imcrc | we champion manufacturing innovation

Innovative Manufacturing CRC (IMCRC)

Annual Highlights 2018-2019

Australian Government
Department of Industry, Innovation and Science

Business Cooperative Research Centres Program

Manufacturing is an essential part of Australia's economy and innovation ecosystem. Together, through collaborative investment, research impact and innovation, IMCRC is helping Australian manufacturing to be thriving, relevant and globally integrated.

Thank you for your support throughout 2018-19.

ABN 24 607 527 499

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imcrc.org

Disclaimer
IMCRC has endeavoured to ensure that all information in this publication is correct. The Annual Highlights have been prepared to align with the IMCRC Commonwealth Agreement, referencing progress, activities, participants and other matters as at 30 June 2019, unless it is otherwise specified within the document.

Contents

Highlights 2018-19

Outcomes and impact that we are proud to have achieved by 30 June 2019:

30 of 30
Commonwealth Agreement **milestones achieved**

25 research projects approved to date, with **9** projects commenced in FY 2018-19

1st
project successfully completed

23 new industry participants, of which **10** joined IMCRC in FY 2018-19

Manufacturing research across **4 states** and within **6 primary industry sectors**

$23 million
of funding of the total $30 million Commonwealth funding allocated

1st
IMCRC conference

272 manufacturing businesses reached through **33** futuremap® workshops

Message from the Chair

Manufacturing in Australia in 2019 continues to be challenging. The globalisation of supply chains and consumer demand for new and innovative products, in addition to increases in energy prices, present new challenges but also opportunities for industry.

Our role as a CRC is to help manufacturers, and small and medium businesses in particular, to overcome these challenges and capitalise on the opportunities.

Through the selection and approval of an exciting range of innovative manufacturing projects across IMCRC's three core research programs, we saw new industry participants join the CRC and invest in emerging technologies to create new business models to take to the world.

To date, we approved $23 million of the $30 million invested by the Commonwealth to advance innovative manufacturing in Australia, generating so far more than $140 million total investment in manufacturing research and development.

Also, we are well into the deployment of IMCRC's Industrial Transformation Program, heralded by futuremap®, our proprietary business maturity diagnostic tool. I am pleased to report that our futuremap workshops, and the diagnostic tool itself, have been extremely well received by industry, particularly SMEs, across the country.

In fact, we have expanded the program to offer more events in collaboration with the Commonwealth's Entrepreneurs' Programme and other industry partners, such as the Australian Industry Group and Swinburne University's Factory of the Future. We are working on other SME engagement models to accelerate the uptake and diffusion of emerging digital and advanced manufacturing technologies.

With the main focus of the past twelve months being the successful allocation of Commonwealth funding, I am pleased to report that we have successfully achieved all Commonwealth Agreement milestones for the reporting period and wish to thank the Commonwealth for its continued support.

On behalf of the Board, I also want to acknowledge the work by CEO and Managing Director David Chuter and his team. With their uniquely commercial, strongly collaborative and industry-focused approach, we have a CRC team extremely well equipped to help realise the development of the critical Industry 4.0 capabilities that Australia will need to compete in the future.

I look forward to the next year, during which we will allocate the final portion of Commonwealth funding and continue work to ensure our projects deliver transformative outcomes for all participants.

Thank you.

The Hon Ian Macfarlane
Chair

We look back on a significant year of progress. We continued to strengthen our position as a catalyst for the transformation of Australian manufacturing, delivering benefits through collaborative investment, research impact and innovation to both the manufacturing sector and the CRC community.

Our primary objective for the year was to continue to invest the Commonwealth's $30 million funding through the selection and approval of new, high-quality and collaborative projects.

Message from the CEO and Managing Director

Another successful year full of achievements for IMCRC, our members and project participants has passed. Together, we created momentum and expanded our range of innovative manufacturing projects that cumulatively will deliver more than $140 million investment into research and development for Australia's manufacturing sector.

Our primary objective for the year was to continue to invest the Commonwealth's $30 million funding through the selection and approval of new, high-quality and collaborative projects. I am delighted to report, as of 30 June 2019, we have allocated a total of $23 million of CRC cash across 26 innovative projects creating new manufacturing technologies and business models. To evidence how wide-reaching manufacturing really is in Australia, these projects cover several primary industry sectors including advanced manufacturing, medical technologies and pharmaceuticals, building and construction, mining, automotive and defence.

Part of IMCRC's role involves being a catalyst for industry participants looking to embrace and invest in the advanced and digital technologies that have become closely associated with the fourth industrial revolution, or 'Industry 4.0'. This year we continued to build Australia's bench of innovative manufacturers, welcoming further ten new industry participants on their transformation journeys as they collaborate with our partner universities and the CSIRO. These collaborations are key to building knowledge and driving competitiveness and innovation within our research and development projects.

As those who have worked with us will know, IMCRC is about more than catalysing the uptake of Industry 4.0 tools and technologies. To us, Industry 4.0 is about adopting a new approach to manufacturing and to business in general – one that will empower manufacturers to continually enhance performance and create new and unique value in a world that is constantly evolving and changing. We take a commercial and industry-led approach, ensuring our participants are well enough informed to understand why and how their companies can use the technologies to drive value for customers, consumers and within their own broader eco-systems.

This year we continued our efforts to advance knowledge and capability within our sector, regularly communicating through numerous events, as well as social media, about the importance of leadership, collaboration, new business models and strategic planning to deliver genuine innovation.

We explored these concepts in detail – and their practical application – throughout our futuremap® program, which saw nearly 300 small and medium enterprises participate in over 30 industry workshops held over the year across Australia.

A particular highlight for all of us was hearing from, and sharing insights with, our industry and research partners at our inaugural IMCRC conference in May at Australia's National Manufacturing Week 2019. We look forward to many more such opportunities.

This year's achievements would not have been possible without the contributions of our team, which remained unchanged throughout the year, and I would like to thank them for their ongoing dedication to our mission and objectives.

I would also like to thank our Chair, the Hon Ian Macfarlane, as well as our Board of Directors, for their continued support.

And, on behalf of our team and Board, I would like to extend our appreciation to all our members and participants, as well as to the Commonwealth, without whose support IMCRC would be unable to deliver on our mission to help catalyse the transformation of Australian manufacturing through collaborative investment, research impact and innovation.

With the significant portion of our funding allocated, we now turn our focus to helping our industry participants meet or exceed their intended outcomes, preparing them to overcome barriers and successfully commercialise their projects in the future.

David Chuter
CEO and Managing Director

This year we continued our efforts to advance knowledge and capability within our sector, regularly communicating through numerous events, as well as social media, about the importance of leadership, collaboration, new business models and strategic planning to create genuine innovation.

About IMCRC

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

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

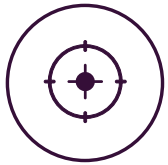
- co-fund, on a dollar-for-dollar matched basis, broad, multidisciplinary and industry-led manufacturing research projects that deliver commercial outcomes
- advance the wider cause of manufacturing transformation through industry education and public advocacy.

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

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

Our Vision

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



Our Mission

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

Our Values

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

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

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

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

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

Our Partners

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

Industry

stryker
HEIQ
TITOMIC
BLUGLASS
UAP
RUAG
SCA
CADwalk
SPEE3D
Whiteley Corporation
Mineral Technologies
TRADIEBOT INDUSTRIES
CARBON REVOLUTION
vaxxas
SLEEPCORP
Corin
Allegra ORTHOPAEDICS
xefco
SPEEDPANEL
MONITUM
Pacific Bio
Codex Research
Proficiency Contracting

Research

Other

Our Board

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

Hon Ian Macfarlane
Independent Director, Chair

Mr David Chuter
Managing Director (and CEO)

Professor Mary O'Kane AC
Independent Director

Dr Alexander Gosling, AM
Independent Director

Mr Simon Marriott
Independent Director

Dr Jens Goennemann
Growth Centre Director

Mr Robert Cohen
Research Nominee Director

Professor Roy Green
Research Nominee Director

Mr Innes Willox
Industry Nominee Director

Dr Jenni Lightowlers
acts as IMCRC Company Secretary

Three advisory committees have been established to assist the Board in the executions of its duties:

Audit and Risk Committee (ARC)
offers guidance in terms of corporate and financial governance.

Nominations and Remuneration Committee (NRC)
provides advice on policies and best practices concerning recruitment, performance and remuneration of IMCRC Board and staff.

Innovation Investment Committee (IIC)
is an independent advisory committee that assesses IMCRC's manufacturing research projects and advises the Board on potential investments. The IIC consists of the following industry and research experts:

- **Mr Tim McLennan**
  CEO, QUT bluebox
- **Dr Michele Allan**
  Chair, Meat & Livestock Australia
- **Dr Ross Pilling**
  ex Chair and Managing Directro
  BASF Australia and New Zealand
- **Mr Mark Peters**
  State Director, Queensland, Northern Territory, AMGC
- **Professor Matthew Cuthbertson**
  Pro Vice-Chancellor (Research Commercialisation)
  Swinburne University of Technology
- **Dr Donald Hector**
  Director at Gelion Technologies Pty Ltd
- **Mr David Chuter**
  CEO and Managing Director at IMCRC

Our Team

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

David Chuter
CEO and Managing Director

Dr Jason Coonan
Chief Operating Officer

Dr Matthew Young
Manufacturing Innovation Manager

Jana Kuthe
Communications, Marketing and Events Manager

Sameera Silva
Finance and IT Manager

Dr Min-Yin Yap
Project Research and Education Officer

David Chandler
Project Research and Systems Officer

Lance Worrall
Director, Industrial Transformation
(Secondment from Flinders University)

In FY 2018-19, IMCRC also engaged in full or part-time capacity:
Dr Melanie Ayre – Industrial Transformation Program (Secondment from CSIRO)
Ms Sarah King – Industrial Transformation Program (Secondment from CSIRO)
Mr Rohann Chapman – Industrial Transformation Program
Liz McMillan – Administration
Nathan Cooper – Marketing Events Coordinator

Championing Manufacturing Innovation

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

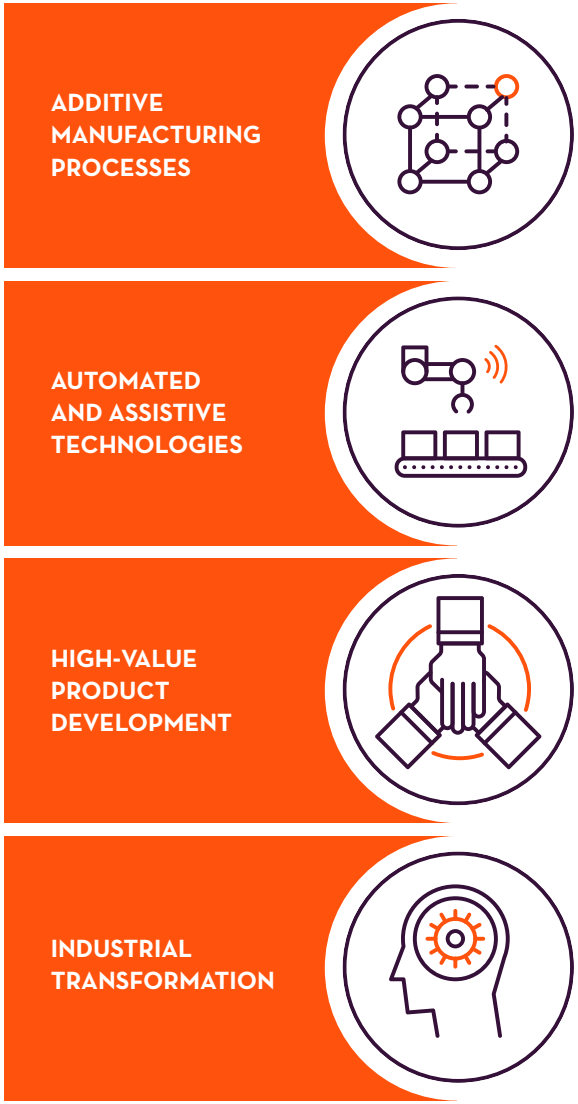
IMCRC co-funds industry-led research into innovative manufacturing technologies and processes. Across four research programs, IMCRC collaborates with manufacturing businesses, research organisations, industry associations and government, investing significantly in partnerships that support innovation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

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

Successful project applications, meeting IMCRC's primary selection criteria, ensure that a project:

- is industry-led, delivers clear outcomes, and involves advanced manufacturing (ideally within key growth sectors)
- demonstrates genuine collaboration, including with SMEs, Industry Growth Centres and other CRCs
- creates opportunities to access global value/supply chains
- delivers wider benefits to Australian manufacturing industry, and contributes to the sector transformation and sustainability
- requires high-quality research with universities and/or other research organisations in Australia, and facilitates higher education
- has a clear IP utilisation/commercialisation plan (Note: IMCRC does not own Project IP. IP ownership is determined between the industry and research participants based upon where it can be most effectively commercialised)
- has a clear business innovation and transformation plan and/or Industry 4.0 adoption plan
- has a defined return on research investment, with both manufacturing and commercial outcomes.

IMCRC's Innovation Investment Committee (IIC) approves projects up to $1m in cash value, or recommends approval to the IMCRC Board.



IMCRC supports four research programs:

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

In FY 2018-19, IMCRC met all Commonwealth Agreement milestones. Nine new projects commenced in the reporting period, increasing the total number of active IMCRC projects to 21 by 30 June 2019, with six further projects approved in the reporting period. One project was successfully completed. To date, there have been no significant technical or scientific impediments impacting on their research progress. At this stage of the IMCRC, no changes to the directions of the four research programs are proposed.

Icon reference

Primary Industry Sector

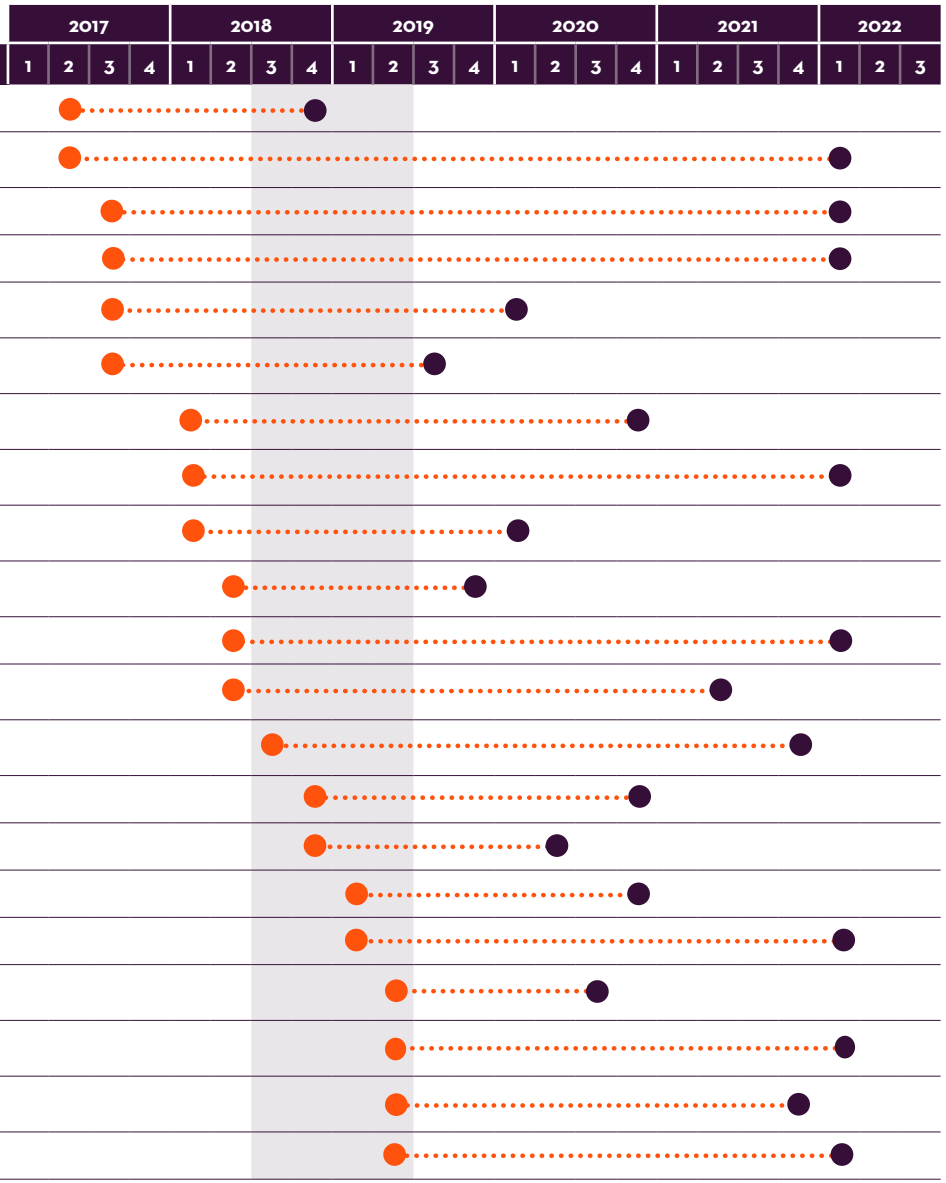
- Advanced Manufacturing
- Aerospace and Defence
- Automotive
- Building and Construction
- Medical Technologies and Pharmaceuticals
- Mining Equipment, Technology and Services

Key Enabling Technology

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

Active Projects in FY 2018-19

#	Program	Organisation	Project Title
1	I	Spee3D	Machine vision for Industry 4.0 high-speed 3D printing
2	II	CADwalk (JVI)	Visualisation tools for the design of manufactured high-end instrumented facilities
3	I	Stryker	Just in time patient specific tumour implants
4	II	UAP	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)
7	II	Tradiebot Industries	Tradiebot
8	III	Corin (Global Orthopaedics)	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
16	IIII	Sleep Corp	A novel virtual manufacturing system approach
17	III	Speedpanel	Manufacture of the next generation Speedpanel
18	I	Spee3D 2.0	Automated part repair using 3D scanning and supersonic 3D deposition
19	III	Codex	Engineering an advanced, high value bioreactor system for research and clinical applications
20	II	Mthing (Monitum)	Automated monitoring and analytics for geotechnical and structural performance using the internet of GNSS things
21	III	Xefco	Atmospheric plasma coating system



Financial Year Project commenced Project completion

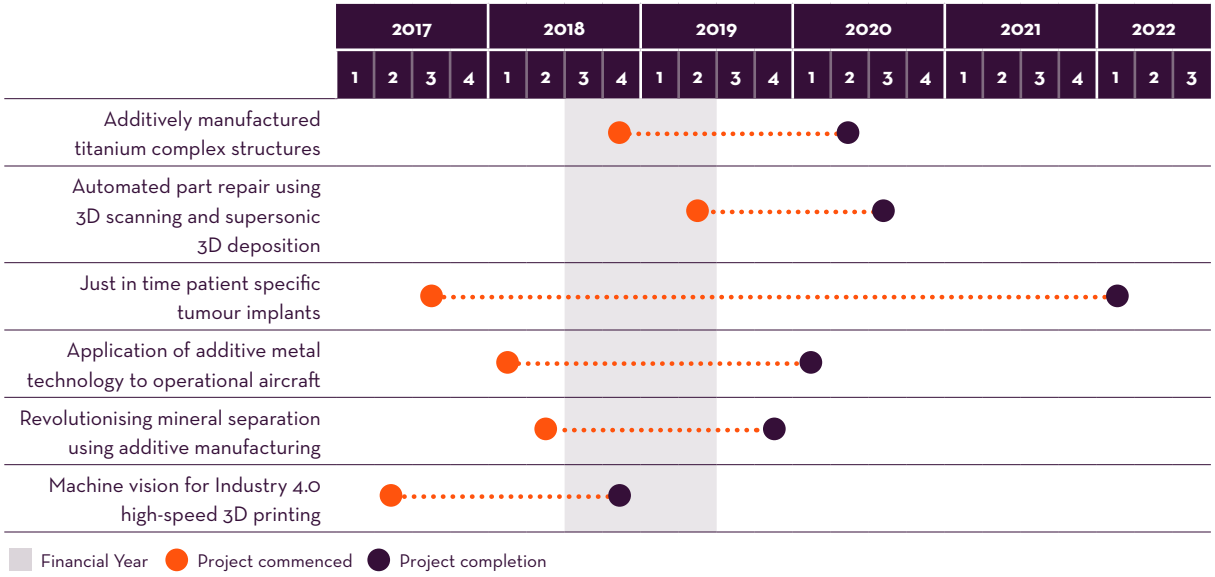
Program 1: Additive Manufacturing Processes

Additive manufacturing, or 3D printing, is on the brink of industrialisation. It is essential that Australian manufacturers stay on top of the latest developments and recognise the benefits that additive manufacturing can offer in terms of new product development, time to market, reduced waste and product cost.

The program's key research focuses on:

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

IMCRC has invested in **six 'Additive Manufacturing Processes' research projects**, with one project already successfully completed.



In FY 2018-19, the following **two research projects** have commenced:

Additively manufactured titanium complex structures					
Total Project Value (AUD)	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**	**Industry Partner**	**Research Partner**
$2,612,762	$470,303	01/11/2018	2.0	Titomic Limited	CSIRO, RMIT University

Objectives

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

Additively manufactured titanium complex structures

Left from right: Dr Liz Jazwinska (RMIT), Jeff Lang (Titomic), Dr Keith Mclean (CSIRO) and Dr Jason Coonan (IMCRC) * photo credit: Titomic

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

Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)	Industry Partner	Research Partner
$915,860	$175,196	01/04/2019	1.5	Effusiontech Pty Ltd (SPEE3D)	University of Technology Sydney

Objectives

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

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

* photo credit: SPEE3D

These **three research projects** continued:

Just In Time patient specific tumour implants					
Total Project Value (AUD)	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**	**Industry Partner**	**Research Partner**
$12,109,690	$2,360,245	01/07/2017	4.75	Stryker Australia Pty Ltd	RMIT University, University of Technology Sydney, St Vincent's Hospital Melbourne

Objectives

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

Just in time patient specific tumour implants

* photo credit: RMIT

Application of additive metal technology to operational aircraft

Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)	Industry Partner	Research Partner
$819,000	$120,000	01/03/2018	2	RUAG Australia Pty Ltd	RMIT University

Objectives

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

Application of additive metal technology to operational aircraft

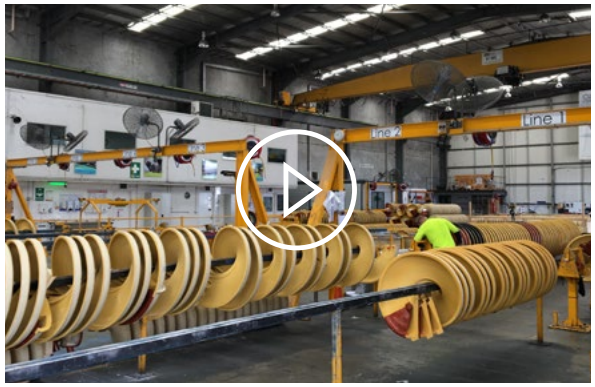
* photo credit: RUAG

Revolutionising mineral separation using additive manufacturing

Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)	Industry Partner	Research Partner
$3,579,384	$700,000	01/04/2018	1.75	Mineral Technologies Pty Ltd	University of Technology Sydney

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



Revolutionising mineral separation using additive manufacturing

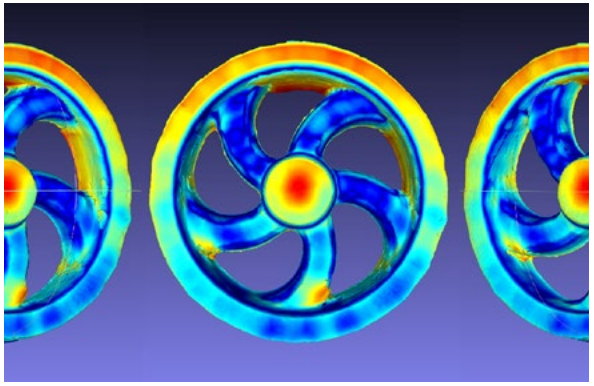
* photo credit: UTS

In FY 2018-19, the **first research project** was completed:

Machine vision for Industry 4.0 high-speed printing					
Total Project Value (AUD)	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**	**Industry Partner**	**Research Partner**
$1,135,845	$349,797	01/04/2017	1.4	Effusiontech Pty Ltd (SPEE3D)	University of Technology Sydney

Outcomes

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



Machine vision for Industry 4.0 high-speed printing

* photo credit: UTS

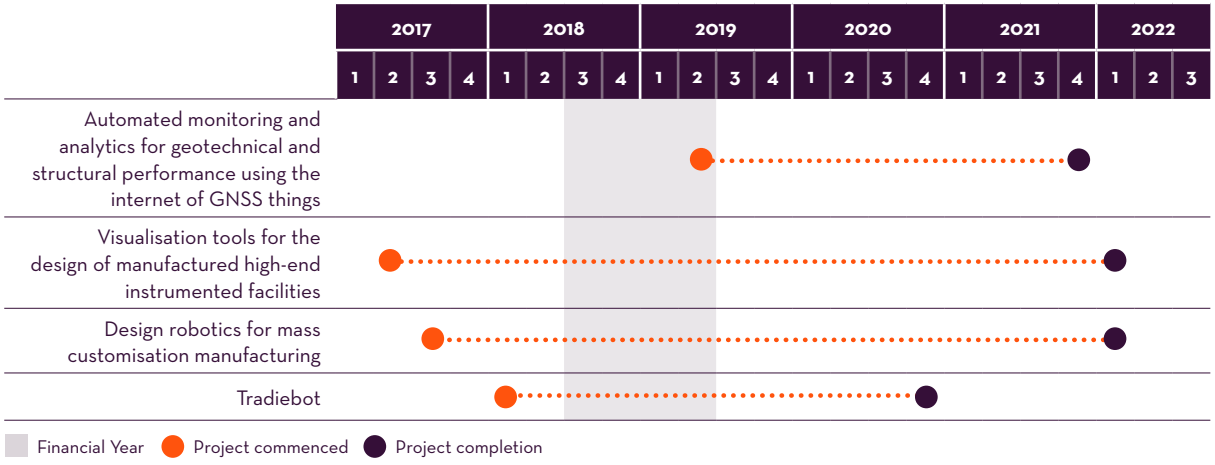
Program 2: Automated and Assistive Technologies

Australian manufacturers have been challenged by lower tariffs, low cost competitors from emerging economies and rapidly changing technologies. To maintain competitive, manufacturers must adapt and invest in assistive and automation technologies that offer quality and operational efficiencies.

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

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

IMCRC has invested in **four 'Automated and Assistive Technologies' research projects**, with one new project having commenced in the reporting period.



In FY 2018-19, **one project** has commenced:

Automated monitoring and analytics for geotechnical and structural performance using the internet of GNSS things					
Total Project Value (AUD)	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**	**Industry Partner**	**Research Partner**
$3,231,200	$500,000	30/04/2019	2.75	Mthing Pty Ltd	Queensland University of Technology

Objectives

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

Automated monitoring and analytics for geotechnical and structural performance

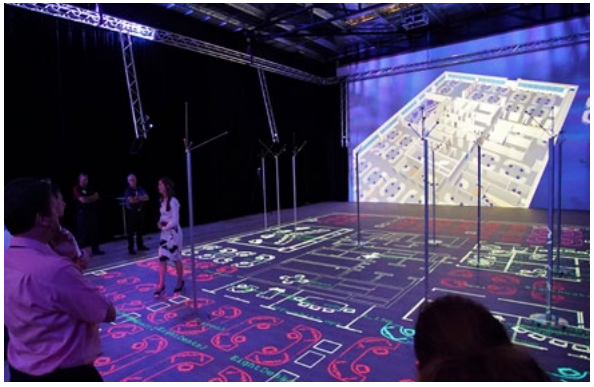
* photo credit: Mthing

The following **three research projects** continued:

Visualisation tools for the design of manufactured high-end instrumented facilities					
Total Project Value (AUD)	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**	**Industry Partner**	**Research Partner**
$5,991,500	$1,050,000	01/04/2017	5	CADwalk (Jumbo Vision International Pty Ltd)	University of South Australia

Objectives

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



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

* photo credit: CADwalk

Design robotics for mass customisation manufacturing

Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)	Industry Partner	Research Partner
$7,978,005	$1,500,000	01/07/2017	4.75	UAP Australia Pty Ltd	Queensland University of Technology, RMIT University

Objectives

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

Design robotics for mass customisation manufacturing

The Design Robotics team

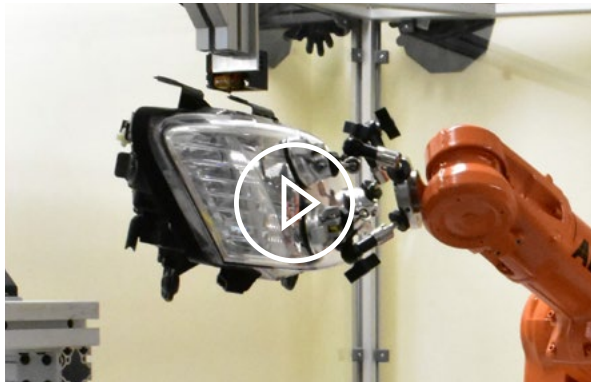
* photo credit: UAP

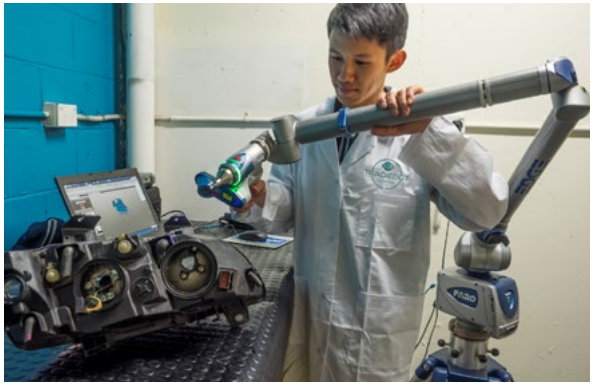
Tradiebot

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

Objectives

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





Tradiebot

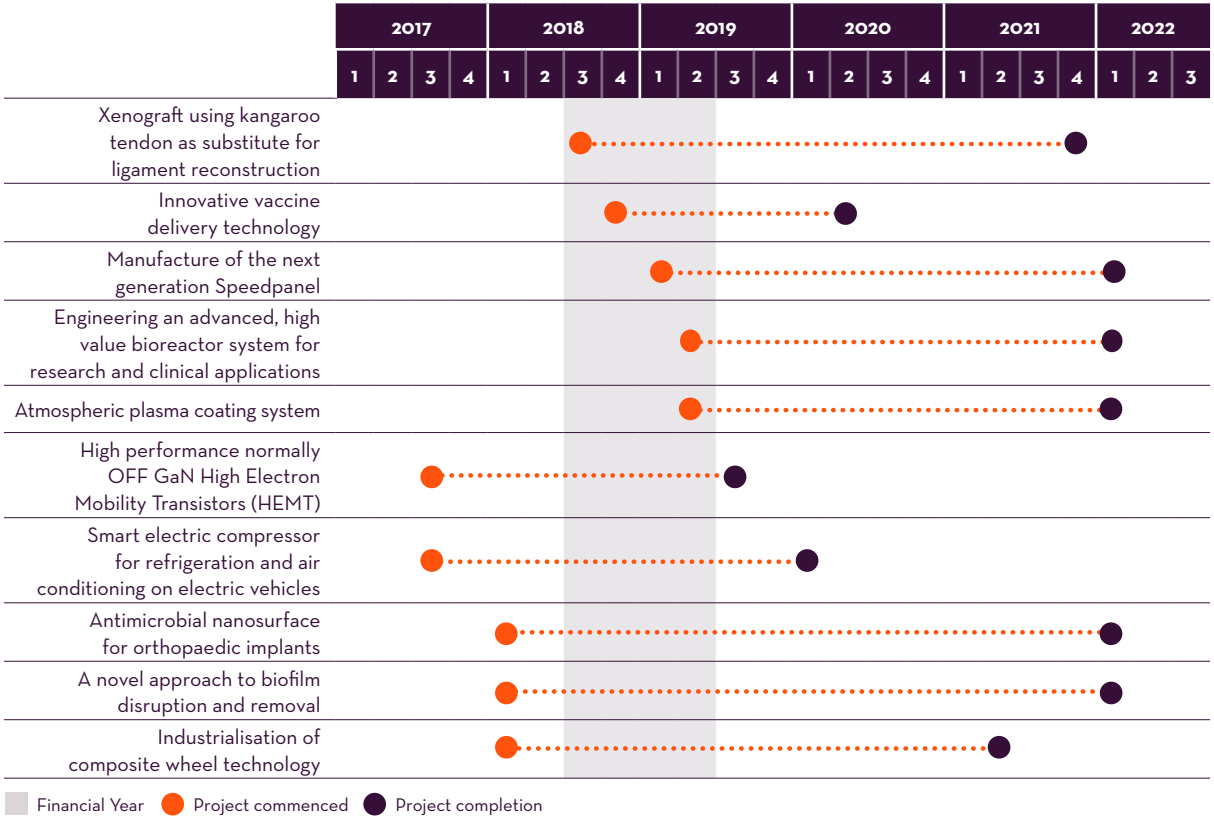
* photo credit: Tradiebot

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 invested in ten **'High Value Product Development' research projects**.



In FY 2018-19, the following **five research projects** have commenced:

Xenograft using kangaroo tendon as substitute for ligament reconstruction

Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)	Industry Partner	Research Partner
$5,867,586	$1,233,217	1/09/2018	2	Bone Ligament Tendon (BLT), Allegra Orthopaedics	University of Sydney

Objectives

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

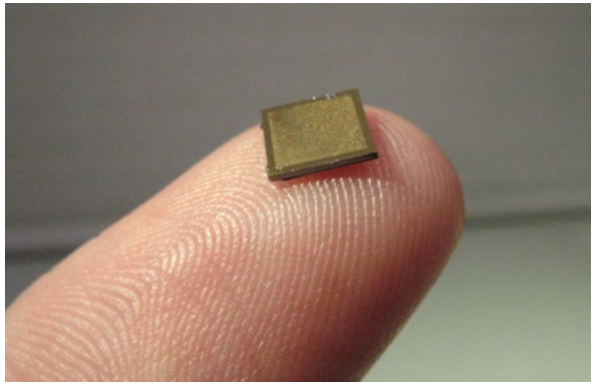
Xenograft using kangaroo tendon as substitute for ligament reconstruction

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

Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)	Industry Partner	Research Partner
$1,434,033	$235,517	1/11/2018	1.6	Vaxxas Pty Ltd	University of Sydney

Objectives

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



Innovative vaccine delivery technology

* photo credit: Vaxxas

Manufacture of the next generation Speedpanel

Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)	Industry Partner	Research Partner
$4,456,350	$876,569	01/02/2019	3	Speedpanel Holdings Pty Ltd, prefabAUS	Swinburne University of Technology

Objectives

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

Manufacture of the next generation Speedpanel

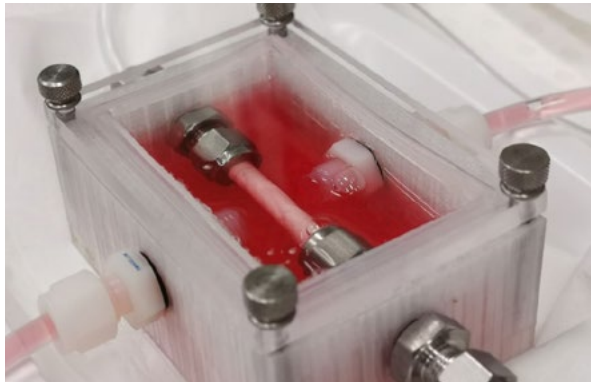
* photo credit: Speedpanel

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

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

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



Engineering an advanced, high value bioreactor system

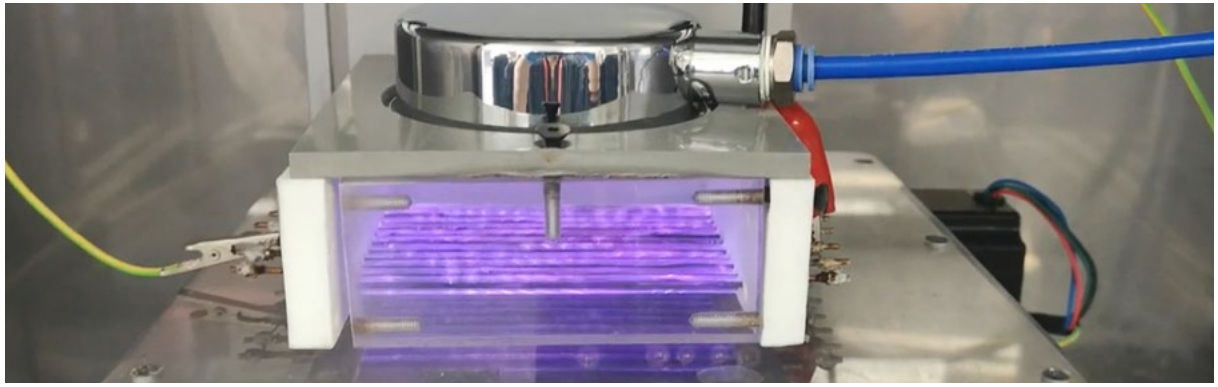
* photo credit: University of Sydney

Atmospheric plasma coating system

Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)	Industry Partner	Research Partner
$3,414,301	$505,231	01/06/2019	2.8	Xefco Pty Ltd	Deakin University

Objectives

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



Atmospheric plasma coating system

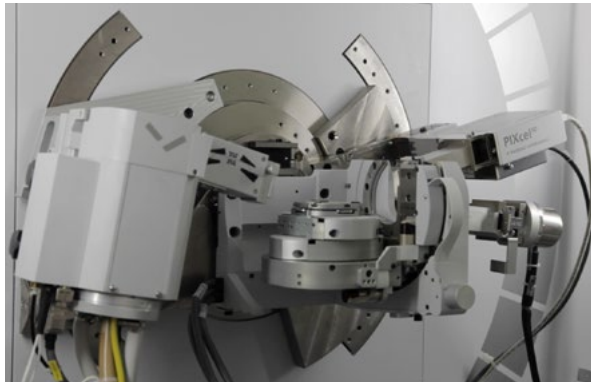
* photo credit: Xefco

The following **five research projects** continued:

High performance normally OFF GaN High Electron Mobility Transistors (HEMT)					
Total Project Value (AUD)	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**	**Industry Partner**	**Research Partner**
$2,635,001	$300,000	01/09/2017	2	BluGlass Limited	Griffith University

Objectives

- to develop commercially viable Normally OFF fail-safe, lower cost and smaller Gallium nitride (GaN) based high electron mobility transistors (HEMT)
- to combine 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
- to deliver world leading enabling technology platform and processes (RPCVD) for the manufacture of GaN Commercially viable SiC on Si substrate that addresses manufacturing cost, difficulty in engineering and the IP 'minefield' that is a barrier to wider manufacturing adoption



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

* photo credit: BluGlass

Smart electric compressor for refrigeration and air conditioning on electric vehicles

Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)	Industry Partner	Research Partner
$1,662,221	$241,110	01/09/2017	2	SuperCool Asia Pacific Pty Ltd	Griffith University

Objectives

- to develop 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
- the smart compressor will be Internet of Things (IoT) enabled with onboard diagnostic systems. Data generated from these systems will provide valuable information for quality control, maintenance and development, leading to a shorter product improvement cycle and providing service provision to end-users
- to design a compact and robust technology that offers transformational services to electric air-conditioned and refrigerated vehicle and equipment operators worldwide

Smart electric compressor for refrigerationa and air conditioning on electric vehicles

* photo credit: SuperCool

Antimicrobial nanosurface for orthopaedic implants

Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)	Industry Partner	Research Partner
19,615,233	$2,999,806	01/03/2018	4	Corin (Global Orthopaedic Technology Pty Ltd)	University of South Australia, University of Adelaide

Objectives

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

Antimicrobial nanosurface for orthopaedic implants

* photo credit: Corin

A novel approach to biofilm disruption and removal

Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)	Industry Partner	Research Partner
$4,152,532	$814,250	01/04/2018	4	Whiteley Corporation Pty Ltd	University of Sydney

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 and 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

A novel approach to biofilm disruption and removal

IMCRC meeting the Whiteley research team

* photo credit: Whiteley

Industrialisation of composite wheel technology

Total Project Value (AUD)	IMCRC Funding (AUD)	Start Date	Duration (Years)	Industry Partner	Research Partner
$14,932,926	$2,997,571	01/07/2018	3	Carbon Revolution Pty Ltd	Deakin University

Objectives

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

Industrialisation of composite wheel technology

* photo credit: Carbon Revolution

Program 4: Industrial Transformation

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

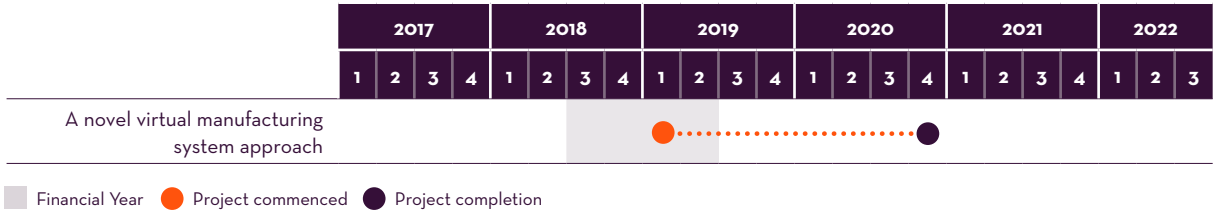
Program 4 - the Industrial Transformation Program – aims to advance the wider cause of manufacturing transformation through industry education and public advocacy. It seeks to create and provide resources that particularly assist SME manufacturers to assess and adopt emerging digital technologies and new business models.

In FY 2018-19, the **Industrial Transformation Program** has successfully:

- deepened relationships with key decision makers, opinion leaders and industry associations involved in Industry 4.0 such as Australia's Industry 4.0 Advanced Manufacturing Forum, Australian Industry Group (Ai Group), the Entrepreneurs' Programme (EP), CSIRO, Austrade and selected partner universities as well as with Germany's Fraunhofer Institutes and New Zealand's Callaghan Innovation and Manufacturer's Network
- signed an Engagement Agreement with the Fraunhofer Gesellschaft which provides a framework for collaboration on joint projects and recognises IMCRC as Fraunhofer's preferred portal for Industry 4.0 in Australia and New Zealand
- adapted Fraunhofer's Industry 4.0 assessment and resources (toolkit) to suit Australia's manufacturing sector and offer particularly manufacturing SMEs practical pathways to adopt and integrate Industry 4.0 principles/ techniques into their production processes. A first pilot in collaboration with Fraunhofer was successfully conducted with Quickstep Holdings Ltd, an advanced manufacturer of carbon fibre composites. Swinburne University's Factory of the Future supported the pilot
- progressed in establishing a national network of connected Industry 4.0 hubs with Swinburne University's Advanced Manufacturing Industry 4.0 Hub joining the Tonsley Manufacturing Innovation Hub (TMI) and the Additive Manufacturing Applied Research Network (ARMARN) in the quest of providing digital enterprise education and service facilities for manufacturing SMEs in their respective states. Swinburne has been trained and accredited by IMCRC to deliver futuremap® and Fraunhofer's Industry 4.0 program as part of their Industry 4.0 service offering

- engaged with 272 manufacturing businesses through futuremap in the reporting period, challenging them to re-think their business operations. Since the launch of futuremap in March 2018, the business diagnostic tool has helped a total of 325 manufacturers to assess their current business processes and identify areas of improvement and potential investment. futuremap was primarily delivered through facilitated workshops, hosted in collaboration with the Entrepreneurs' Programme and other industry partners across Australia. Note: 30 EP Business Advisors have been trained and accredited to deploy futuremap on a one-to-one basis as part of the EP's service offering

IMCRC has invested in its **first 'Industrial Transformation Program' research project** with Sleep Corp and Swinburne University of Technology.



In FY 2018-19, **one project** has commenced:

A novel virtual manufacturing system approach for integrated flexible low- cost manufacturing to enhance cost competitiveness, value differentiation and market focus					
Total Project Value (AUD)	**IMCRC Funding (AUD)**	**Start Date**	**Duration (Years)**	**Industry Partner**	**Research Partner**
$2,201,870	$260,305	01/01/2019	2	Sleep Corp Pty Ltd	Swinburne University of Technology

Objectives

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

A novel virtual manufacturing system approach

* photo credit: Sleep Corp

futuremap®

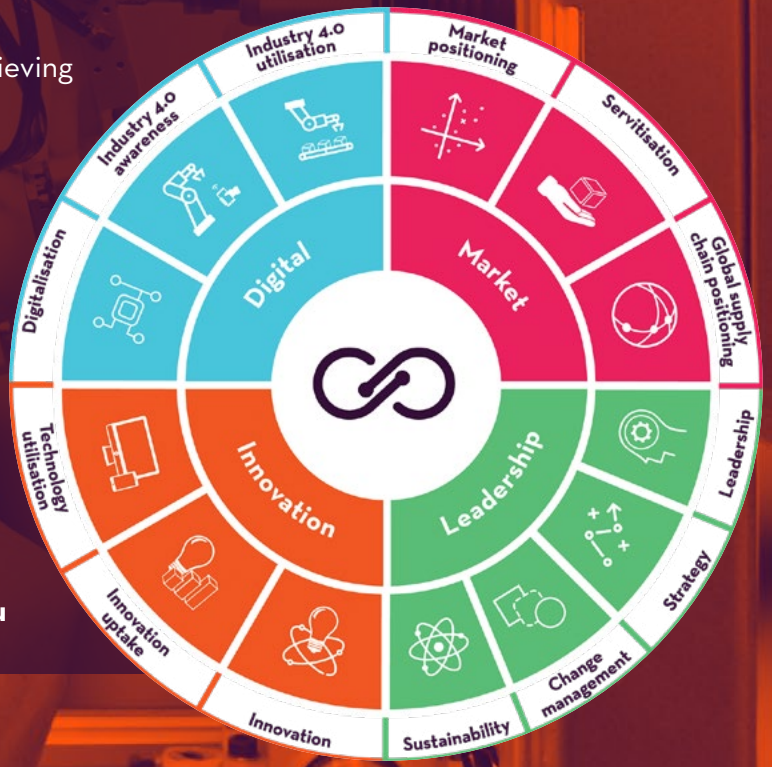
futuremap is business diagnostic tool designed by IMCRC to help Australian manufacturing SMEs assess their maturity and capabilities across 13 areas of industrial and manufacturing competitiveness. In FY 2018-19, futuremap has yielded fresh and unique insights on the challenges facing business leaders today and their ambitions. Here is a snapshot of the initial findings:

- Just one third have a strategic lock in with their customer, despite 80% believing that they provide significant benefits to their customers
- Two thirds say business priorities are determined by operational and financial imperatives
- Two thirds have the capacity and capability to be more innovative, but 40% face barriers and challenges in becoming so
- More than half are now aware of Industry 4.0, yet less than 10% have a well-defined digital strategy

These findings are based on the analysis of 325 unique survey responses* futuremap from individual manufacturing businesses across Australia.

* as at 30 June 2019

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



Catalysing Industry Transformation

Collaboration

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

Research

- IMCRC has established a unique ecosystem of manufacturing research expertise and infrastructure, consisting of CSIRO and 11 universities in Victoria, New South Wales, Queensland and South Australia, that offers manufacturers diverse perspectives and inclusive environments to unlock innovation and business potential.
- IMCRC collaborated with three Industry 4.0 hubs – Swinburne's Factory of the Future, Tonsley's Manufacturing Innovation Hub (TMI) and the Additive Manufacturing Applied Research Network (ARMARN) – to offer manufacturing SMEs access to technical capabilities, equipment and resources to take innovative ideas from concept to reality.
- Since signing a Framework Engagement Agreement with Germany's Fraunhofer Gesellschaft at the beginning of FY 2018-19, which sees IMCRC as Fraunhofer's preferred Industry 4.0 portal within Australia and New Zealand, IMCRC has adapted Fraunhofer's Industry 4.0 resources and assessment approach to meet the requirements of Australian manufacturing SMEs. A first pilot, supported by Fraunhofer, was conducted in the reporting period.

Industry

- IMCRC worked with small, medium, large and multinational companies across a range of industry sectors including advanced manufacturing, medical technologies, mining, building and construction and defence. To date, IMCRC has approved a total of 26 industry-led research collaborations that focus on advancing technical capabilities and delivering real benefits for Australian manufacturing.
- In FY 2018-19, futuremap® enabled IMCRC to engage directly with 272 manufacturing businesses across Australia, encouraging them to assess their core business model and re-think their current business processes. As a next step, futuremap recommended further information as well as access to a wider support ecosystem.
- IMCRC joined forces with its member industry associations, Ai Group and prefabAUS, to inform and educate Australian businesses about the potential of advanced manufacturing technologies, especially around Industry 4.0. In FY 2018-19, Speedpanel, a prefabAUS member, commenced a research project with Swinburne University of Technology to develop their next generation of products.

Government

- IMCRC partnered with the Australian Mathematical Sciences Institute's (AMSI) APR.Intern program, offering manufacturers access to skilled PhD students to apply their specialist expertise to drive advanced manufacturing and optimisation solutions within the business.
- IMCRC worked with the Commonwealth Government as well as with state and local governments to help catalyse industry-research collaboration and manufacturing growth, particularly with SMEs and in regional areas.
- futuremap exemplifies the effective collaboration of multiple government organisations. In collaboration with the Entrepreneurs' Programme and other partners, IMCRC delivered 33 interactive futuremap workshops across Australia. The Queensland Government references futuremap in their "Advanced Manufacturing 10-Year Roadmap and Action Plan".
- IMCRC CEO and Managing Director accepted the lead of the 'Technology Application and Digital Business Models' (former Research and Innovation) stream of the Industry 4.0 Advanced Manufacturing Forum. The Forum aims to facilitate dialogue and collaboration around Industry 4.0 in Australia.

SME Engagement

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

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

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

In FY 2018-19, IMCRC:

- invested in industry-led manufacturing research with eight small and medium businesses from a diverse cross section of industries, sizes and location, all aligned with IMCRC's SME collaboration requirement
- raised awareness and shared 'digital manufacturing' insights impacting SME manufacturers at industry conferences, seminars and workshops
- hosted 33 futuremap workshops in collaboration with the Entrepreneurs' Programme and other industry partners that were attended by 272 businesses including 256 SME manufacturers. The workshops guided attendees through futuremap – a business diagnostic tool that helps manufacturing SMEs assess and map the current and future state of their business across thirteen key areas of industrial and manufacturing maturity
- partnered with National Manufacturing Week 2019 offering manufacturers access to RMIT's Advanced Manufacturing Precinct and Swinburne's Factory of the Future to explore the research facilities and learn about the benefits of industry and research collaboration
- worked closely with Swinburne University's Factory of the Future to develop a SME engagement model to accelerate the uptake and diffusion of digital and advanced manufacturing technologies
- engaged with several state governments in support of specific programs for manufacturing SMEs, including in regional areas

NSW Chief Scientist visits Swinburne University

futuremap workshop

Education and Training

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

In FY 2018-19, IMCRC continued to build on the foundations it established in the previous years and focused on

Student Engagement and Development

- IMCRC created a community of 17 PhD and two master students from seven universities, meeting its Commonwealth Agreement milestone of ten PhD students or equivalent commencing in the period. It also offered two students first-hand industry experience through Industry 4.0 internships.
- To gain industry exposure and build professional relationships, IMCRC invited its first cohort of eight PhD students to present their research at the IMCRC Conference in May. Hosted alongside National Manufacturing Week, the conference also offered them the opportunity to explore the trade exhibition and meet with thought leaders and industry experts.
- In February 2018 IMCRC entered into a funding partnership with the AMSI's APR.Intern program to match 23 skilled PhD students with manufacturing SMEs and larger companies to drive manufacturing transformation. As of 30 June 2019, two PhD students had been offered an internship position.

Industry Training

- In FY 2018-19, IMCRC hosted 33 interactive futuremap® workshops, attracting 272 manufacturing businesses interested in learning more about the opportunities that Industry 4.0 technologies and new business models pose for their business. Since the launch of futuremap in March 2018, a total of 325 manufacturers used the business diagnostic tool to assess the maturity of their business and identify areas of focus and potential investment.
- The past year saw IMCRC work closely with Fraunhofer to adapt and successfully pilot their Industry 4.0 toolkit in Australia. Quickstep Holdings Ltd was the first Australian manufacturer to undertake the assessment which identified the business' Industry 4.0 improvement potential.
- To prepare manufacturers for the digital future, IMCRC is collaborating with universities and other stakeholders to help establish a national network of Industry 4.0 hubs. In FY 2018-19, IMCRC developed with Swinburne University's Factory of the Future an engagement model and training services based on futuremap.

PhD students at the IMCRC Conference

National Manufacturing Week

Communications

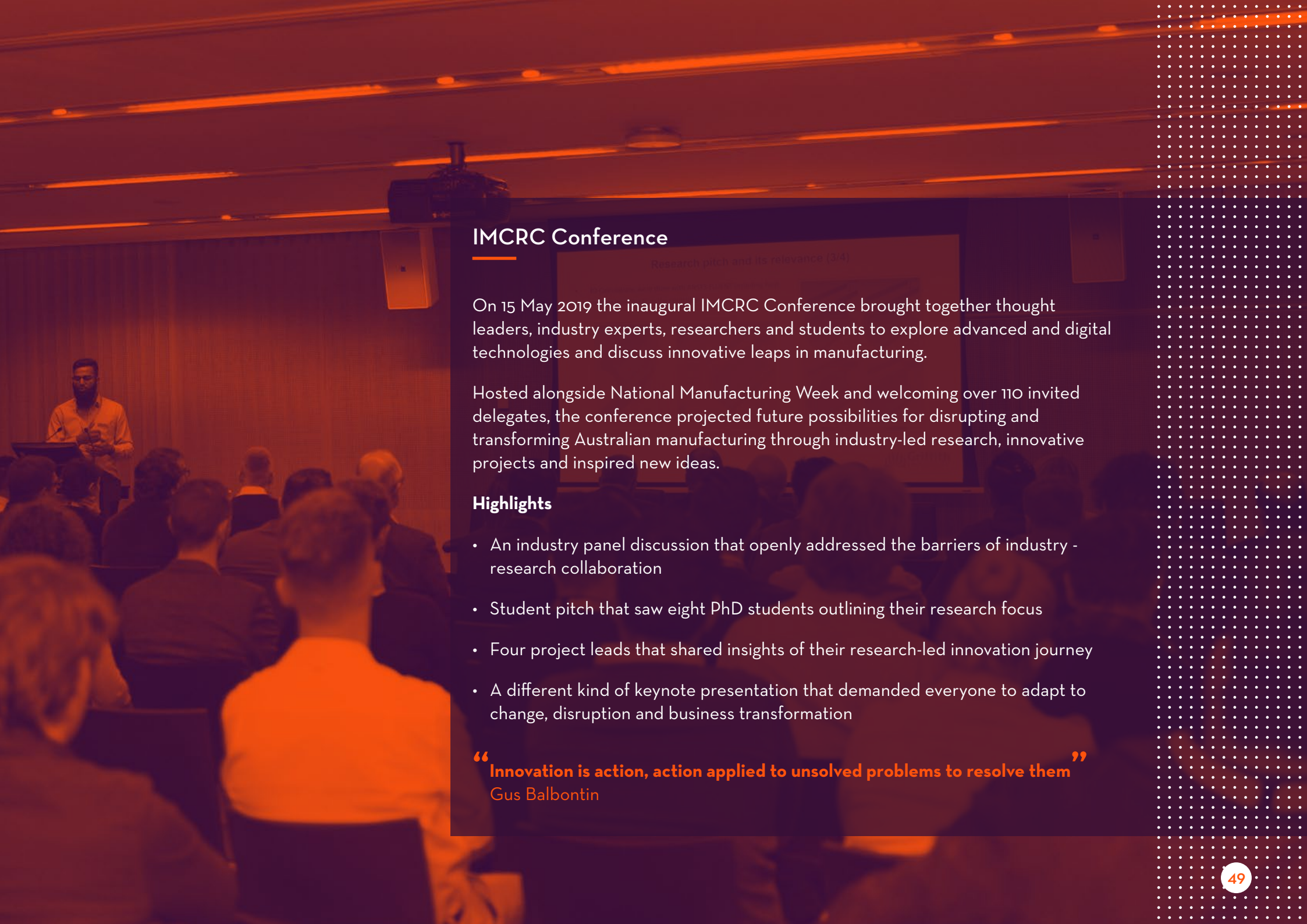
The Australian manufacturing sector is diverse. Effective and relevant stakeholder engagement and communications are essential to realise IMCRC's vision for a thriving, relevant and globally integrated Australian manufacturing industry.

IMCRC's strategic communications intent is to:

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

In FY 2018-19, IMCRC's priority was to deliver consistent and impactful communications that promoted available funding opportunities in advanced and digital manufacturing (Industry 4.0) and positioned IMCRC as "a catalyst for manufacturing transformation in Australia". This was achieved by:

- strengthening IMCRC's brand identity to reflect the organisation's values and purpose of helping Australian manufacturers prosper in today's global economy through collaborative investment, research impact and innovation
- creating an integrated communications campaign that demonstrated the impact, value and benefits of industry-led research collaboration. Central to the campaign were **three video case studies** that focused on the business opportunities that working with an Australian research organisation through IMCRC created for those organisations
- hosting the first IMCRC Conference, attended by 110 industry, research and government representatives, at the Melbourne Convention and Exhibition Centre alongside National Manufacturing Week
- announcing nine manufacturing research partnerships which secured news coverage in 200+ publications – nationally and internationally
- publishing two articles in scholarly refereed journals and one conference paper (refereed proceedings)
- providing regular updates about IMCRC's research initiatives, organisational and industry news through Innovate – IMCRC's e-newsletter – reaching an audience of 300+ subscribers
- cementing IMCRC's online and social media presence – with, for instance, an active and engaged network of 832 LinkedIn followers at 30 June 2019. This represents an increase of 135% on the previous year
- speaking at more than 50 industry events including National Manufacturing Week and Siemen's Digitalise 2018, engaging with 3,000+ manufacturing stakeholders and shaping the conversation about what's next for Australian manufacturing
- delivering 33 interactive futuremap® workshops across Australia, encouraging 272 manufacturing SMEs to think differently about the opportunities that emerging digital technologies and new business models create for their business



IMCRC Conference

On 15 May 2019 the inaugural IMCRC Conference brought together thought leaders, industry experts, researchers and students to explore advanced and digital technologies and discuss innovative leaps in manufacturing.

Hosted alongside National Manufacturing Week and welcoming over 110 invited delegates, the conference projected future possibilities for disrupting and transforming Australian manufacturing through industry-led research, innovative projects and inspired new ideas.

Highlights

- An industry panel discussion that openly addressed the barriers of industry - research collaboration
- Student pitch that saw eight PhD students outlining their research focus
- Four project leads that shared insights of their research-led innovation journey
- A different kind of keynote presentation that demanded everyone to adapt to change, disruption and business transformation

> **"Innovation is action, action applied to unsolved problems to resolve them"**
> Gus Balbontin

we champion
manufacturing
innovation

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