

Institution: Cranfield University

1. Context and mission

Cranfield is an exclusively postgraduate university focused on technology and management, recognised as a research-intensive specialist institution within the UK Higher Education (HE) sector. Founded in 1946 as the postgraduate-only College of Aeronautics, we became Cranfield Institute of Technology in 1969 through a Royal Charter. The National College of Agricultural Engineering was incorporated in 1975 and the Royal Military College of Science in 1985, prior to becoming Cranfield University in 1993. We operate from two sites: the main campus at Cranfield near Milton Keynes and from the Defence Academy of the UK at Shrivenham, near Swindon.

Cranfield’s Mission is to create leaders in technology and management, unlocking the potential of people and organisations by partnering with business and governments to deliver transformational research, postgraduate education, and professional development (www.cranfield.ac.uk/about/about).

Our high-level academic organisational structure **embeds interdisciplinarity by having market sector focussed Themes, rather than Departments** that are typical of a conventional, discipline-led university. The eight Themes are Aerospace, Defence & Security, Energy & Power, Environment & Agrifood, Leadership & Management, Manufacturing, Transport Systems and Water. These Themes are in four Schools as budgetary groups: Cranfield Defence and Security (CDS), School of Aerospace, Transport and Manufacturing (SATM), School of Water, Energy and Environment (SWEE), School of Management (SoM); which are supported by a unitary framework of professional service units (PSUs). Each is led by a Pro-Vice-Chancellor (PVC) who is a member of the University’s Executive, reporting directly to the Chief Executive and Vice-Chancellor (Fig. 1). The PVC Research & Innovation and PVC Education take a pan-University leadership role including the Profession Service Units (PSUs) directly supporting research and innovation and education activities, whilst PVC International has been a dual role for one of the PVC-Schools.

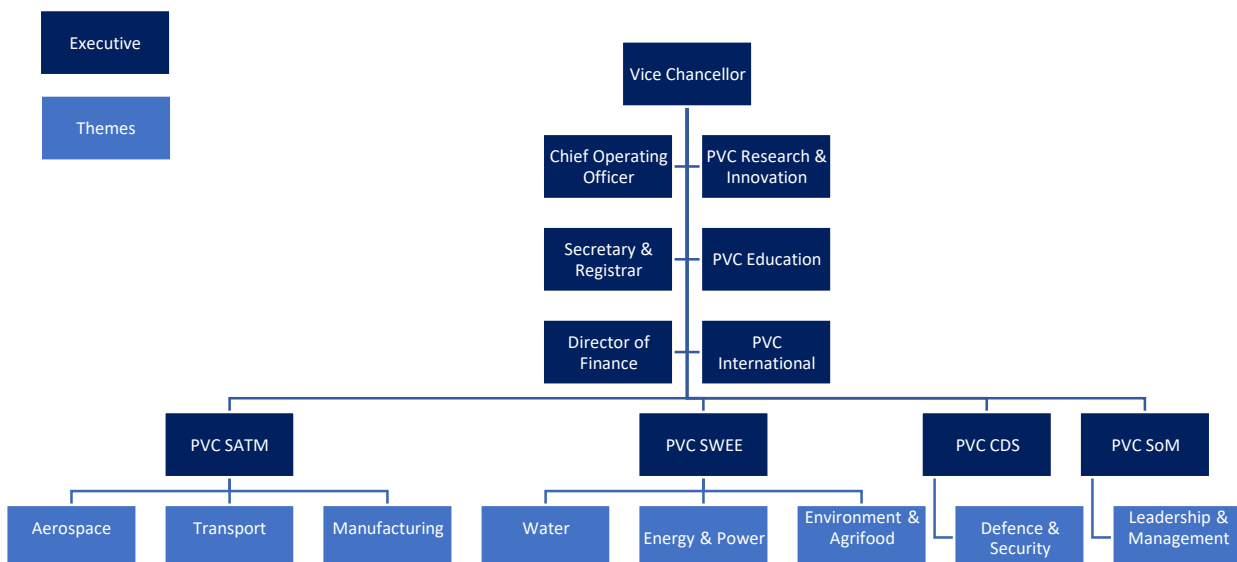


Figure 1: High level academic line management structure of Cranfield University, showing members of the Executive, PVC - Schools and interdisciplinary Themes (<https://www.cranfield.ac.uk/about/senior-team/senior-management>).

In 2019/20, Cranfield’s income was £184.6M, with £38.4M from research contracts (as reported to HESA). Total postgraduate student numbers were 7,095, with 5,989 registered for taught Master’s degrees (48% part-time) and 1,040 studying for doctoral research degrees (27.0% part-time); 48.9% of research students were from the UK, 17.1% from EU countries and 34.0% from the rest of the world. As of July 31st, 2020, 367 (348.05FTE) academic staff and researchers have responsibility for independent research: only 20 (5.4%) were on fixed-term contracts. Therefore 100% were submitted to REF2021 across three UoAs: 40 (38.21FTE) UoA 6, Agriculture, Food and Veterinary Sciences; 285 (269.74FTE) UoA 12, Engineering; 42 (40.10FTE) UoA 17 Business and Management. Of those submitted, 76 (21%) were Early Career Researchers (ECRs) and 37 were Independent Researchers. A further 243 research staff, mainly Post-doctoral Research Assistants, termed Research Fellows (RFs) at Cranfield, supported by 113 specialist technical staff, help deliver our research.

We are a specialist institution and have always considered that the impact of our research is mainly through our industrial collaborators, nationally and internationally. However, since 2014 Cranfield has engaged proactively with the local economy with significant impact (Figure 2). We co-operate with the South East Midlands Enterprise Partnership (SEMLEP), located on our Technology Park, with £14.9M of funding awarded since 2014 to stimulate the local economy. Within the Central Bedfordshire Unitary Authority, we are the second largest employer at the core of their 2050 vision (www.centralbedfordshire2050.co.uk/) and local economic development plan; in particular, our research in manufacturing, food and the green economy. Cranfield’s main campus borders the Milton Keynes Unitary Authority; Cranfield is the lead for the development of MK:U – a digitally and business focused undergraduate offering and feeder university in the heart of this fast growing city.

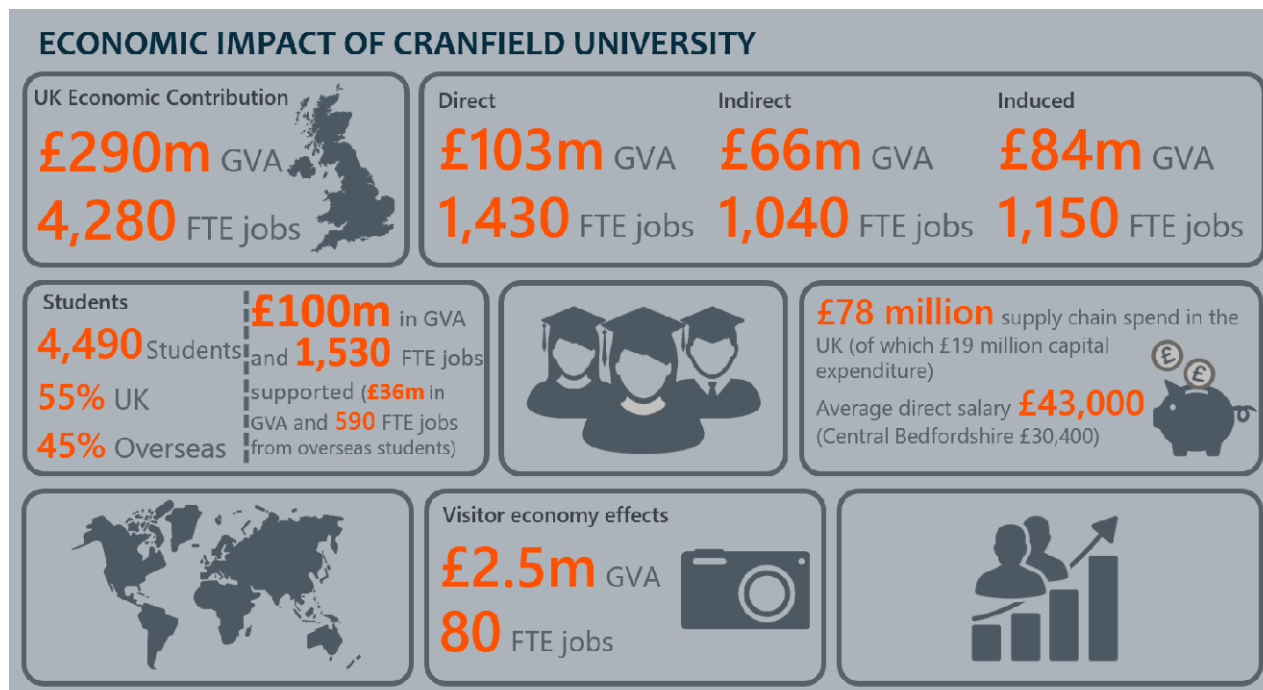


Figure 2. Cranfield economic impact (Hatch Regeneris, 2020).

Cranfield is a member of two regional University groups:

- Midlands Innovation (MI), a research partnership with Aston, Birmingham, Keele, Loughborough, Leicester, Nottingham, Warwick (www.midlandsinnovation.org.uk)

- The Oxford to Cambridge Arc Universities Group (AUG) with Oxford, Oxford Brookes, Northampton, Bucks New, Open, Bedfordshire, Anglia Ruskin, Cambridge (www.arcuniversities.co.uk/)

Cranfield is in Peer Group B (research income 15% or more of total) for TRAC classification (<https://www.trac.ac.uk/wp-content/uploads/2018/10/Annex-4.1b-TRAC-Peer-groups-2017-18.pdf>). **Cranfield's singular status among UK HE Institutions is illustrated by our classification as the sole Engineering university** in the specialist STEM peer group - one of 8 'clusters' - for the Knowledge Exchange Framework (KEF) (<https://re.ukri.org/documents/2019/kef-consultation-and-pilot-outcomes-publication-pdf/>).

2. Strategy

Cranfield's research priority is "to be recognised for outstanding transformational research that meets the needs of business, government and wider society" (www.cranfield.ac.uk/research/rio/research-strategy). This is one of four strategic priorities; together with providing a premier learning experience to enhance individuals and organisations; growing as a sustainable enterprise; and renown for impact - regionally, nationally and internationally. These priorities launched in 2014 within a 5-year Corporate Plan, reaffirmed in 2019 (www.cranfield.ac.uk/about/about).

Research at Cranfield focusses on interaction with businesses to co-create new knowledge by addressing their strategic research agendas. This is a distinctive focus: **our engagement with business being proportionally more than three times greater than that of the universities average** (35% of research income compared to the sector average of 11% - HESA Finances of HE Institutions 2018/19). Our overall impact is exemplified by winning the Queens Anniversary Prize in Further and Higher Education 6 times since 2005 – three times since 2014 for aerospace, soil, and water (<https://www.cranfield.ac.uk/about/rankings-and-awards/queens-anniversary-prize>)

Research and innovation strategies were rethought in 2014 with standalone Research (www.cranfield.ac.uk/research/rio/research-strategy) and Knowledge Exploitation (www.cranfield.ac.uk/research/rio/knowledge-exploitation-strategy) strategies. Each Theme has a research strategy (www.cranfield.ac.uk/research/why-cranfield/theme-research-strategies) to support an individual's academic freedom to pursue fundamental and applied research topics. Headline outcomes for the REF2021 period include:

- Building on the success of sector-focused Themes, emerging before REF2014, now embedded for line management. This unique structure enables better delivery of transdisciplinary research, e.g., engineers, creative designers and microbiologists undertaking the multi-award winning Gates Foundation nanomembrane toilet project (www.cranfield.ac.uk/case-studies/).
- Strengthening research support by creating a Research and Innovation Office (RIO) in 2014 (www.cranfield.ac.uk/research/rio). Consequently, research income has grown, e.g., consistently top 10 of InnovateUK funded universities.
- Increasing research infrastructure investment (c£100M on capital facilities committed since 2014) to expand Cranfield's large, near industrial-scale national facilities. Examples of UKRI and industry co-funded initiatives include:
 - Research Partnership Infrastructure Fund (RPIF) Aerospace Integration Research Centre (AIRC), (www.cranfield.ac.uk/centres/aerospace-integration-research-centre) (£35M*)

- Agri-Tech Centre on Agricultural Engineering Precision Innovation (Agri-EPI) (www.cranfield.ac.uk/themes/environment-and-agrifood/centres-for-agricultural-innovation) (£10M*)
- UK Collaboratorium for Research in Infrastructure and Cities (UKCRIC) Water Hub (www.cranfield.ac.uk/themes/water/improving-the-resilience-of-infrastructure-and-cities) (£7.2M*)
- RPiF Digital Aviation Research and Technology Centre (DARTEC) (www.cranfield.ac.uk/centres/digital-aviation-research-and-technology-centre) (£6.7M*)

*including operational research expenditure

- Enhancing engagement with industry strategic research partners, e.g. the first with a restyled BAE Systems Strategic Partnership (www.cranfield.ac.uk/press/news-2016/cranfield-university-the-first-to-sign-strategic-framework-agreement-with-baesystems); one of three UK Unilever Science Grid universities.
- Improving the research environment by embedding best practice resulting from implementing formal institutional-level quality certification and concordats, e.g., ISO45001 health and safety accreditation, Athena SWAN Bronze award, HR Excellence in Research (HREiR) (www.cranfield.ac.uk/about/working-at-cranfield/diversity).

Our priority for transformational research continues for the next five years. We will:

- Build on recent infrastructure investment through research procurement with industrial partners, developing researchers and growing staff diversity.
- Develop our research staff; examples include recruiting 75th Anniversary Research Fellows and Research England Development (RED) fund TALENT technician programme (www.mitalent.ac.uk).
- Increase research efficiency through co-operation, e.g., equipment sharing and technical staff development through MI.
- Stimulate further transdisciplinary research through Grand Challenges (www.cranfield.ac.uk/research/why-cranfield/grand-challenges).
- Grow international co-operative research with strategic partner institutions.

Recognising Cranfield's business-focussed mission, the Research Strategy informs a Knowledge Exploitation Strategy (KES) to enhance delivery of impact through '3i's' – industry, individuals, and investment (www.cranfield.ac.uk/research/rio/knowledge-exploitation-strategy). We seek impact for industry from start-ups, through SMEs, to large multinationals. Individual academics, researchers and students are encouraged to protect and exploit Intellectual Property (IP). We only seek a long-term return on investment. Cranfield's knowledge exchange strategy was commended by HEFCE with ten priority objectives (<https://webarchive.nationalarchives.gov.uk/20180405122213/http://www.hefce.ac.uk/ke/heif/strategies/>). Entrepreneurship is encouraged: staff and doctoral students learn about commercialisation through activities including Start-up Weekend and the Ideas to Innovation (i2i) programme (www.cranfield.ac.uk/business/entrepreneurship). A pre-seed fund, financed entirely by Cranfield alumni, aids student-led start-ups. Our incubator is Cranfield Eagle Lab, a unique partnership with Barclays Bank offering co-working and 'makerspace' for start-ups (www.labs.uk.barclays/locations/cranfield). Among recent spinouts are Corrosion Radar, Herotech8 and WAAM3D (www.cranfield.ac.uk/business/develop-your-technology-and-products/spin-out-and-start-up-companies).

Research integrity

Cranfield committed to the 2012 (and 2019 update) Concordat to Support Research Integrity through:

- A Research Integrity Policy and underpinning policy and implementation plans (www.cranfield.ac.uk/about/research-integrity).

- An annual statement submitted to the University's Council, made public.
- All relevant research complying with the Joint Code of Practice for Research (JCoPR).

An ethical culture underpins research integrity with ethical approval required for all research (www.cranfield.ac.uk/about/research-integrity).

- The Cranfield University Research Ethics Committee (CUREC) oversees delivery of the Research Ethics Policy with a Human Tissue Act sub-committee and representation on a Defence Academy Scientific Advisory Committee for MODREC.
- All 'nil ethical risk' projects are logged in addition to those requiring scrutiny.
- All research undertaken on Master's degrees requires ethical approval.
- Perceived bureaucratic burden for compliance is reduced through the bespoke Cranfield University Research Ethics System (CURES).
- The Responsible Research Evaluation Policy reflects principles of statements such as the Leiden Manifesto to ensure ethical use of research metrics.

Cranfield's open research environment builds upon our Research Integrity Policy (www.cranfield.ac.uk/about/research-integrity):

- All research requires data management plans conforming to the Management of Research Data Policy: updated as required by the Research Data Management Strategy (www.cranfield.ac.uk/about/governance-and-policies/policies-and-regulations).
- Since 2016, data can be stored on the bespoke Cranfield Online Research Data (CORD) repository (<https://cord.cranfield.ac.uk>) when no suitable external repository exists. Over that time, there were 999 uploads across the three UoAs. Over 12 months to February 2021 there were around 530,000 views and 281,000 downloads.
- Perceived bureaucratic burden is reduced through support of CORD by a Research Data Manager.
- The Cranfield Research Information System (CRIS) is the central repository of research outputs and related information.
- All research staff and students can have a CRIS profile, which feeds their Cranfield webpage.
- Research Outputs are added to our open access repository, CERES (<https://dspace.lib.cranfield.ac.uk>), to ensure compliance with our Open Access Policy.
- Open access publishing is supported by individual publisher deals, UKRI funding and payment of Article Processing Charges when there is an industrial co-author.

Cranfield's Public Engagement Policy (www.cranfield.ac.uk/about/governance-and-policies/policies-and-regulations) conforms to the Concordat for Engaging the Public with Research and as a Manifesto for Public Engagement signatory.

Support for interdisciplinary research

Interdisciplinary research support is embedded through the Theme-based line management structure. Cranfield's distinctive longstanding business focus has long driven us to develop interdisciplinary interaction, stimulated through co-location of Theme staff from different science and engineering disciplines. Cranfield further supports interdisciplinarity through four Grand Challenges linked to the UN Sustainable Development Goals: Connected Resilience; Smart Living; Green Technologies; Security for Development (www.cranfield.ac.uk/research/why-cranfield/grand-challenges). We also have a 'bottom up' mechanism for academics to co-operate across disciplines through formation of Networks with support from RIO, e.g., Materials, Hydrogen (www.cranfield.ac.uk/research/rio/hydrogen-research-network)

Research partnerships

Cranfield particularly values industry partnerships; we have 14 formal, high-level industry strategic partnerships. Our partnership with Severn Trent has been rated one of the top 100 university-industry partnerships in the world (www.cranfield.ac.uk/press/news-2018/cranfield-and-severn-trent-one-of-top-100-global-partnerships). In addition to the BAE Systems partnership noted above, Cranfield is an Airbus Global University Partner, has a Rolls-Royce University Technology Centre - and the £35M Airbus/Rolls-Royce AIRC. We are a strategic partner of PepsiCo. Cranfield is one of only 5 universities with a strategic partnership with AWE (www.cranfield.ac.uk/press/news-2016/awe-renews-strategic-alliance-with-cranfield) and one of only few universities with a Defence Science and Technology Laboratory (Dstl) strategic relationship. Babcock, Boeing, P&G, Safran, Siemens, Spirit Aerosystems and Thales are strategic partners.

We frequently partner with UK universities, 45% of our £42.8M UKRI grants at July 31st 2020 were in partnership with 143 universities (53 in the UK), e.g. the £160M Energy Research Accelerator (ERA) with our 7 MI partners (www.era.ac.uk); UK Aerospace Research Consortium with 9 universities (www.cranfield.ac.uk/press/news-2018/leading-universities-unite-to-strengthen-uk-aerospace-sector); Agri-EPI with 6 universities (www.agri-epicentre.com/membership/network/). We collaborate with >100 universities in EU funded consortia.

Our international strategic university research partners are selected for their technology and industry focussed missions (www.cranfield.ac.uk/about/international-partnerships). In Europe, we have formal double degree arrangements with 111 European institutions in 18 countries. Research relationships with a select few of these – three French Engineering Grandes Ecoles in France (Université de Technologie de Compiègne, ESTACA, and ESTIA) and two Spanish Universidad Politecnicas (Catalyuna and Madrid) - have joint PhDs. In China, we have a Ministry of Education approved Sino-UK Joint Institute with Jiangsu University (www.cranfield.ac.uk/press/news-2020/cranfield-partners-with-jiangsu-university-to-accelerate-the-green-economy). We are building research capability in agri-technology for North Africa with Mohamed VI Polytechnic, Morocco (Environment & Agrifood Theme). Strategic partnerships at an earlier stage include Purdue University, USA (Defence & Security, Environment & Agrifood), Royal Melbourne Institute of Technology, Australia (Water) and NTU Singapore (Manufacturing).

3. People

Staffing Strategy

Cranfield's values of ambition, impact, respect and community are at the heart of our staffing strategy (<https://www.cranfield.ac.uk/about/working-at-cranfield>), developed through active staff engagement (<https://www.cranfield.ac.uk/about/about/values>).

For academic staff, Cranfield has two main career pathways; on both there is the opportunity for promotion to Professor.

- Research and Teaching: within this pathway, we provide career flexibility with research only appointments such as Senior and Principal Research Fellows (SRFs, PRFS), equivalent to Lecturer and Senior Lecturer/Reader respectively, who are independent researchers. 100% of 354 academics (335.05FTE) are submitted to REF2021.
- Education and Scholarship: within this pathway there is no responsibility for research. The majority of staff on this teaching only pathway deliver specialist executive education and professional development programmes for business and military personnel.

For delivery of our research as a distinctive business focussed, postgraduate-only university, we need academics who are able to win the confidence of industry clients for their research, as well as pursuing fundamental research. As such, we aspire to develop our own RFs to become Cranfield academics:

- Of 76 ECRs submitted, 54% were 'home-grown', having previously been Cranfield RFs or are RFs identified as independent researchers.
- Of the 151 Research and Teaching academics appointed during the REF2021 period, 21% had originally joined Cranfield as RFs.
- Of the 185 staff employed as researchers, from RF to PRF, 37% are on Open Ended ('permanent') Contracts (OECs).
- Exceptionally talented RFs have the opportunity to be appointed as Academic Fellows (AFs) on a 5-year contract with the expectation of promotion to Lecturer: 5 independent researchers submitted to REF2021 are AFs.
- We also recruit exceptional ECRs from the UK and internationally through Cranfield's £6M 75th Anniversary Fellowship Scheme (www.timeshighereducation.com/hub/p/cranfield-universitys-fellowship-scheme-tackling-problems-future). The scheme will support up to 30 early career fellowship positions from September 2020.

Cranfield provides comprehensive support for staff in terms of flexible working:

- Study leave is available to all. Academics can take sabbatical periods by agreement with line managers. Aligned to our Mission, we particularly encourage sabbaticals to industry and governments; e.g., mid-career academics joining the Flemish Government and an ETH-Zurich spin-out.
- Our Flexible Working Policy and Procedures (www.cranfield.ac.uk/about/working-at-cranfield/diversity) support formal and informal agreements for staff, regardless of length of service. From a 2020 staff survey, 45% of staff worked flexibly through an agreement.
- A comprehensive Supporting Carers at Work Policy uses a 'Carers Passport'.
- All staff have the opportunity to progress their careers, regardless of working patterns and hours.

As a Concordat to Support the Career Development of Researchers signatory, support for research careers from ECRs to Professors is implemented through actions in our HREiR and subsequently, Researcher Development Concordat, plans (<https://www.cranfield.ac.uk/about/rankings-and-awards>).

Staff development and support

Staff development is underpinned by a long-established annual Performance and Development Review (P&DR), which was updated, following staff consultation, to an online system in 2016. Along with reviewing key objectives and deliverables, the new process enables individuals to discuss and set personal career goals and identify training, in collaboration with their line manager. Widespread engagement with the process is shown by the 93% participation in 2019. To support staff ambitions, we provide comprehensive professional development, including bespoke programmes to enhance research skills and knowledge for all career stages.

- The Postgraduate Certificate in Academic Practice (PgCAP) is accredited by Advance HE. All new academic staff without existing Advance HE recognition are expected to enrol. The focus is on postgraduate education that includes research-informed teaching and research student supervision. The PgCAP is also made available to all FTC RFs who wish to develop academic careers. Of 153 RFs on FTCs at 31st July 2020, 52% had applied for and been offered a place on the PgCAP.
- All staff have the opportunity to develop through an apprenticeship, which can include award bearing programmes such as a part time MBA. To date, almost 50 staff have registered for an apprenticeship.
- A tailored career development programme based on the established VITAE National Researcher Development Framework is available to all staff and particularly promoted for RFs and ECR academics. A minimum of 10 days a year continuing professional development is mandated.
- ECRs are represented in research governance processes, e.g., Research Committee, providing development opportunities.

- A bespoke programme delivered by RIO supports ECRs and more senior academics to apply for fellowships. Those interested receive coaching from experienced academics which has resulted in an increase in successful applications, e.g., European Research Council (ERC), Royal Academy of Engineering (RAEng) Fellowships.
- As a signatory to the Science Council's Technician Commitment (<https://www.cranfield.ac.uk/about/working-at-cranfield/technician-commitment>), Cranfield recognises technical staff make a vital contribution to research. Access to bespoke training and secondments across MI universities is available through the £5M Research England Development (RED) Fund TALENT programme promoting technician careers (<https://www.mitalent.ac.uk/Home>).

The RIO provides workshops on raising awareness of funding sources and supports industrial research relationships; identification, development, and submission of funding opportunities; Intellectual Property (IP) and commercialisation; and incubation services for start-ups and spin-outs. All new research and academic staff have a mentor from another Theme. This has been extended to provide specific, specialist mentoring, e.g., writing journal publications, peer review of research proposals.

We have developed a **wellbeing strategy that goes further than just maintaining mental health** of staff and students. It captures Cranfield's proactive commitment to managing everyone's health and wellbeing and covers the range of health promotion initiatives e.g., over 80% of line managers participated in the promoting wellbeing in the workplace training in 2019. Our programme of wellbeing activities includes sessions on mental wellbeing and stress management, women's health, men's health, mindfulness and resilience, and menopause at work.

Equality, diversity, and Inclusion

Cranfield's Charter embeds equality of opportunity (www.cranfield.ac.uk/about/governance-and-policies): we aim to go beyond requirements of the Equality Act 2010. The Equality, Diversity, and Inclusion (ED&I) Strategy promotes a positive learning, teaching and working environment for all staff and students, irrespective of background, with annual progress reporting to the University's Council (www.cranfield.ac.uk/about/working-at-cranfield/diversity). We are committed to promoting work-life balance, joining Working Families (1 of 13 universities) (<https://www.workingfamilies.org.uk/>). They endorsed our Flexible Working Policy and ran a workshop on for our Senior Management Team in 2019. We participated in their benchmarking surveys in 2019 and 2020: we were in the top 40 organisations, with a number of our policies highlighted as demonstrating best practice.

Since 2014, Cranfield has renewed its focus on progressing the ED&I agenda. We recognised that females were under-represented in senior academic roles. Whilst females make up 22% of academics, 23% of the successful promotion cases to our 2020 Senior Academic Promotions Board were female. We have a detailed action plan to address female under-representation:

- We achieved an Athena SWAN Bronze Award at institutional level in 2017 with a further award in 2020, valid for five years (www.cranfield.ac.uk/about/working-at-cranfield/diversity).
- We are signatories to Women in Aviation and Aerospace (WiAA) (www.cranfield.ac.uk/press/news-2018/pledge-for-gender-balance-across-aviation-aerospace--and-defence-sectors) and Women in Defence (www.womenindefenceuk.com).
- We are the only UK university to sponsor International Women in Engineering Day (www.inwed.org.uk).
- We have revised recruitment processes to ensure they are inclusive and bias-free e.g. changing language, signposting flexible working opportunities in advertisements, ensuring recruitment panel diversity and appropriate training.

- Significant numbers of female staff have attended Advance HE's Aurora programme, Cranfield's Women as Leaders programme and our Step-Up women's network.

In terms of going beyond our obligations under the Equality Act, we:

- Have mandatory ED&I training for all staff, including unconscious bias and flexible working (www.cranfield.ac.uk/about/governance-and-policies/policies-and-regulations). We regularly update our ED&I Intranet page.
- Became a Level 1 'Disability Confident' employer in 2018, achieving Level 2 in 2020.
- Joined the Business Disability Forum (1 of 21 universities) who provide advice on supporting disabled staff and students; they inputted to our updated Staff Disability Policy and Procedure (www.cranfield.ac.uk/about/working-at-cranfield/diversity).
- Have developed our BAME agenda to help attract and retain BAME staff. We recently commissioned independent research into the perceptions of BAME people in local communities as an employer, as well as BAME staff. Research findings will identify potential barriers and inform our BAME Action Plan.
- We are one of twelve Founding Partners of the 'Change the Race Ratio' campaign to increase BAME participation on Boards (www.changetheraceratio.com). Of >50 signatories, we are the only university.
- Joined Stonewall in 2020 to progress our LGBT+ agenda and policies.
- Have trained a number of staff to become mental health first aiders to help staff and students in crisis and support their wellbeing.

Cranfield embedded ED&I in the formulation of its REF submission as described in its Code of Practice (CoP) (www.cranfield.ac.uk/research/why-cranfield/research-excellence-framework).

Independent REF Strategy and Operational Boards were convened, chaired by a senior member of academic staff and with academics from all the Themes, the Head of ED&I and other support staff. All those on the Boards undertook REF-specific ED&I training to mitigate bias and ensure decisions were fair and inclusive. A comprehensive communication plan, including using all available internal channels, ensured staff engagement for the CoP consultation. The University Executive was the final decision-making body for all aspects of the REF2021 submission: members received bespoke ED&I training that specifically addressed REF issues. An equality impact assessment was undertaken throughout the REF process with no evidence of bias emerging.

Support and training of research students

Since 2014 we have revised research degree provision to ensure standards and improve student experience. The Postgraduate Research Experience Survey (PRES), overseen by AdvanceHE, is a key tool to gather feedback to inform improvements. We have participated in PRES since the 2007 pilot. In 2019 the participation rate was 56.9%, above the national average of 42%. Changes introduced include:

- Forming a student experience PSU to improve the learning environment for all students, including research degrees.
- Ensuring that views and suggestions of students are collated through several communication channels, including surveys, social media and membership of bodies such as Senate, Research Committee.
- Embedding student participation through 'Student Voice' in a new Student Charter, feeding into formal decision-making committees of Cranfield, e.g., Research Committee to improve research degrees (<https://www.cranfield.ac.uk/about/student-charter>).

- Integrating improvements to the student experience into the annual Academic Plan, approved by the University's Council.
- Enhanced training for supervisors, appointment of two supervisors and improving progress monitoring to help focus on intellectual contribution and timeliness, as well as reducing bureaucratic burden.

Introduced in 2016, the Cranfield Doctoral Network (CDN) brings together research students and staff across the University to share experiences, learn from others and broaden research knowledge (www.cranfield.ac.uk/research/research-degrees/cranfield-doctoral-network). Within the CDN are eight Thematic Doctoral Networks (TDNs), aligned to each of Cranfield's Themes, with programmes of events, many offered across the CDN to encourage interdisciplinarity.

The Doctoral Researchers' Core Development (DCRD) programme, based on the established VITAE National Researcher Development Framework, started before 2014 (www.cranfield.ac.uk/study/centre-for-andragogy-and-academic-skills). It uses workshops, webinars, online material and other resources linked to key stages of the research journey from starting, through researching to completion. Supervisors are mandated to ensure students take full advantage of the programme, which also ensures that doctoral graduates prepare for careers beyond academia. Success of this aim is confirmed by the Destination of Leavers from Higher Education (DHLE) surveys for the 3 years 2014-2016: only 1.6 % of 223 Doctoral graduates were unemployed after 6 months. Of the 88.5% in employment, 46% had university research posts.

Cranfield co-operates with other UK universities to support research students through Centres for Doctoral Training (CDT) or Doctoral Training Partnerships (DTP), funded by AHRC, BBRSC, EPSRC, ESRC and NERC (www.cranfield.ac.uk/research/research-degrees/doctoral-training-centres). The university delivers its own EPSRC DTP with studentships across the seven technical Themes. In 2019 an agricultural technology CDT was started in partnership with Mohammed VI Polytechnic University, Morocco, and Rothamsted Research.

The proportion of BAME research students increased from 44.7% in 2017 to 50.0% in 2019.

4. Income, infrastructure, and facilities

Administrative support for research

As part of the implementation of the Corporate Plan 2014-19, the Research and Innovation Office (RIO) was set up in August 2014 to deliver a step-change in research support (www.cranfield.ac.uk/research/rio). Research Committee was created, with wide academic and student representation, managed by RIO and reporting into Senate, focussing on improvements to the research environment. Concurrently, a senior Professor was appointed as Director of Research for each Schools to ensure implementation of changes as part of the annual academic plan reported to Council.

Researchers at all levels are treated as valued internal clients by RIO helping to engage participation of academics, RFs, and research students. Services provided are communicated via the intranet and collated in the Researchers Handbook (www.cranfield.ac.uk/research/rio) e.g., crafting proposals, liaising with industry partners, and delivering impact. RIO was the Association of Research Managers and Administrators (ARMA) research team of the year in 2017. The total value of new research contracts signed in 2019-20 was £46.2M, up by 49% from £31.1M in 2015-16. One staff member is undertaking the ARMA Certificate in Research Management, another is an ARMA mentor and RIO runs sessions at the annual ARMA conference.

Health, safety, and environmental infrastructure

Cranfield adheres to the highest standards for health, safety, and environment (www.cranfield.ac.uk/about/governance-and-policies/policies-and-regulations). Health and safety (H&S) is supported by a central H&S team of 9 professionals and a Board for Energy and Environment oversees our ambitious carbon reduction targets

(www.cranfield.ac.uk/about/environmental-credentials) to achieve net zero by 2030. All university operations are accredited with internationally recognised standards used by industry:

- ISO45001, previously OHSAS18001, for H&S - the only university in England with institutional accreditation.
- ISO5001 Energy Management.
- ISO14001 Environmental Management System (EMS).

Facilities

Cranfield has a range of unique research facilities, often at or near industrial-scale, to deliver the mission of transformational research that meets the needs of business, government and wider society. The majority of our facilities are made available to third parties

(www.cranfield.ac.uk/facilities) and Cranfield is one of 52 universities signed up to the national equipment sharing service (www.equipment.data.ac.uk).

As a consequence, Cranfield has made a step change in ambition to provide more unique, large-scale facilities through research infrastructure investment, commissioning capital projects totalling £100M. Future developments were summarised in the Cranfield campus Masterplan (www.cranfield.ac.uk/press/news-2016/investing-in-the-future) which incorporates the campus as a Living Laboratory, further development of the airport as a research facility and investment in state-of-art analytical equipment. These initiatives have resulted in 14,900m² of new research facilities being commissioned, representing an expansion of 11.5% compared to that available in 2014.

Cranfield is taking advantage of its own airport, roads, wastewater treatment works and solar power farm as a Living Laboratory. A key component of the Living Laboratory is the Cranfield Urban Observatory with instrumented infrastructure as part of the UKCRIC (www.cranfield.ac.uk/facilities/urban-observatory). Full-scale facilities commissioned since 2014 include the £10M Multi-User Environment for Autonomous Vehicle Innovation (MUEAVI) (www.cranfield.ac.uk/facilities/mueavi), the Digital Air Traffic Control Centre (www.cranfield.ac.uk/facilities/digital-air-traffic-control-centre) and the UKRIC Urban Water Innovation and Test Facilities (www.cranfield.ac.uk/themes/water/improving-the-resilience-of-infrastructure-and-cities).