

School of
Applied Sciences



Applied Sciences at Cranfield University



Our core strengths, based on in-depth expertise, are wide-ranging and address a number of areas:

- Aerospace
- Agriculture
- Automotive and motorsport
- Competitive design
- Cost and decision engineering
- Energy
- Environment
- IT and business
- Land management
- Manufacturing
- Materials
- Microsystems and nanotechnology
- Offshore
- Soil
- Sports surfaces
- Sustainability
- Water
- Waste
- Welding

Applied Sciences operates across materials, manufacturing, natural resources and sustainable systems. Our focus is on fundamental research and its application to meet the needs of industry and society. This research informs our teaching, training and consultancy services.

Cranfield has a successful track record of working closely with organisations around the world. Our success is based on the expertise of our staff and the quality of the students whose careers we help develop. We operate state-of-the-art facilities, many of which are unique to Cranfield and are focused on industry. This ensures we are well positioned to serve our clients' needs with this infrastructure underpinning the work of our staff, students and short course delegates. We add a practical dimension to our development programmes.

We adopt a multidisciplinary approach to our work, drawing on expertise throughout Cranfield University to support our partners. Research in Applied Sciences focuses on key themes. Each research theme contributes to Cranfield's strategy of 'research informing teaching'. This ensures that we translate research activity to our postgraduate teaching, continuing professional development (CPD) and consultancy activities.





Research Manufacturing

Our manufacturing research has developed to integrate decision engineering, manufacturing systems and precision technologies. The Engineering and Physical Sciences Research Council (EPSRC)-supported Cranfield Innovative Manufacturing Research Centre (IMRC) has been central to this integration. The IMRC provides a platform for further integration across the wider university and for continued growth of manufacturing research including Product-Service Systems (PSS).

Decision engineering

Research in decision engineering covers cost engineering, applied soft computing and product engineering which provides facts, techniques and infrastructure required for competitive design.

The Manufacturing Department is the focus of the of the new Centre for Competitive Creative Design (C4D). This is a £5.5m partnership with the University of the Arts London (UAL) that aims to encourage students, lecturers, researchers and industry partners to explore creativity and use design as a core driver to improve innovation and competitive practice in UK and global industries. Core research covers:

- development and manufacturing costs of aero-structures, automotive components and systems such as hydraulics for aircraft
- design optimisation
- applied soft computing
- design information management.

Manufacturing systems

Research in manufacturing systems aims to contribute to practice through innovative research which focuses on complex, real-life industrial issues. We work closely with major global organisations such as Ford, Rolls-Royce, Airbus UK and many small and medium-sized enterprises (SMEs). Core research capabilities in manufacturing systems are:

- computer simulation techniques
- manufacturing operations strategy
- innovation
- electronic task support.

Precision technologies

Cranfield is world renowned for its research in ultra precision technologies. We focus on the design and development of novel machine tools which operate at nano levels of accuracy. Core research capabilities are centred around major projects that include a RCUK Basic Technologies grant for the design, development and build of the Big OptiX (BoX™) grinding machine together with new reactive atom plasma processing technology for the production of large scale optics; the 3D-Mintegration Grand Challenge and the recently established EPSRC £8m Integrated Knowledge Centre (IKC) in ultra precision and structured surfaces.

Key research areas in precision technologies include:

- precision machine technologies including machine tool design
- advanced fabrication processes
- process development including abrasive machining, diamond turning and plasma assisted machining
- micro-engineering including micromachining
- photochemical machining
- metrology.





Image courtesy of Rolls Royce Plc

Research Materials

Our materials research is directed towards processing, properties and performance together with the associated manufacturing technologies.

Composites

Research in materials science of polymer composites focuses on improving the mechanical performance of polymer matrix composites.

We have benefited from substantial investment funding to refurbish our lightweight structures laboratories.



Research activities include:

- through-the-thickness reinforcement of polymer matrix composites
- dielectric monitoring of composite cure
- aerospace resins modified with carbon nanotubes to create adhesive films, gel coats and matrix resins with an entirely new balance of properties.

Research into large scale cost effective manufacture has led to:

- large scale facilities for polymer matrix fibre composite processing
- a unique facility for the lamination of high performance carbon fibre tape
- a resin processing facility, which includes resin transfer moulding and vacuum infusion systems
- several large demonstrator structures such as a commercial aircraft aileron and a complete sports car frame - the first composite vehicle framework world-wide.

Microsystems and nanotechnology

Within microsystems and nanotechnology we offer expertise in functional ceramics and microsystems which complement three overarching projects – an EPSRC platform grant (Nanoscale multiferroic materials and devices) and two EC networks of excellence (MIND- Multifunctional and integrated piezoelectric devices and 4M- Multi-Material Micro Manufacture).

Key areas of research include:

- functional nanoparticle
- thin and thick film processing fabrication
- machining of ceramics
- microscale structuring/direct writing
- finite element modelling of microsystems
- piezoelectric microsystems
- nano-biological interactions
- particle/fluid/electric field interacts
- multiferroic materials
- nano light emitting devices
- micro solid oxide fuel cells
- fabrication of core-shell particles.

Surface science and engineering

Research focuses on coatings and high temperature materials using a variety of techniques to create high temperature coatings. The National High Temperature Surface Engineering Centre is a key partner in the Rolls-Royce University Technology Partnership in this area. Surface engineering facilities have benefited from significant investment, including £1.1m of industrial funding. Our focus is on:

- PVD, CVD coating and plasma spray (LVPS) coating
- EB-PVD thermal barrier coatings
- high temperature oxidation/corrosion, erosion and wear testing
- coating characterisation and evaluation
- life prediction modelling.

Welding

In welding research we have developed capability in arc and laser pipeline welding. We are now a research resource provider to major organisations, including BP and TransCanada, as well as to research and development organisations. Research activity includes:

- high strength pipe steel welding
- hybrid laser/arc process for pipeline welding
- real-time weld quality evaluation
- plasma keyhole welding of high strength aluminium alloys
- laser micro welding
- stress engineering for management of residual stresses and distortion
- friction stir welding.



Research

Natural Resources

Research in Natural Resources focuses on soil and water sciences in the context of land management for food, fibre and bio-energy crops, environmental services and biodiversity, using expertise in biophysical and social sciences and agricultural engineering. The overall aim is the development of knowledge in relation to natural systems and an understanding of their management by human society. The main research themes are land processes, natural resources management and soil.

Land processes

Land processes research is centred around the application of biophysical science to integrated land management. Specific research areas include:

- application of remote sensing and Geographical Information Systems (GIS) to land resources monitoring
- modelling the physical, chemical and biological processes that drive landscape, river and coastal systems
- modelling integrated land and water management in the context of economics and climate change
- applied ecology in the context of ecosystem functions
- conservation and biodiversity as a basis for ecological restoration.

Natural resources management

Natural resources management combines social sciences with applied mathematical and operational research in order to understand the nature of institutions, environmental economics and natural resource systems and their relationship to land management and agricultural production. Research interests include:

- using anthropology and environmental sociology to understand human behaviour towards natural resources
- understanding how institutions regulate relationships between people and their environment, including property rights and entitlements
- the application of economic theory to the validation of natural capital in land and water resources so that capacity for ecosystem services is optimised
- analysing policy, including legal frameworks, regulatory, economic and voluntary measures, and the management of technology, including knowledge exchange and innovation
- urban, rural and agricultural development studies, including sustainable agriculture, rural livelihoods and agri-environmental systems.

Soil

Soil research aims to develop and apply knowledge about the physical, chemical and biological processes within soil and how these provide soil-based ecosystem services, in urban as well as rural settings. Current research includes:

- fundamental studies on soil systems aimed at understanding processes operating at scales from micrometres to kilometres
- inventories and monitoring systems for soil resources using advanced GIS technologies to support soil management, especially in Europe
- soil management and conservation through the application of engineering to improve tillage, erosion and compaction control and water management. This includes sports surface technology and soil-related urban ecotechnology.





Courtesy of LM Glasfiber A/S

Research Sustainable Systems

The Sustainable Systems Department is concerned with managing treatment processes, service systems, utility infrastructures, policy and regulatory processes and the product cycle – more effectively for the future. Research focuses on: automotive technology, energy technology, resource management and efficiency and water science.

Automotive technology

Our automotive technology research focuses on supporting industry with innovative and sustainable research intensive technology solutions, in the key areas of motorsport, road crash-safety and off-road dynamics. Focusing on the end user and life cycle interactions with the environment, our research capabilities are based on advanced technologies and tools:

- simulation-based real world analysis, including physical prototyping, testing and validation
- impact testing, design and rating
- robust optimisation, reliability analysis and stochastic modelling methods
- biomechanics modelling
- mechatronics design and multi-criteria optimisation integration
- materials and composites testing and modelling
- cost-benefit analysis
- Cranfield Impact Centre (CIC), the industrial design office for high added value expertise.

Energy and offshore technology

We undertake leading research in offshore and subsea technology, risk and reliability engineering and advanced power generation technology. We offer specialist expertise in wet and dry renewable energy, biomass and energy from waste, process simulation, diving and underwater technology and offshore materials engineering. Our research covers:

- high-temperature materials
- manufacturing
- advanced combustion technologies
- hot gas cleaning
- process development
- component life modelling for both conventional and advanced power generation systems.

Resource management and efficiency

Our resource management and efficiency research covers waste and related resource management. We are a key contributor to the UK Government's funded Environmental Knowledge Transfer Network (Environmental KTN) in integrated pollution management – IPM-Net. Key research areas include:

- landfill science
- risk assessment and decision making
- amenity impacts
- regulatory science
- sustainable resource recovery
- contaminated land
- new waste technologies
- life cycle engineering
- policy appraisal and implementation.

Water science

Water science research encompasses water and wastewater treatment, engineering, irrigation, governance, water supply and sanitation in developing countries, human dimensions and policy evaluation in relation to water and the natural, human and industrial environments. Research addresses:

- irrigation methods and management
- membranes, including membrane bioreactors (MBRs)
- modelling and decision support
- Natural Organic Matter (NOM)
- risk management and water safety plans
- scaling and corrosion
- micropollutant removal
- stakeholder engagement and participative planning
- water resources management and water recycling
- water supply and sanitation for rural and urban communities.



Education and training

Cranfield University is a wholly postgraduate university with an international community and global reputation. Ranked first in the UK for staff to student ratios, with a top five ranking for student employment on graduation, an excellent rating for teaching and exceptional facilities, Cranfield makes an ideal destination for advancing careers. Our focus is on applied research and developing industry's future engineers, managers, consultants and entrepreneurs.

Masters and research programmes

We offer an extensive range of full and part-time Masters-level courses and research degree opportunities. Students on our full-time courses engage with external organisations through projects, solving real-life problems, resulting in excellent career prospects. Flexible, modular Masters' programmes designed specifically to meet the training needs of industry are ideally structured for professionals wishing to study part-time.

A novel professional qualification – the Master of Technology (MTech) – has been developed in response to the demand for high calibre professionals who possess strong technical knowledge with applied commercially-driven research capability.

In partnership with the University of the Arts London we have developed a new Master of Design (MDes) qualification in the area of design which aims to provide future leaders with an understanding of how to exploit creativity within technology organisations.

Postgraduate-level courses available within Applied Sciences include:

- Advanced Materials
- Agricultural and Environmental Engineering
- Cost Engineering
- Decision Engineering
- Economics for Natural Resource and Environmental Management
- Enterprise System Implementation
- Environmental Diagnostics
- Environmental Management for Business
- Fellowship in Manufacturing Management
- Geographical Information Management
- Innovation and Creativity in Industry
- Innovation and Design for Sustainability
- Innovative Manufacturing
- IT for Product Engineering
- Knowledge Management for Innovation
- Land Management
 - Ecotechnology for Cities
 - Ecological Conservation
 - Land Reclamation and Restoration
 - Natural Resource Management
 - Soil Management
- Manufacturing
 - Engineering and Management of Manufacturing Systems
 - Management and Information Systems
 - Manufacturing Consultancy
- Microsystems and Nanotechnology
- Motorsport Engineering and Management
- Offshore and Ocean Technology
 - Diving Science and Technology
 - Offshore Materials Engineering
 - Offshore Renewable Energy
 - Risk Management
 - Pipeline Engineering
 - Subsea Engineering
- Operations Excellence
- Sports Surface Technology
- Ultra Precision Technologies
- Waste and Resource Management
- Water and Wastewater Engineering
- Water and Wastewater Technology
- Water Management
 - Advanced Irrigation
 - Community Water Supply
 - Environmental Water Management
 - Water and Society
 - Water for Sustainable Agricultural Development
- Water Processes
- Welding Engineering.



Short courses

An extensive range of professional development courses complement our Masters-level teaching. Courses are delivered by our own subject specialists, often supported by external practitioners. Delegates use our accredited short courses in relation to their own continuing professional development (CPD). In addition to our programmes, we develop and deliver bespoke courses tailored specifically to organisations' needs.

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