Deakin University

Capability Statement: Additive Manufacturing Research at Deakin University
Advancing Smart Materials, Digital Processes, and Industry Transformation

Deakin University is at the cutting-edge of Additive Manufacturing (AM) research and development, offering world-class expertise across a breadth of disciplines including materials innovation, advanced AM processes, digital integration through Industry 4.0, artificial intelligence (AI) enablement, and organisational transformation. Our multidisciplinary approach integrates engineering, materials science, data analytics, and business innovation to deliver practical, scalable solutions for industry.

Materials Innovation

Deakin's research in materials for AM encompasses metal alloys, polymers, glass, ceramics, customisable tow-preg filament for continuous fibre 3D printing, biomaterials, and emerging smart materials. Deakin's researchers develop and optimise materials tailored for high-performance AM applications, including: lightweight titanium alloys for aerospace; stable invar alloys for space satellites; high entropy alloys for biomedical implants; high resolution polymers and ceramics for parts, including lab-on-a-chip applications; the biofabrication of living tissue engineered constructs; flexible meta-materials for soft robotics; and energy-responsive 4D-printing materials. These materials are engineered to meet the demands of functionality, sustainability, and performance in next-generation manufacturing environments. Deakin has previously worked with many of the AMCRC industry partners on materials innovation projects. Our materials innovation is led by the Deakin Institute for Fronter Materials.

Additive Manufacturing Processes

Deakin is actively advancing the full spectrum of AM processes—including friction stir AM (Meld), laser-based directed energy deposition (LB-DED), laser-based powder bed fusion (LB-PBF), cold spray processes, fused deposition modelling (FDM), selective laser sintering (SLS), in-house developed continuous fibre 3D printing, stereolithography (SLA) and Digital Light Projection (DLP) for ultra-high resolution polymer 3D printing (BMF MicroArch), large format AM (LFAM), multi-material polyjet printing, and non-planar multi-axis 4D-printing. Our research focuses on process modelling and simulation, parameter optimisation, defect minimisation, functional integration, and scale-up for industrial applications.

Integration with Industry 4.0

Deakin is a leader in the fusion of manufacturing with Industry 4.0 technologies. We integrate smart monitoring systems, robotics, and connected devices into manufacturing workflows to create intelligent, adaptive production environments. Deakin's researchers apply smart sensors, data platforms, and digital twins to enable predictive maintenance, quality assurance, supply chain analysis, and traceability. Our systems approach to Industry 4.0 research encompasses comprehensive decision support capabilities using advanced modelling and simulation. Deakin's researchers develop simulation tools for process design optimisation, capacity planning, and operational decision support. These capabilities include physics-based simulations for process improvement, production scheduling models, capacity planning, and strategic planning tools that help manufacturers optimise their operations.

This systems-level integration is vital for enabling mass customisation and agile manufacturing in sectors such as defence, medtech, and automotive. Deakin has previously worked with several of the AMCRC industry partners on Industry 4.0 projects. Our Industry 4.0 development is led by the Deakin Institute for Intelligent Systems.

Artificial Intelligence and Process Control

Deakin's AI research helps manufacturers improve productivity and reliability. We do this by using AI to discover new materials faster, augment human experts to detect and fix production errors, and help design stronger, lighter, and more innovative products from the design stages on. In the context of additive manufacturing, we can help you: (i) Find Better Materials, Faster: We can create systems that rapidly analyse and predict the properties of new materials, speeding up your R&D ~ helping you find the perfect material for the task. (ii) Automate Quality Control: Use AI as a smart supervisor for your machines. The AI Agents watch printing process in real-time and address causes of errors. This means fewer failed parts, less waste, and higher reliability; and (iii) Design Smarter Products: Before you even print, AI methods can help design parts that are stronger but lighter (topology optimisation) or generate innovative new design options that meet specific requirements.

Leveraging recent advances in artificial intelligence (AI) to solve real-world manufacturing challenges is a core strength of Deakin's integrated research portfolio with over 2 decades of delivered projects. Our AI research is led by the Deakin Applied Artificial Intelligence Initiative.

Business and Organisational Innovation

Deakin recognises that the transformation of manufacturing requires more than technological innovation—it demands new business models, leadership paradigms, and workforce capabilities. Deakin's research in strategy, innovation, entrepreneurship, organisational behaviour, and digital capability building skill underpins industry transition to AM technologies.

Deakin has the well renown Deakin SME Research Centre that provides cutting-edge SME business and organisational applied research, policy advocacy, and training. Also, Deakin has ManuFutures, which is Deakin's innovation and incubation hub. ManuFutures helps local businesses accelerate through its unique facilities, programs and services.