion of digital and advanced manufacturing technologies among SMEs
- helped three manufacturing SMEs access the specialist expertise of PhD students via the Australian Mathematical Sciences Institute (AMSI) APR.Intern program. The short-term internships help SMEs drive advanced manufacturing and optimisation solutions within their business
- raised awareness and shared 'manufacturing' insights impacting SME manufacturers at 65 industry events, including webinars and workshops. Through thought leadership articles and commentaries in publications such as Manufacturers' Monthly, @aumanufacturing and AMT Magazine, IMCRC raised awareness for topics pressing Australian manufacturers. On a regular basis, IMCRC released media statements (24 throughout the reporting period) and facilitated interviews with project participants to highlight the outcomes and benefits of industry-led research collaborations
- sponsored the Australian Technology Competition which helps manufacturing SMEs to scale up and solidify their position in the market, connect with established collaborators and investors to identify new opportunities for growth. The 2021 Advanced Manufacturing Award was won by IMCRC partner FormFlow.

Christian White

IMCRC's Masters by Coursework Scholarship provided exposure to different areas of research

Project description

SpeeDx develops and manufactures molecular diagnostic solutions that go beyond simple detection to offer comprehensive information for improved patient management.

This science-focused project aimed to develop and validate antibody-oligonucleotide conjugates as an add on to SpeeDx's PlexZyme platform technology. It is hoped that by developing this technology, the detection parameters of the PlexZyme technology can be expanded to include exosomes – which are increasingly being seen as disease specific biomarkers. The ideal end result would be a specific and fast point-of-care testing device that is manufactured in Australia.

What led you to undertaking an industry-led research project ?

As part of undertaking my Masters, I have tried to gain experience in a number of research areas. I was drawn to the work being done in the Mathematical and Physical Science lab as it exists at the intersection of biomedical engineering and biochemistry, which provides a lot of opportunities. This interest led me to reach out to Dr Gungun Lin, the project supervisor, to ask if he had any room for an intern.

What have been the highlights of your Masters degree?

The highlight was validating the functionality of the antibody-oligonucleotide conjugate. At that point, it had been the result of six months' work, so not only was it amazing to see that this technology did work, but also a relief!

Once you have completed your Masters degree, what's next? What would you like to do?

I recently started working at a health economics consultancy and I am really enjoying working with pharmaceutical and biomedical device companies to ensure the best care is available for all. I would also like to continue to develop hard skills by getting involved in side-projects for startups in industry.

READ MORE HERE

Biography

Christian is currently undertaking his Master of Science at the UTS majoring in Biomedical Engineering. As part of his Masters degree, Christian secured a Masters by Coursework Scholarship through IMCRC and completed an internship with Dr Gungun Lin in the Mathematical and Physical Sciences department at UTS. Christian holds a Bachelor of Medical Science from the University of Sydney and currently works at health economics and outcomes research consultancy HTANALYSTS.

Industry Partner
SpeeDx

Research Organisation
University of Technology Sydney

Academic Mentor
Dr Gungun Lin

Education and Training

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

In FY2021-22, IMCRC continued to build on the foundations it established in previous years and focused on

Student Engagement and Development

- IMCRC welcomed two new PhD students into its student community of 20 PhD and eight Masters students in FY2021-22. Five PhD and one Masters student completed their candidature successfully throughout the reporting period.
- 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.
- In August 2021, IMCRC held a virtual 'Take care of your career' workshop to prepare students for the transition from university-based research into the workforce. Over two afternoons, 25 students learned how to be strategic about their next career move, build a network of contacts and develop a career plan tailored to their strength and ambitions.
- IMCRC continued its monthly webinar series 'Unlocking potential in Manufacturing', providing additional four PhD students and two early career researchers a platform to present their work and share with attendees their industry collaboration experience.
- In June 2022, IMCRC connected PhD and Masters students at IMCRC's 'Innovative Manufacturing Accelerated' conference in Sydney. Hosted alongside Australian Manufacturing Week, the conference allowed them to explore latest research and technology trends bound to accelerate the transformation of Australian manufacturing. A tour of the UTS Tech Lab added a practical element, as they had the opportunity to interact with IMCRC projects like HALO – a robotic system that makes rock scaling operations safer.
- IMCRC is on target to meet, and potentially exceed, its partnership obligation with the Australian Mathematical Sciences Institute's APR. Intern program. As of 30 June 2022, a total of 22 PhD students participated in internships with Australian manufacturing SMEs, with eight students completing their short-term research projects in FY2021-22, and more slated to be completed by the end of 2022.
- IMCRC granted five $5,000 Masters by Coursework scholarships. As part of a semester-long research project, students collaborated with industry and explored additive manufacturing as a potential career path.

IMCRC plays a critical role supporting the commercialisation of research. I'm proud to work for an organisation so focused on driving positive outcomes for Australia's manufacturing industry and our nation more broadly.

Lydia Gunawan
Project Research Officer

As IMCRC's Project Research Officer, Lydia is responsible for account managing over 30 of IMCRC's industry-led collaborative projects. She works closely with both industry and research partners to oversee their administrative commitments, including reporting requirements, and makes sure each project achieves its milestones.

Lydia also manages IMCRC's Masters by Coursework Scholarship program, which enables students to contribute to a manufacturing-focused research project as part of their degree.

With a Bachelor of Veterinary Science and Master of Applied Science, and extensive experience working in medical research, Lydia brings a wealth of scientific knowledge to IMCRC. Prior to joining the team in 2021, Lydia spent 10 years working on a preclinical study developing therapeutic treatment for Parkinson's and Alzheimer's disease.

Although she now focuses on the management side of research and development, Lydia retains her passion for the human-centric nature of the work, which often links back to making life better for people.

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

"I'm most proud of the work I have done supporting students through our 'Masters by Coursework Scholarship' program. As a former international student, I've experienced firsthand some of the challenges these students face when undertaking study. Because of this, it's especially rewarding to help them participate in industry-led projects and build invaluable connections. I can really see the difference the scholarships make in their lives and in turn, the value they create for our industry partners."

Areas of focus:

- Project management
- Education
- Client services

Industry Training

- Since the launch of futuremap® in March 2018, a total of 761 manufacturers 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. In FY2021-22, IMCRC helped 121 manufacturing businesses demystify Industry 4.0 and weigh up the benefits, costs and practicalities of its implementation.
- In February 2022, Investment NSW and the Department of Education – Training Services launched the 12-week 'Driving Digital Skills Pilot Program' designed to lift digital skills across the NSW manufacturing sector. IMCRC supported the program by hosting several interactive workshops with the leadership teams of participating businesses to access their Industry 4.0 capabilities as well as their ambitions for the future, helping them set their goals for the program.
- On behalf of IMCRC, Swinburne's Factory of the Future assessed the digital capabilities of four manufacturing businesses using IMCRC's futuremap Industry 4.0 assessment methodology.
- COVID restrictions continued to impact industry events and conferences throughout 2021. IMCRC participated in 65 events in various formats and capacity in FY2021-22, re-connecting with project partners and the wider manufacturing community at the inaugural InnovationAus Awards in December 2021. As sponsor of the Advanced Manufacturing category, IMCRC highlighted the importance of investing and translating Australian research into commercial outcomes to build a resilient and globally relevant manufacturing industry.
- IMCRC welcomed approximately 100 of its industry and research partners at the 'Innovative Manufacturing Accelerated' conference in June 2022. The two-day conference spurred many discussions about how best to support and empower Australian manufacturers – start-ups, scale-ups and/or mature businesses – to take their ideas from proof of concept through to commercialisation. In her keynote address, Dr Amantha Imber challenged industry leaders, researchers and students alike to reinvent the way they approach research and innovation.

IMCRC Conference

futuremap® workshop at UTS Tech Lab

Aditi Aiyer

A PhD student paving the way for more effective therapies for patient with antibiotic-resistant cystic fibrosis

Project description

Whiteley are Australia's largest manufacturer of sterilants, disinfectants and professional cleaning technologies. The project focuses on the removal of bacterial biofilms in different medical and industrial applications. Biofilms are a microbial community encased in a produced matrix, providing protection to the enclosed microorganisms and increasing the difficulty of eradication and removal.

As part of my PhD, I work on the cystic fibrosis module. Patients with cystic fibrosis are more predisposed to having poor lung function as they lack a gene that aids in thinning mucus that coats the lungs. Unfortunately, a thicker lung mucus creates a perfect environment for bacteria to grow in and leads to bacterial infections in the form of biofilms. Due to the structural complexity of biofilm infections, they are difficult to treat with conventional antibiotics and they contraindicate patients for lung transplants that could help them survive.

The research concentrates on developing a novel formulation that combines antibiotics and other elements such as antioxidants to assist not only in breaking down the biofilm, but also treating the infection, and managing the disease to the point where patients can get a lung transplant.

READ MORE HERE

What led you to undertake an industry-led research project?

I'd never been exposed to industry prior to my PhD. The thing I like about an industry-led project is that there are firm milestones that need to be met. Having set milestones helps frame the research work, providing an idea of how the research should progress.

Before joining the Whiteley project, I never thought about whether my work could be commercialised. Now being exposed to industry has given me a lot of things to think about career-wise. That being said, I would have still done this project even if it wasn't industry-led, as I can progress the scientific community in some way, and also have my work peer-reviewed.

What have been the highlights of your PhD?

I'm thankful that a PhD isn't like a conventional 9-5 job and that I have the freedom to plan my life and work. Research fulfils my curiosity – if I'm intrigued by a question, I can review scientific literature and/or do an experiment. Even if the experiment fails, I have answered a question because even failure is a success in disguise allowing me to move forward. Sometimes I answer one question, and 10 new questions pop up in its place, which isn't a bad thing. I've learnt that this is what progress in research looks like, and if I do everything to the best of my abilities, success will eventually follow. I didn't realise how passionate I could be about something, and I'm glad that I'm able to whet my curiosity through my PhD, and do it independently as well, with amazing support from my supervisors.

Biography

Aditi Aiyer is a PhD researcher in the field of Infectious Diseases and Microbiology at the University of Sydney. She completed her undergraduate studies majoring in neuroscience and immunology at Sydney University and then undertook a Master of Science (Immunology and Infectious diseases), also at Sydney University. Here she developed a passion for applying cutting-edge research to real-world problems and began work with the Whiteley team to develop and commercialise novel treatments against antibiotic-resistant cystic fibrosis opportunistic infections.

Industry Partner
Whiteley Corporation

Research Organisation
The University of Sydney

Academic Mentor
Associate Professor Jim Manos and Dr Das Ashish Kumar

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 subsidises 50% of the cost to each business of short-term internships that explore the adoption of Industry 4.0 technologies and business models to address manufacturing-specific challenges. To date, 22 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 22 interns placed so far, 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

Nimal Balasubramani

APR.Internship created an opportunity to contribute to the pioneering works of Omni Tanker

Project description

Omni Tanker is a technology company, manufacturing Type IV (thermoplastic lined) tanks for the international lightweight chemical transport market. The company has recently commenced research and design efforts for Type IV and Type V (linerless) tanks for the aerospace market. The tanks, for use within the transport and aerospace markets, also have the option to be equipped with baffles for fluid surge mitigation.

The APR.Internship was put together to advance the development efforts and demonstrate the feasibility of the technology, finally resulting in the development of human capital familiar with Omni Tanker structures and processes. Some of the key research tasks completed include resin gel time study, structural testing of nanoparticle-modified composite material system and sandwich composite material system for material qualification, preliminary structural design and analysis, developing manufacturing process plan, fabrication of moulding tool, and large-scale prototyping study of baffle structures.

READ MORE HERE

What have been the highlights of your internship?

The four-month-long internship at Omni Tanker's facility at Smeaton Grange, NSW, was carried out during the thesis examination period of my PhD candidature. From a project management perspective, I was involved in two internal projects that were at various stages of the product development cycle. As such, the tasks carried out were aligned with the ongoing development at Omni Tanker and hence provided realistic exposure to the research undertaken in an industrial setting.

Having conducted research at an academic institution for the preceding three years, the internship has greatly benefitted me in learning the transition between research in an academic and fast-paced industry setting. The internship also provided exposure to the practical aspects involved in conducting research for the eventual commercialisation of industry-leading products.

Once you have completed the PhD internship, what's next?

Besides the obvious research objectives of the internship, the APR.Internship program supported by IMCRC provided a cost-effective and obligation-free opportunity for Omni Tanker's engineering team and me to test the compatibility of working together on long-term projects. In that context, the internship turned out to be a successful one resulting in my full-time employment at Omni Tanker where I am further continuing the research works dedicated to developing advanced composite tank structures.

Biography

Nimal Balasubramani is an early career researcher working on the design and development of advanced composite structures for the chemical transport and aerospace sector at Omni Tanker. He holds a PhD in Mechanical and Manufacturing Engineering from UNSW Sydney, where he specialises in developing novel damage prediction tools for composite structures through an ARC Linkage Grant-funded project with Boeing Aerostructures Australia. Before moving to Australia, Nimal completed his Master of Aerospace Technologies at The University of Nottingham and accumulated a few years of industry and academic experience in designing and developing composite structures and electro-mechanical product systems.

Industry Partner
Omni Tanker Pty Ltd

Research Organisation
UNSW

Academic Mentor
Garth Pearce

APPENDIX

* photo credit: IMCRC

Glossary

IMCRC	Innovative Manufacturing Cooperative Research Centre
ACNC	Australian Charities and Not-for-profits Commission
AGM	Annual General Meeting
Ai Group	The Australian Industry Group
AMGC	Advanced Manufacturing Industry Growth Centre
APR.Intern	Australian Postgraduate Research Intern
ARC	Audit and Risk Committee
ASIC	Australian Securities and Investments Commission
BDO	BDO Australia - Certified Public Account
Board	Company Board of Directors
CEO	Chief Executive Officer
CRC	Cooperative Research Centre
CY	Calendar Year
CSIRO	The Commonwealth Scientific and Industrial Research Organisation
Deakin	Deakin University
FY	Fiscal (financial) Year
Griffith	Griffith University
IIC	Innovation Investment Committee
IP	Intellectual Property
ITP	Industrial Transformation Program
MD	Managing Director
MRL	Manufacturing Readiness Level
MTP Connect	Medtech and Pharma Industry Growth Centre
MOU	Memorandum of Understanding
NRC	Nominations and Remuneration Committee
R&D	Research and Development
SCM	Supplementary Cementitious Material
SME	Small and Medium Enterprise
SUT	Swinburne University
Sydney	University of Sydney
TC	Transition Committee
TMI	Tonsley Manufacturing Innovation Hub
TRL	Technology Readiness Level
UniSA	University of South Australia
UTS	University of Technology Sydney
UTSA	University of Tasmania
QUT	Queensland University of Technology

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