Additive Manufacturing

Cooperative Research Centre

Fostering collaborative investment in additive manufacturing and innovation that will transform the Australian Manufacturing sector.

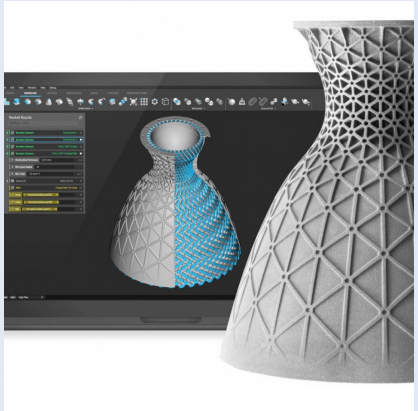
ADDITIVE MANUFACTURING CRC
AUSTRALIA MAKES

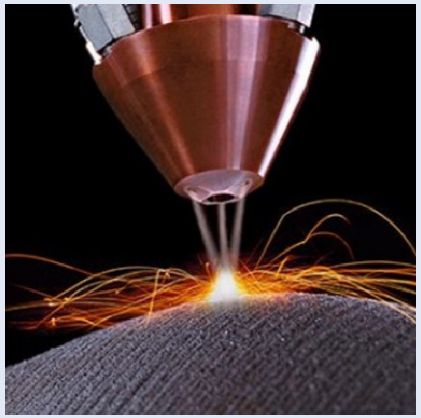
Contents

A new CRC supporting industry research through a federal government funding initiative.

The Additive Manufacturing Cooperative Research Centre (AMCRC) is an industry led collaborative research funding proposal that is focused on advancing Australia's additive manufacturing sector.

The center brings together industry partners, developing the next generation of products and services, and research institutions to conduct cutting-edge research, develop new technologies, and drive innovation to foster a globally competitive innovation ecosystem for advanced manufacturing.





- Be a leading industry partner in next generation additive manufacturing research, development and innovation.
- Access 1:1 (dollar for dollar) matched cash funding from the CRC for industry-led collaborative projects of between 2 and 5 years in duration, commencing from 2025 onwards.
- Create unique pathways to new products, processes, services and markets through development and adoption of technology and transformative business models.
- Work within research clusters with common problems and opportunities.
- Access world class research teams, infrastructure and expertise, and build immediate and complementary R&D and innovation capability and capacity
- Join a network of ambitious and progressive business and research leaders in advanced manufacturing.
- Accelerate an IP and commercialisation strategy and deliver a substantial return on investment.
- Leverage the CRC business model and team working to support progress, drive outcomes and reduce risk, through proven project agreements, governance, milestones and reporting.
- Create high value and meaningful jobs, and career pathways for research students.

Additive manufacturing – what is it? and why focus?

Additive manufacturing (AM) has been described as a manufacturing revolution. The process allows for the creation of complex three- dimensional objects by adding and then bonding material layer by layer. Metals, polymers, composites and almost any material can be run through these automated platforms, from the nano scale right up to the printing of houses. Globally, industry adoption of AM technology has been growing rapidly at an average of 24% per annum and in 2022 over $US18 billion was invested in AM & 3D printing equipment alone. Australian research organisations have been early adopters of AM technology and in metal and life science research they are considered world leaders. Through the new CRC Australian manufacturers will be able to access this knowledge with collaborative research projects to commercialise innovation and develop new business models.

Since its inception in the early 1990s AM has rapidly transformed the product development cycle across all industry sectors. Building parts one slice at a time, has sparked a wave of creativity and introduced transformative business models. From discrete aligners for straightening teeth to lightweight titanium wheels on the Mars Rover, AM has inspired a new generation of innovation and products. Companies have also used AM to disrupt long established industries and take significant market share from existing players, the dental, orthopaedic implant, and hearing aid markets have all seen enormous change over the last 10 years on the back of AM technology.

Some of the unique problems that Australian manufacturer's face including a heavy reliance on overseas supply chains with massive shipping costs and associated emissions are a huge opportunity for AM to solve by allowing the localisation of volume sensitive production of complex, high value, and customisable components. AM also gives product designers and engineers incredible freedom to light weight the next generation of transport and aerospace components driving fuel efficiency and emission reduction, while increasing electric vehicles range. EV battery technology is rapidly evolving and AM's ability to print high surface area to weight ratio parts in almost any critical mineral opens up opportunities for those very minerals to be converted into high value products that could unlock net zero pathways for Australian manufacturing. Couple this with our growing access to affordable renewable energy, means there will be long term sustainable opportunities for ambitious manufacturers to build new product portfolios for export markets.

The development and application of next generation AM technologies coupled with innovation and capability building will be the catalyst for manufacturing growth and transformation and the focus of the Additive Manufacturing CRC.

Hip Implant – image courtesy of Stryker

Additive manufacturing – benefits

Additive Manufacturing (AM) is poised to elevate the Australian Advanced Manufacturing sector's global competitiveness and sustainability.

This cutting-edge technology facilitates economical yet high-value production, characterized by new levels of product personalisation. This transformative capability empowers Australia to swiftly shift towards sustainability, embracing eco-friendly, carbon-conscious, and circular manufacturing practices to cater to global supply chains and targeted export markets.

AM embodies sustainability by fostering the creation of environmentally-responsible products. This is achieved through the reduction of weight and integration of functionalities within intricately shaped components. Furthermore, AM can utilise novel bio-derived and recycled materials, alongside renewable energy sources allowing manufactures to explore innovation in zero-waste, zero-emission products and processes. This has been very evident in the construction industry where early success of onsite printing of integrated walls has slashed material transport costs, dramatically reduced site waste and overcome skilled labour shortages.

Building a world-class Additive Manufacturing Industry – Developing the ecosystem and a full supply chain

Australia's exceptional access to a wide range of high-value critical minerals, metals, and bio-based materials, coupled with ever more affordable renewable energy provides unique opportunities for manufacturing growth. By strategically capitalizing on these resource strengths, combining with Australia' s excellent R&D capability in the AM area and addressing cost and sustainability challenges, AM is perfectly poised to offer low volume, high value add manufacturing capability, linking critical parts of Australia's supply chain and develop a resilient manufacturing ecosystem.

Combining additive with surface capabilities supports an integrated manufacturing innovation ecosystem to provide the next generation of high quality, sustainable and customised products.

The AMCRC will be critical in joining up R&D capability, linking material and service providers, AM technology partners and SMEs, manufacturers with end users and establish Australia as a world-leading player in AM, forging a sustainable path to economic growth and technological advancement.

Cat777F Dump Truck Wheel spindle showing Journal Fretting and Spline Wear

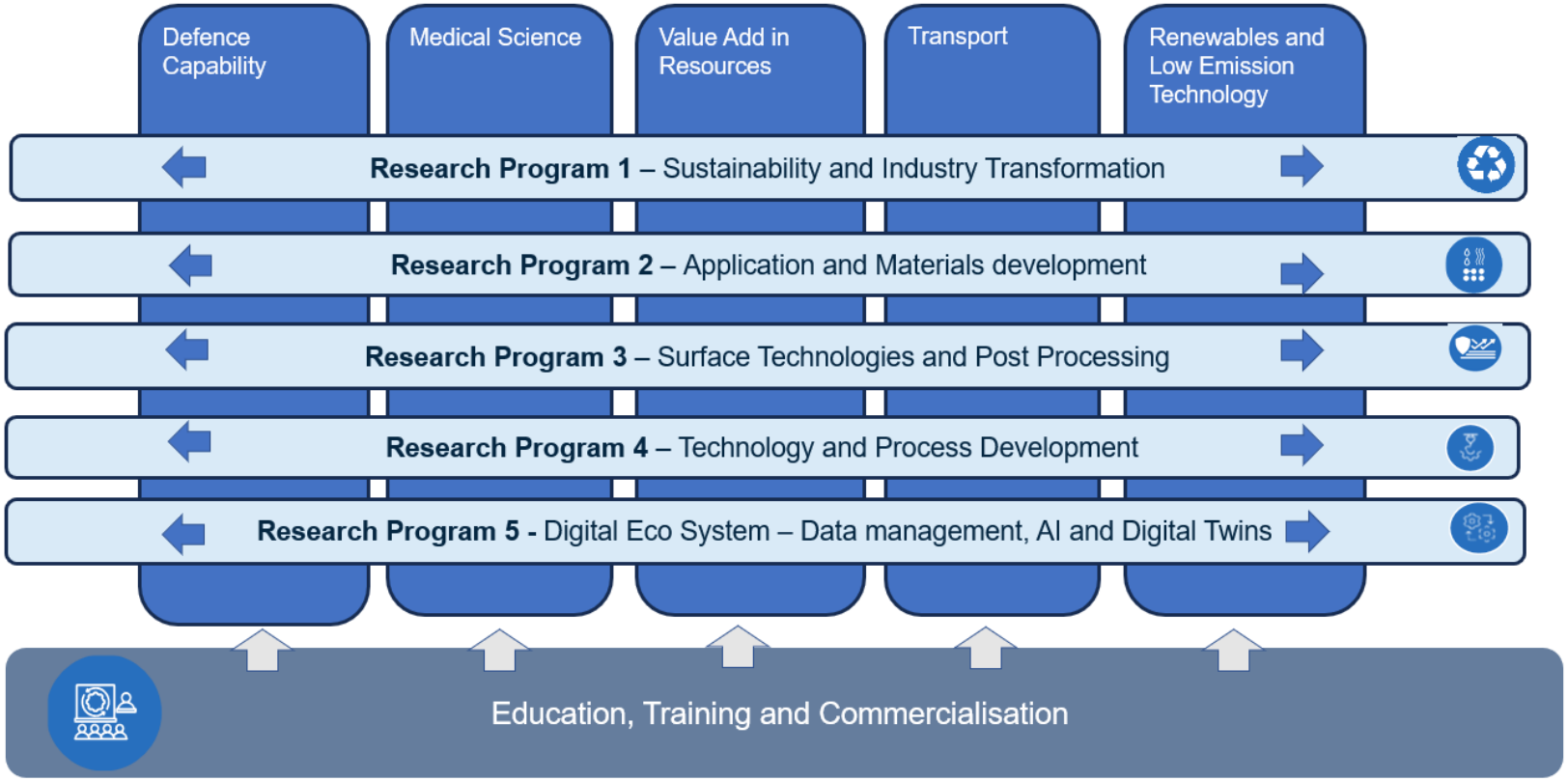
LaserBond repaired CAT 777F Wheel Spindle Bearing and Journal

Courtesy of Laserbond Pty Ltd

Research programs

The Additive Manufacturing CRC will have five research programs each embracing projects and initiatives that solve problems and deliver outcomes to both the project partners and provide benefits to the broader Australian manufacturing industry.
Collaborative projects will be designed and industry-led, taking proof of concepts through to pilot line and commercial investment readiness – from Manufacturing/ Technology Readiness Level (MRL/TRL) 4 – 8.*

National Reconstruction Fund Priority Areas and Research Programs



* Manufacturing Readiness Levels (aligned with Technology Readiness Levels)

Research Program 1

Sustainability and Transformation

The program aims to develop new and unique sustainable (ecological, economic and social) solutions for the companies using Additive Manufacturing (AM) and transform the AM industry towards a world-leading one.
The sustainability research includes, but is not limited to

- New AM processes supporting Zero Waste and Zero Emission opportunities, incl. Re-manufacturing
- Development of sustainable new and reusable materials, including biomaterials from renewable resources
- Healthy, inclusive and productive AM workplaces with a focus on safety, ergonomics, work content, operator assistance
- AM as part of an Industry 5.0 integration including Sustainability Accounting of AM-based processes and products to participate in global supply chains
- Socio-techno-economic aspects of distributed and remote AM-based manufacturing in the regions, e.g. social responsibility programs to support community-based projects and Indigenous enterprises

The transformation research can be clustered in two main programs: supporting companies using AM technologies in a transformation to higher productivity and Industry 5.0 as well as transforming the Australian AM Industry.

- AM Company Transformation: "Company's Journey to AM Excellence"
    - Research for Awareness, Assessments, Best Practice, Transformation Tools
    - International and national experts & networks on AM
- AM Industry Transformation for "Creating a world-leading AM Industry"
    - Growth & transition strategies with industry roadmaps
    - Developing supply-chain resilience
    - Creation local centres for AM excellence

Research Program 2

Application and Materials Development

The program aims to develop new and unique applications for AM technologies across key priority industries for Australia creating new Circular Economy focused business models.

- Researchers work on identifying and understanding the specific requirements of different applications to optimize the use of additive manufacturing.
- The program focuses on exploring novel ways to leverage additive manufacturing for complex geometries, personalisation, and advancing new materials.
- Application development includes areas such as aerospace, automotive, healthcare, consumer goods, construction and more.

The program emphasizes the development of innovative and sustainable materials suitable for AM processes.

- Researchers aim to create the next generation the range of materials available for additive manufacturing, including metals, polymers, ceramics, composites, and biomaterials.
- Material development for advanced metals and polymers involves exploring nanomaterials and nanocomposites. Nanotechnology offers unique opportunities to tailor material properties at the nanoscale level by manipulating the size, shape, and composition of nanoparticles. Nanocomposites exhibit superior mechanical strength, electrical conductivity, and thermal stability compared to their bulk counterparts.
- AM feedstock efficiency by waste upcycling and right size, scalable feed stock production using the vertical integration of local mineral resources.
- The program also focuses on improving material compatibility with specific additive manufacturing technologies like; laser powder bed fusion (LPBF) selective laser sintering (SLS), fused deposition modeling (FDM), and stereolithography (SLA) etc.

Research Program 3

Surface Technologies and Post Processing

This program will support the application of additively manufactured parts to make them fit for purpose. That is modify the surface to achieve the desired shape and performance.

Combining leading edge research in additive and surfacing can lead to innovative products that are best in class. This is an area of development that has had insufficient attention and can lead to new knowledge, approaches and processes.

In addition, it will support the develop of surface treatments and coatings more broadly.

- Develop capabilities in the repair, remanufacture and re-use of components, which will help deliver green manufacturing to industry partners and support platform sustainment activities
- Developing surface treatments and new coatings for high temperature, corrosive and abrasive environments.
- Development of surface structures, textures and shapes
- Developing biologically relevant surfaces for implants, sensors and support the development of medical devices.
- Develop decorative effects, aesthetic, optical coatings and treatments.
- Support laser processing (including laser etching, cleaning and hardening)
- Strategies to minimize post processing
- Development of efficient and environmental-friendly post-processing techniques (hard surfacing/cladding/ heat-treatment etc.) for improving surface finish, dimensional stability and part performance.

Research Program 4

Technology and Process Development, Product Qualification and Validation

This program will focus on the development of new additive manufacturing technologies and novel processes to grow our advanced manufacturing sector, including;

- New development of additive manufacturing technology, platform and processes.
- Creating the next generation of process parameters to enhance part quality and performance.
- Development of multi-material and hybrid additive manufacturing techniques.
- New and enhanced technologies for improved build rates
- Improved process flow connectivity: feed stock, material validation, printing and post processing
- Development of new standards and guidelines for qualifying additive manufacturing processes.
- Validation of additive manufacturing processes to ensure part quality and consistency.
- Development of Certification protocols for additive manufacturing systems, materials, and processes.
- Development of test methods for evaluating mechanical, thermal, and chemical properties of additively manufactured parts.
- Characterization of microstructure and defects in additively manufactured parts.
- Assessment of the impact of process variations on part quality.
- Verification of part performance through mechanical testing and analysis.

Research Program 5

Digital Eco System – Data Management, AI and Digital Twins

A Digital Ecosystem will be crucial for the productive use of AM in an industrial environment. Digital AM solutions enable the Australian industry to exploit the full potential of AM.

- Data management, control and protection
  Digital solutions for the full AM data life cycle are critical. From embedded sensor providing real-time data to the management and sharing of product and process data via secure and reliable infrastructure and including Big Data analysis for quality management multiple new solutions are needed to fulfill Cybersecurity standards, improve efficiency and participate in international supply chains.
- Scanning and 3D-image recognition, interpretation & Design Optimisation
  Real-time digital modelling devices, new image and voxel recognition and interpretation are needed to integrate the physical with the digital world and increase the productivity of industrial AM. The combination of digital prototyping and physical testing cycles will be significantly accelerated. Leveraging these product and process data will optimize the product design and increase productivity while reducing resources and life-cycle cost and impact.
- Process automation, Human Assistance and Industry 4.0/5.0 integration
  Partial or full process automation and digital support for human operators are necessary to harness the full productivity potential of modern AM. The integration in smart Industry 4.0/5.0-based production systems and supply chains will give the manufacturing and related sectors a competitive advantage.
- Machine Learning and AI
  Based on validated data innovative Machine Learning and AI models and algorithm will support operators of AM systems with real time advice, product, process and quality control. This includes performance improvements based on product design, multi- material selection, process selection and post-processing and leveraging AI software for cradle to grave integration.
- Digital Twins for processes, product and materials Digital Twin solutions consisting of full 4D models enriched with additional features, multi-physics and process simulation will enable the AM based production and life-cycle maintenance of complex, individualized and specialized components, products and systems. Innovative Digital Twins combined with AM will enable new value-creation such as local and personalised Manufacturing on Demand.

Qualification Program

Education, Training and Commercialisation

This program aims to provide training and support for Australia manufacturers in adopting additive manufacturing technologies. It focuses on enhancing knowledge, skills, and capabilities related to additive manufacturing to drive transformational change in the way new products are developed. Ultimately supporting our industries be more sustainable and lifting our global competitiveness.

The program also recognizes the importance of developing a skilled workforce capable of leveraging additive manufacturing technologies. It offers training and certification programs to enhance the employability of individuals in the additive manufacturing industry with certificate III apprenticeship.

A key part of this program is the integration of Masters/PhD's into the collaborative research projects. These are partly funded by the CRC and Universities and enable career pathways for researches into industry. The CRC will support industry placements from 3 to 12 months within the partner organisation.

Following a strong industry demand, the CRC will develop and implement qualification program to up-skill the existing and available workforce and creating inclusive workplaces.

The commercialisation part facilitates technology transfer by providing guidance on intellectual property rights, licensing agreements, and commercialization strategies. This includes support for robust Business Case development and market access It helps participants navigate the complexities associated with bringing additive manufacturing innovations from the research stage to commercialization and utilization.

Collaborative project investment model

Project co-investment with Industry and the CRC

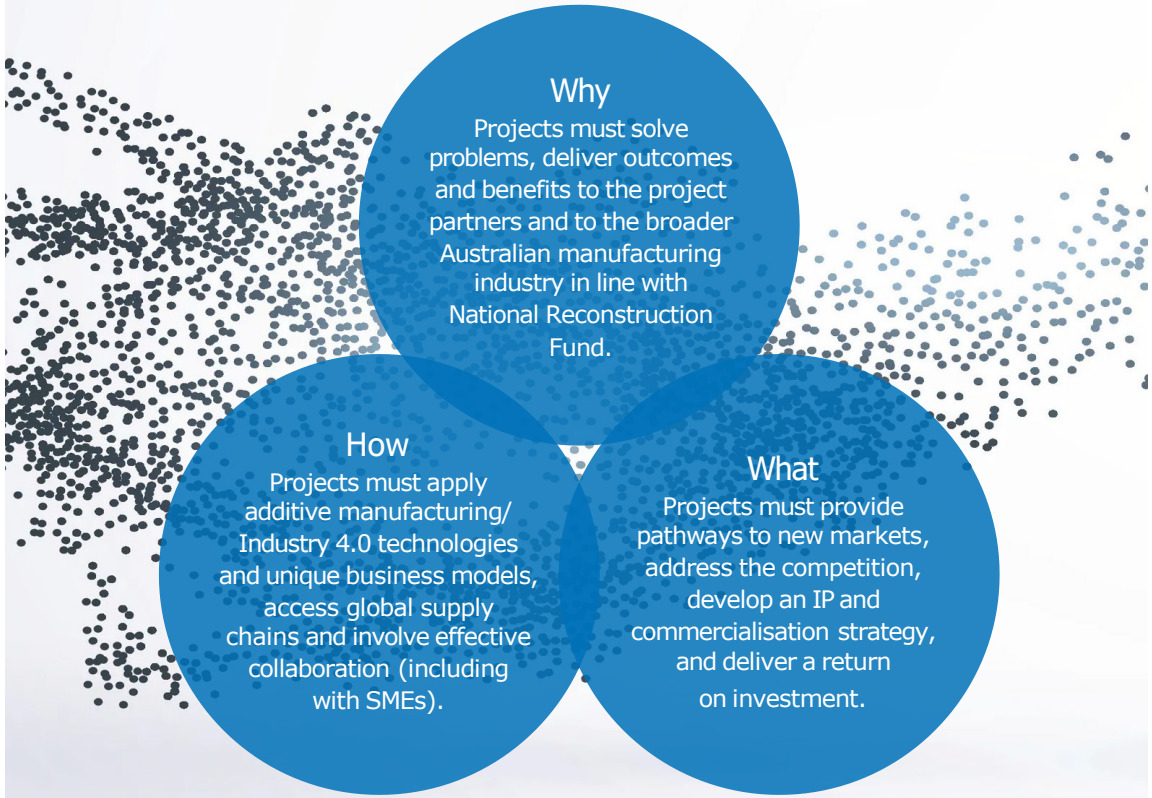
Funding multiplier: dollar for dollar matched cash funding from the CRC matching industry cash investment in projects (noting while in-kind contributions are required and valued, these are not matched by CRC cash). Importantly, this typically enables a total project investment value in excess of five times the industry cash contribution value when CRC and other Partner contributions are included.

Capped funding: project funding is capped per business to ensure efficient and effective use of CRC grant funding on projects. The new CRC proposes this is capped at $5m per business with up to a 5 year project term. The CRC has a running term of 7 years.

Project IP ownership: to maintain independence no project IP is owned by the CRC. Ownership of both background and Project IP is agreed prior to the commencement of any projectto ensure no barriers will exist to successful commercialisation.

Project maturity: CRC funds projects typically from MRL/TRL 4 through to 7 or 8 to take projects from proof of manufacturing concept through to pilot readiness and commercial investment.

Research proposal rationale



Potential Industry Partners – is this a good strategic fit?

The CRC matches dollar-for-dollar Industry Partner cash for collaborative manufacturing R&D and innovation projects with CRC Research Partners. This is a potential fit for Industry Partners (e.g. manufacturing and related businesses) where their strategy includes:

- investing in an eligible transformative manufacturing R&D project with a CRC Research Partner of between 2 and 5 years in duration, that can commence from 2025 onwards
- spending at least $250,000 industry cash per project to fund the cost of researcher salaries and operating costs at a CRC Research Partner(s) (which, if eligible, the CRC can match dollar for dollar up to a maximum of $2.5 million industry cash per business – total maximum project cash $5 million)
- with the Research Partner(s) conducting at least 50% of the overall project research effort
- utilising and/or developing new manufacturing technologies and business models aligned with the CRC Research Programs to deliver commercial outcomes, including within Australia, ideally within 3 years of completion of the project
- collaborating with other Australian manufacturing SMEs through the project.

It is important to note that the CRC:

- only uses Industry Partner cash contributions for the approved project, and that Industry Partner payments are paid monthly to the CRC in line with an approved project budget and Research Partner expenditure profile (i.e. cash payments are not required from Industry Partners to the CRC until project commencement)
- only provides matching cash funding for eligible expenditure at the Research Partner(s) and not for the Industry Partner's own internal project or other expenses (these may be eligible to be valued as in-kind costs)
- requires in-kind contributions to be valued by the project parties, with the expectation that the total project in-kind (staff in-kind and other non-staff in-kind) is at least 3x the value of the Industry Partner project cash contribution
- does not provide funding for capital equipment, production tooling, buildings or facilities.

Next steps

If you are interested in being involved in the new Additive Manufacturing CRC please make contact with:

John Croft
+61 414 747 636
john.croft@amcrc.com.au

ADDITIVE MANUFACTURING
AUSTRALIA MAKES
CRC