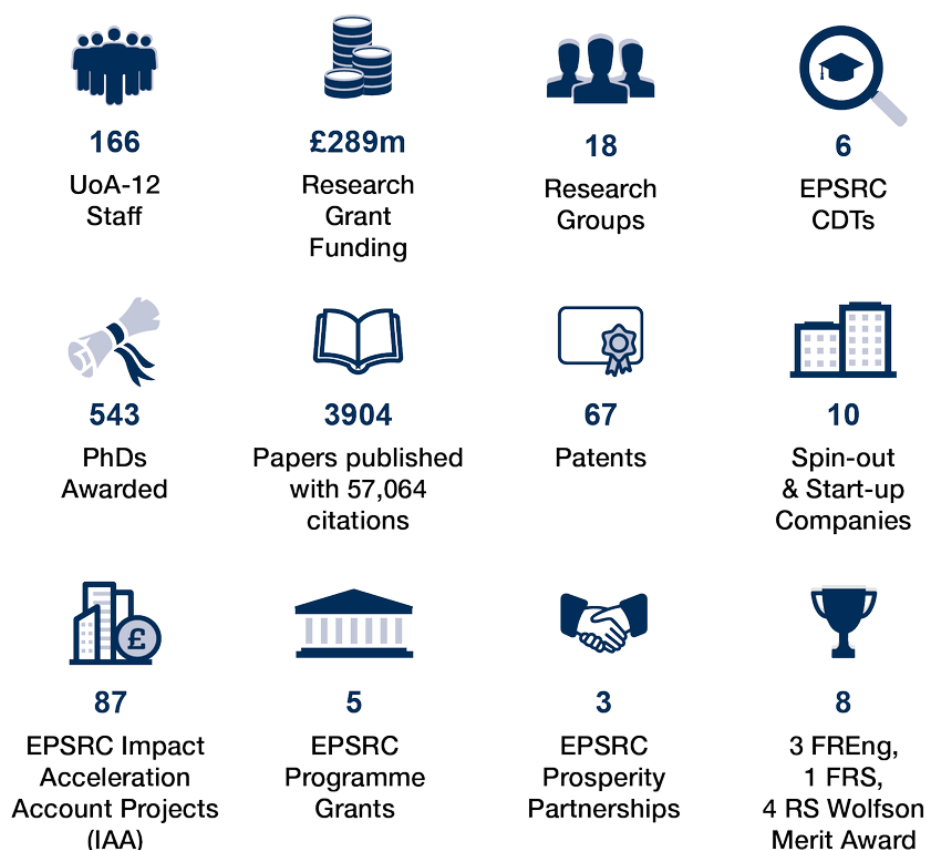


<b>Institution: University of Bristol</b>
<b>Unit of Assessment: 12: Engineering</b>
<b>1. Unit context and structure, research and impact strategy</b>

### Overview

**The Faculty of Engineering at the University of Bristol (UoB) is a vibrant centre for research and research-led educational excellence making a positive impact in the world. We have an environment and culture where research excellence and impact are paramount and where people and ideas are valued, nurtured and encouraged to flourish. We are a thriving community of internationally recognised scholars, using world-class facilities to provide excellent training to the next generation of engineering researchers. We actively collaborate across disciplines and with enterprise partners to maximise our research legacy.**

In UoA12 we make transformative contributions to societal and industrial challenges, including in energy, environmental sustainability, transport, materials and manufacturing, next generation digital technologies, healthcare and well-being, and international development. Over the REF period we have developed an ambitious growth strategy, improved diversity of appointments, and invested in our people, research training, facilities and infrastructure. Through Centres of Excellence, we have demonstrated our critical mass and ambition, enabling us to secure major grants, resulting in over £289m of funding from Research Councils, industry and the EU. We have increased our entrepreneurship and impact activities, especially through the establishment of the Quantum Technology Enterprise Centre and via SET-Squared (the University's incubator), resulting in 10 companies incorporated in the REF period and 67 patents pertaining to UoA12. Our portfolio of Centres for Doctoral Training (6 of which are led by the Faculty) has created a focus for our training of postgraduates, setting them up for their own career paths which have included obtaining personal fellowships, going into industry and setting up their own businesses.



**Figure 1:** Overview of UoA12 over the REF Period.

In UoA12 we are submitting 59 Professors (6 female), 18 Associate Professors (3 female), 40 Senior Lecturers (5 female), 33 Lecturers (4 female), 8 Research Fellows (1 female), and 8 Senior Research Associates (RA) (1 female), who lead a research community of 144 RAs. An overview of our achievements is presented in Figure 1. Our research grant funding in Figure 1 captures our BIS Research Council, UK, EU and Non-EU funding sources over the REF period (detailed in the REF4b data).

Due to the word limit and large size of our submission, we have adopted the approach of using **Examples** throughout the document to illustrate specific actions, initiatives or outcomes that give a flavour of the collegiate environment supporting our research and impact strategy.

### Research Structure

Our UoA12 research activities are primarily managed within 18 research groups which provide intellectual stimulation and opportunities for collaboration as well as a nurturing and supportive environment for people to flourish. They also act as a conduit of research and career advice and information to group members from the wider School, Faculty and University. Heads of Group are selected for the strength of their vision for the role, their research standing and their leadership skills. Leaders assume responsibility for maintaining a productive and highly supportive research environment and for coordinating and facilitating activities and interactions. A key aspect of the role is to ensure strong support for the career development of Early-Career Researchers (ECR).

## Unit-level environment statement (REF5b)

To promote the Faculty's work externally we use eight themes to articulate our research expertise, four of which are challenge focused: Energy & Environment; Health & Living; Networks & Security; Transport & Infrastructure, and four of which are technology focused: Advanced Computation & Quantum Technologies; Artificial Intelligence & Data Science, Materials & Manufacturing; Robotics & Autonomy.

Over the REF period, we have continued to build interdisciplinary critical mass in our areas of key strength through five Centres of Excellence: the Bristol Composites Institute, Smart Internet Lab, Quantum Engineering Technology Labs (QETLabs), Bristol Robotics Laboratory (BRL) and South West Nuclear Hub.

### Bristol Composites Institute (Director: Wisnom)

Established in 2017, building on the 10-year track record of the Advanced Composites Collaboration for Innovation and Science, the Bristol Composites Institute (BCI) has a world leading position in composites research and education, combining cutting edge fundamental science with strong industrial links for technology transfer.



**Figure 2: Overview of BCI Centre of Excellence during the REF Period.**

The Institute has 26 core staff with over 200 researchers and postgraduate students and is home to a Centre for Doctoral Training (CDT), an Industrial Doctorate Centre (IDC), the Rolls-Royce UTC (RR-UTC) in Composites, the Future Composites Manufacturing Hub (jointly led by Nottingham), as well as several other major research activities funded by industry, EPSRC and the EU. It works

## Unit-level environment statement (REF5b)

closely with the University-owned National Composites Centre (NCC, part of the network of High Value Manufacturing Catapult) to expedite technology transfer. Two companies, Actuation Lab (2018) and iCOMAT (2019) have been spun out from the University by former PhD students from the Institute. The Institute's performance during this REF cycle is given in Figure 2 above, with further specific details provided in [Example 1](#), page 9.

### Smart Internet Lab (Director: Simeonidou)

Established in 2015, the Smart Internet Lab is one of the UK's most renowned Information and Communications Technology centres' offering a holistic approach to hardware and software co-design. Specifically, the Lab addresses the current knowledge shortfall in the face of rapidly changing utilisation and creation of internet services. Figure 3 below highlights some of the headline achievements during the REF period.



**Figure 3:** Overview of Smart Internet Lab Centre of Excellence during the REF Period.

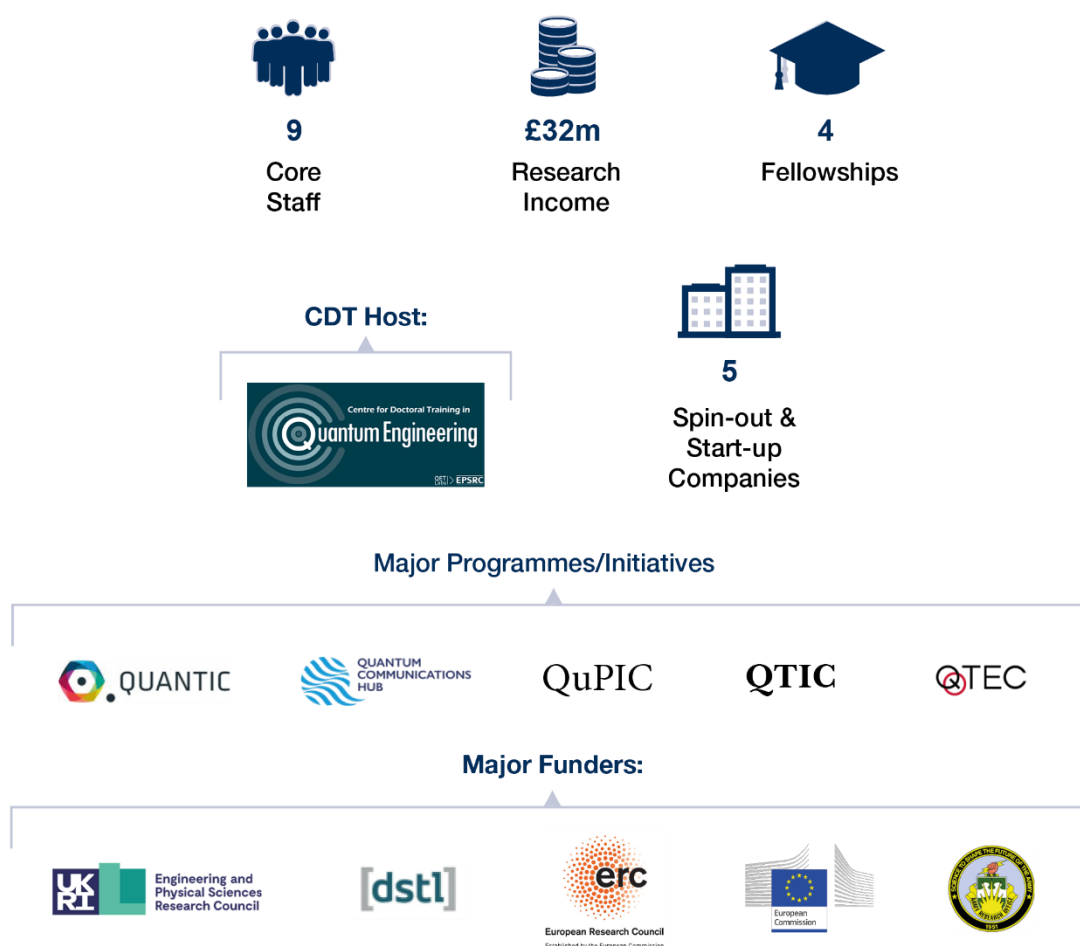
Specialising in wireless, optical communications and networks, over 200 researchers from three research groups (High Performance Networks, Communication Systems and Networks and Photonics and Quantum) fuse expertise and innovation in areas such as end-to-end network convergence, mobile edge computing, autonomous vehicles, machine learning, artificial intelligence, IoT, human-centred networking and quantum internet. Smart Internet Lab research has shaped the development of 5G standards (e.g. 3GPP and ETSI) (see REF 5G Case Study, section 4). Thanks to its 5GUK Test Network, a national asset, it has been instrumental in the

## Unit-level environment statement (REF5b)

UK's lead in 5G development and deployments in vertical sectors (smart cities, manufacturing, tourism, creative), thereby keeping the country at the forefront of digital connectivity. The Centre has secured £44m of funding during the REF period. It holds a broad portfolio of grants including: EPSRC Programme Grant (TOUCAN, £5.89m, 2014 – 2020, Simeonidou); Platform Grant (MANGI, £1.46m, 2018 – 2023, Physics led, Engineering-lead Beach); involvement in the UK Quantum Communications Hub (led by York) and National Dark Fibre Facility; EPSRC Prosperity Partnership (£2.24m, 2019 – 2024, Beach), EPSRC Centre for Doctoral Training in Communications (Co-Director: Beach), as well as significant Innovate UK (Piechocki), EU (Nejabati and Simeonidou) and industry funding, including from JLR (Doufexi), Toshiba (Morris), Samsung (Simeonidou) and BT (Beach, Simeonidou). Nejabati spun-out Zeetta Networks in 2015 and Beach spun-out Forefront RF with former PhD student Leo Laughlin (£210k).

## Quantum Engineering Technology Labs (Director: Rarity)

Launched in 2015, QETLabs encompass the activity of 9 core staff supported by a further 100 academics, staff and students, as summarised in Figure 4. Its cross-Faculty (Science and Engineering) vision is transforming fundamental quantum science into real concept demonstrators in imaging, communications and computing.



**Figure 4:** Overview of QETLabs Centre of Excellence during the REF Period.

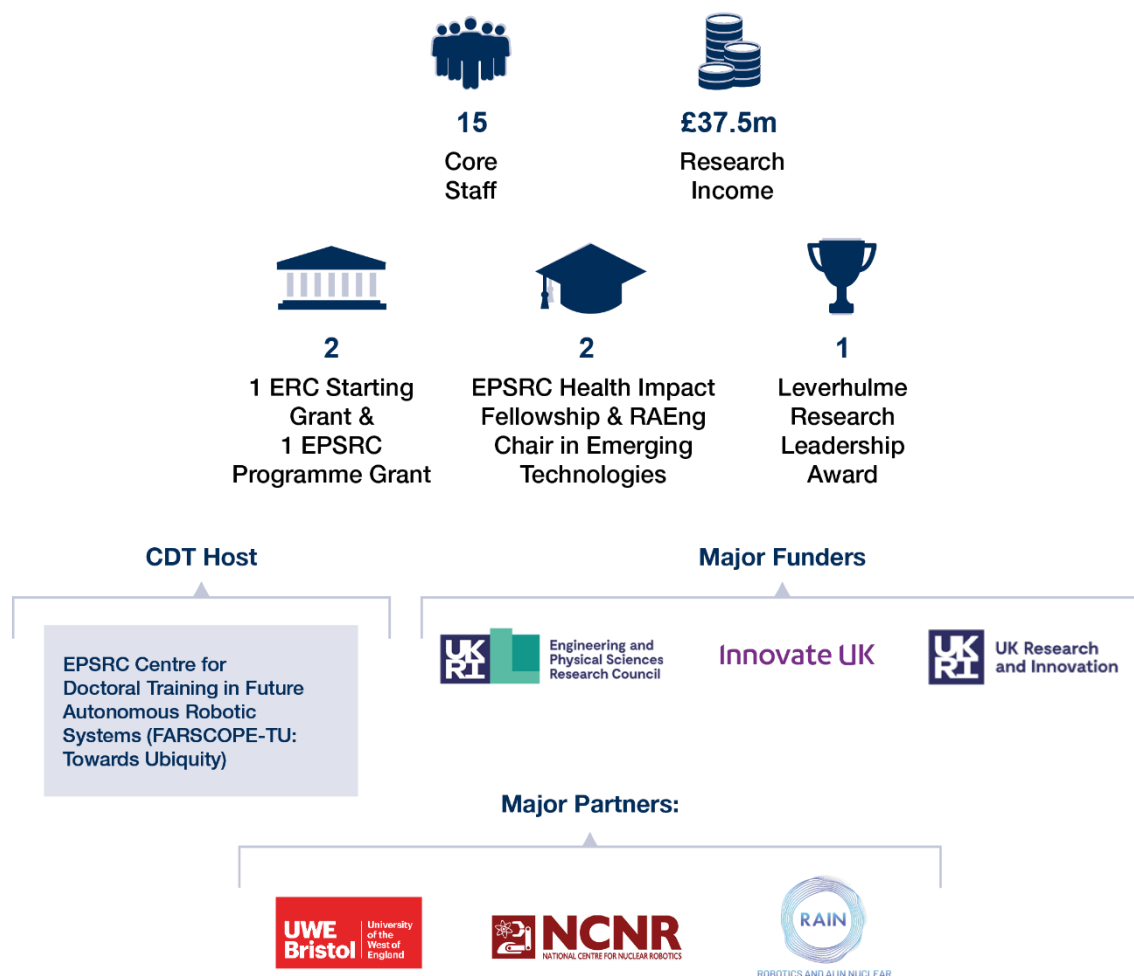
**Unit-level environment statement (REF5b)**

World-renowned for major advances in photonic quantum technology, QETLabs pioneered the field of integrated quantum photonics, showing that photonic circuits can be implemented on-chip in waveguide architectures. Working closely with industry, key components have been established to advance the integrated approach including the development of quantum communication transmitter and receiver chips. Now, using silicon photonics, experiments are one million times more compact and five hundred times more complex than the original devices of 2008. The five areas of interest for exploitation are quantum-enhanced sensors, secure communication systems and networks, quantum simulators, and quantum information processors.

QETLabs incorporates the EPSRC Quantum Engineering Centre for Doctoral Training (QE-CDT), the Quantum Technology Enterprise Centre (QTEC), an incubator for innovators for quantum inspired technologies, and the Quantum Technology Innovation Centre (QTIC), a new open-access innovation facility. These initiatives have created 28 new companies including KETS, QLM, Nu Quantum and SeeQC and a report in November 2019 showed that a third of the UK's funded Quantum start-ups originated from QTEC. QTEC alumni companies have raised a total of £18.9 million in equity, contract and grant funding to date and have created 56.5 new highly skilled jobs for the UK quantum workforce. QETLabs Director Rarity is a co-investigator in the UK National Quantum Hubs (imaging and communications). He is a Fellow of the Royal Society, held an EPSRC Quantum Technologies Fellowship (£1.61m, 2015 – 2020) and spun out a company with a PhD student and QTEC Fellow, Xiao Ai, QLM Ltd in 2017. Cryan spun out company Fluoretiq in 2017 with PhD students and QTEC Fellows Neciah and Dorh.

**Bristol Robotics Laboratory (UoB Director: Richards)**

Established in 2006, the Bristol Robotics Laboratory (BRL) is a comprehensive academic centre for multi-disciplinary robotics research. It is a collaborative partnership between the University of the West of England (UWE) and the University of Bristol, and home to a vibrant community of academics, researchers and industry practitioners. An overview of BRL is given in Figure 5.



**Figure 5:** Overview of BRL Centre of Excellence during the REF Period.

BRL aims to understand the science, engineering and social role of robotics and embedded intelligence. Interdisciplinary research projects address key areas of robot capabilities and applications including smart automation, human-robot interaction, bio-energy and self-sustainable systems, biomimetic tactile sensors and haptic feedback systems, unmanned aerial vehicles, driverless cars, swarming behaviour, assisted living technologies, machine vision, verification and validation, and soft robotics. The BRL currently has 369 members and 25 incubator companies. It also hosts an EPSRC CDT in Robotics (renewed in 2019) as well as significant portfolio of research projects: Richards and Richardson are co-investigators on the Birmingham-led National Centre for Nuclear Robotics (EPSRC, £11.59m, 2017 – 2021), Rossiter holds an EPSRC Health Impact Fellowship (£1.18m, 2019 - 2022), an EPSRC Programme Grant (£6.14m, 2020- 2025) and an RAEng Chair in Emerging Technologies (£1.3m, 2018 – 2028), Richardson is a co-investigator on a Southampton-led programme grant (£4.45m, 2018 – 2023). Due to the interdisciplinary nature of our Faculty, some BRL colleagues have been submitted to UoA11.



**South-West Nuclear Hub (Directors: Mostafavi and Scott (Physics))**

Established in 2011 in recognition of strengths in nuclear engineering in the Faculty of Engineering and the School of Physics, the Hub works with its partners at the universities of Oxford, West of England, Plymouth and Southampton to accelerate and grow nuclear research and teaching activities across the region. An overview is given in Figure 6.



**Figure 6:** Overview of South West Nuclear Hub Centre of Excellence during the REF Period.

The Hub provides a place for academia, industry and government to come together to meet the opportunities and challenges facing nuclear energy in the UK and around the world. Its industry and government partners include: EDF, Cavendish Nuclear, IDOM, National Nuclear Laboratory, Nuclear Advanced Manufacturing Research Centre and Nuclear South West. The hub is part of the Imperial-led EPSRC CDT in Nuclear Engineering and runs an MSc in Nuclear Engineering. Engineering Director Mostafavi is a RAEng Senior Research Fellow with UKAEA and Engineering academics (Truman (lead), Knowles, Mostafavi, Booker, Pavier, Peel, Coules) run the EDF funded High Temperature Centre. In 2018 the Hub won The Engineers 'Collaborate to Innovate' Academic Innovator category, showcasing innovative projects such as diamond detectors for radiation dose rate measurements, seismic qualification of graphite and pipeline devices for radioactive environments.

**2014 Research Strategy**

In REF2014 our research strategy was to “**attract the best staff and students; target strategic collaboration with industry and to collaborate with the best researchers nationally and internationally**”. We have made significant progress against this strategy across the whole UoA12, but we use the BCI here to demonstrate our approach:



**Example 1 – delivering our 2014 research strategy.** *As a result of its international reputation as a Composites research centre, over this REF period BCI attracted excellent staff both to diversify and strengthen its research expertise in materials and manufacturing and to replace retiring Professors. Eichhorn, Thomsen and J Barton were strategic appointments; Hamerton and Ting (named one of the Top 50 Women in Engineering Sustainability in 2020) were recruited as Readers and have since both been promoted to Professor. The calibre of staff is illustrated by the fellowships awarded (Allegri, Pirerra Ting, Trask, Woods) and prizes received (e.g. Swinburne prize for Eichhorn in 2019). The BCI Director (Wisnom) was made Fellow of the Royal Academy of Engineering in 2018, Hallett is a Fellow of the IMechE, and Bond is a Fellow of the Royal Aeronautical Society. Retention of excellent ECRs in manufacturing are supported by an EPSRC Platform grant (£1.12m, 2017 – 2022, Hallett).*

*BCI's Centre for Doctorial Training (twice renewed) and Industrial Doctorate Centre complement each other in attracting excellent students from across STEM (in the CDT) as well as engineers looking to gain a doctorate whilst working in industry (IDC). Students in both Centres have opportunities to work on industry-inspired projects which are co-supervised by technical experts in companies such as GKN, Airbus and Rolls-Royce.*

*The BCI's strong connections to the University-owned NCC, which include a joint Chair (Thomsen), RCUK Catapult Researcher in Residence (Kratz, 2018 – 2021) and co-located equipment, facilitate industrial collaborations with the NCC's partners and enable research pull-through. In addition, the BCI has hosted the RR-UTC in Composites (Hallett, Allegri) since 2007 which has resulted in work presented in one of our impact case studies and 28 patents over this REF cycle (resulting in explicit recognition of the UTC by Rolls-Royce). The relationship with Rolls-Royce is recognised through Allegri's RAEng Industrial Fellowship. The UTC has been formally linked to another RR-UTC (Lightweight Structures) at TU Dresden since 2012, as one example of our international collaborations, with whom a dual PhD programme has recently been established.*

*Major collaborations on a national scale include a project with the Offshore Renewable Energy Catapult (OREC) Wind Blade Research Hub (Weaver, Pirerra) and several major EPSRC funded activities. These include: Future Manufacturing Hub in Composites Manufacturing (£10.45m, 2017 – 23) co-led by Nottingham and Bristol (Thomsen) and involving Cranfield, Imperial, Manchester and Southampton; Programme Grants with Imperial (HiPerDuCT, £6.42m, 2011 – 2018, Wisnom, and NextComp, £6.20m, 2020 – 2025, Trask) and Bath and Southampton (CerTest, £6.29m, 2019 – 2024, Thomsen).*

In using this **Example**, we highlight how our strategy has successfully achieved our objective of growing both the quality and volume of our research outputs. This approach has also been successful in the other research groups where we deliver cutting-edge research in a balance of challenge led and technology led topics across the Faculty's eight research themes. Our broad research portfolio allows us to expand fundamental scientific knowledge, lay the foundations for the technologies of the future, as well as having impact more immediately, contributing to wealth creation and quality of life. It also opens up a diverse range of funding sources ensuring that we remain resilient when funding priorities change.

### Future Strategy

**Our vision is to make a perpetual positive impact in the world. We will tackle the opportunities presented by the rapid digitalisation and data enrichment of all technological and engineering domains, and by the need to establish a sustainable and resilient world economy. We will ensure that our research is socially responsible and benefits the whole of society.**

Building on our REF 2014 success, in early 2016, under the [University's Vision and Strategy](#), the Faculty of Engineering developed an ambitious growth strategy which was refreshed in 2020 in light of changes to the Faculty leadership team.

The underpinning priorities for the Faculty strategy are to:

- Apply world-leading research to major societal challenges
- Inspire and develop future leaders through a challenging educational offering
- Partner with local and global innovators to accelerate impact
- Advance equity and diversity.

To achieve our ambitions, our research objectives for 2020 and beyond are to:

- Continue to grow our research reputation
- Demonstrate academic leadership of the highest calibre and develop future leaders
- Recruit, retain and invest in our great staff and students
- Ensure we are meeting our institutional commitments to the Concordat to support ECRs
- Enhance stewardship of our key research partnerships
- Increase and diversify our external research funding
- Celebrate diversity within our community and encourage inclusivity in all we do.

### Delivering Impact

**We aim to maximise the economic and societal benefit that can be brought about through the influence that our innovative, high-quality research has on other users, disciplines or sectors.**

The leadership of the two School Impact Directors (Beach and Hallett) helps to facilitate impact, as they assist with identifying opportunities for, and routes to, impact at an early-stage and assist with the development of the impact through ongoing mentoring and monitoring. Through training workshops (for example; 'routes to impact' and 'entrepreneurship and enterprise skills'), connecting academics with potential users of their research, and signposting relevant funding opportunities, the Impact Directors help academics and research groups recognise and facilitate the wider impact of their work. One initiative piloted in 2019 provided funding for students to undertake summer internship projects focussed specifically on research impact. As detailed in the Institutional Statement, the Research and Enterprise Development Directorate (RED) provides guidance and practical advice, including on the commercialisation of research, as well as managing impact funds. The Faculty's Industrial Liaison Office (ILO) works with Industry Advisory Boards and Faculty key partners to help build effective collaborations with industry.

During this REF cycle, key impact highlights include:

- Securing £35m of West of England Combined Authority (WECA) funding for a technology innovation centre (QTIC+) which is bringing together researchers, students, businesses and entrepreneurs for the commercialisation of disruptive technological approaches.
- 87 ESPRC Impact Acceleration Account (IAA) projects totalling £2.7m, funding new activity in commercialisation, knowledge transfer secondments, ECR kick-starter grants or more exploratory projects. Some of our REF Impact Case Studies, including Ice-pigging, BT's 5G roll-out and Team-GB bicycles, have been developed through IAA funding.
- Ten student and academic enterprise and spin-out companies supported by our commercialisation team, SET-Squared or QTEC, including Actuation Lab (awarded Innovate UK iCURE funding in 2019); Zeetta Networks (winner of the prestigious 'Cool Vendor' accolade from Gartner in 2019); and FluoretiQ and ForeFront RF (pitching for further investment, November 2020).
- Existing industry partnerships strengthened by three EPSRC Prosperity Partnerships with Thales; Toshiba, Roke Manor & GCHQ; and BT (led by Lancaster) and RAEng Fellowships (Cooper/Airbus, Yuan/Safran, Mostafavi/UKAEA and Allegri/Rolls-Royce). Longstanding partnerships with EDF and Rolls-Royce underpin two of our REF Impact Case studies.
- PolicyBristol support for researcher/policy-maker interactions, e.g. ECRs from BCI presented their work to MPs and won two prizes (Dyson Sustainability Prize and the Cavendish Medal) at the annual STEM for Britain exhibition at the Houses of Parliament (9 March 2020); Pregnolato took part in the Royal Society MP Pairing Scheme 2020.
- Faculty Research Showcases for industry held in 2015 and 2017. In 2017 over 100 industry representatives attended the event, which was followed by a dinner for key partners hosted by the Vice-Chancellor.
- Engaging the public on wide-ranging topics and raising awareness of the benefits of Engineering research (as detailed in 'Engaging with diverse communities and the public', page 32).

The two examples below highlight different successes of our approach to delivering impact:

**Example 2 – increasing our understanding in the innovation ecosystem:** *An IAA funded placement with the Digital Catapult resulted in an increased understanding of the application of open innovation processes and ways to engage with SMEs within the experimental ecosystem. Using this expertise, new collaborations have developed. Two newly-engaged SMEs, Mativision and Mo-Sys, played key roles in an £8m DCMS funded 5G Smart Tourism project, adding value to the telecommunications, tourism, and creative sectors.*

**Example 3 – commercialising our research:** *iCOMAT, co-founded by Kim and BCI CDT student Zympeloudis, developed Continuous Tow Shearing (CTS), the world's first automated composites manufacturing process that can place carbon fibre tapes along curved paths without generating defects. iCOMAT won an Innovate UK's Open Competition for Spin-Out Companies in 2018, was a finalist of 2019's Enabling Innovation at Advanced Engineering in 2019, shortlisted as a finalist of the Composites UK Start-Up Business of the Year in 2019 and won the same category in 2020.*

### Interdisciplinary and Collaborative Research

Collegiality, collaboration and partnership-working is embedded within our research ethos. We work within and across research groups and Faculties, and with national and international institutions and organisations. Several staff have joint appointments across the University

## Unit-level environment statement (REF5b)

(Robson-Brown, Rochat, Oulton, Thompson, Turner) or with other institutions – for example Knowles is CEO of The Royce Institute (2019 – present), Thomsen holds a Joint Chair with the National Composites Centre and Craddock was Managing Director of Toshiba Research Labs from 2011 to 2019. The multi-disciplinary nature of our six CDTs also provides major stimulus for interdisciplinary research within the UoA, between UoAs and across institutions. CDTs also have many international partners, including KU Leuven, Cornell, MIT, Deakin, RMIT, National Aerospace Laboratory, TU Delft, Texas A&M, University of New South Wales, Oak Ridge National Lab, Fraunhofer IZP and University of California San Diego.

Our Centres of Excellence, described earlier, play a critical role in driving collaborative research: Smart Internet Lab brings together three research groups within the Faculty; QETLabs unites research groups from the School of Physics and Faculty of Engineering; BRL involves researchers from the University of Bristol and the University of West of England; the South West Nuclear Hub integrates researchers from a number of Universities with industry and government organisations.

To make the most of cross-University opportunities, members of UoA12 work with the University Research Institutes (see Institution Environment Statement: REF5a), particularly the Jean Golding Institute (Data), Cabot Institute (Environment), Elizabeth Blackwell Institute (Health) and the Bristol Quantum Information Institute (a University Specialist Research Institute). The Smart Internet Lab, Cybersecurity group (UoA11) and Vision Information Lab (UoA11) have joined colleagues from Social Sciences to form the new University-level Bristol Digital Futures Institute (BDFI), co-directed by Simeonidou. Craddock directs Digital Health activities across the University, working closely with the Elizabeth Blackwell Institute for Health. We benefit from the University's GW4 alliance with partners Bath, Cardiff and Exeter. For example, the GW4 Water Security Alliance is a large community of researchers, spanning natural, earth, biological and social sciences and economics and engineering across the GW4 universities.

We are actively involved in a number of national research consortia: Bristol is the managing University for the Research Centre for Non-Destructive Evaluation (RCNDE) (Director and Research Director, Smith and Wilcox), co-leader of the Future Composites Manufacturing Hub (PI: Thomsen), a member of the EPSRC Centre for Power Electronics UK (Yuan and Mellor are members of the Research and Management Team), a participant in two of the UK Quantum Hubs (Rarity, Nejabati and Simeonidou) and in the National Centre for Nuclear Robotics (Richards and Richardson). Bristol is a founding Partner of UK Collaboratorium for Research on Infrastructure and Cities (UKCRIC), working with partners including Cambridge, Imperial, Oxford and UCL to deliver an integrated research capability underpinning the renewal, sustainment and improvement of city infrastructure.

## Open Access and Sharing Research Data

The Institutional Statement (section 2.4) describes our policy on Open Access science. As a Faculty, we are fully committed to transparency with the majority of our papers uploaded to the University's public repository (PURE), which also underpins the public catalogue of UoB's research. We make research data accessible via the University's Research Data Storage Facility, which provides stable, long-term storage. Furthermore, many of our research papers are deposited on preprint servers (such as arXiv.org) after submission, and on academic social networks (such as ResearchGate) once accepted.

## Unit-level environment statement (REF5b)

The Library's Research Data Service works with the Jean Golding URI to support UoA12 individual researchers and collaborations in planning, managing and sharing research data. As a signatory to the 'Concordat on Open Research Data', an explicit commitment to Open Research is a University promotion criterion. Researchers are required to store/archive significant primary research datasets through the University's research information system. Where computational code is a key deliverable, the standard practice is to preserve and release the commented and documented code under an open license using a code repository platform (e.g. GitHub). Researchers budget for development and maintenance of webpages to share their results with the wider scientific community. Our larger projects employ research project managers who take responsibility for sharing research and maximising impact.

## Research Culture and Integrity

We strive to create a research culture recognised both internally and externally for its inclusivity, integrity and responsible innovation. We embed responsible innovation in our research, from the planning stage through to writing up and publication. Research groups set the tone by conducting research in an ethical and responsible way, focussing on the sustainability and end-use of the research and recognising the strong influence local culture can have. Research groups are fora where people share ideas and gain inspiration from the work of others, but researchers are also strongly encouraged to explore collaborations beyond their immediate circle. Engagement with cross-Faculty Research Centres, University Research Institutes and partnerships, with national and international third-party organisations facilitates innovative research ideas and, as the recent UKRI report (Research Culture/Integrity section13, [UKRI-020920-ResearchIntegrityLandscapeStudy.pdf](#)) identifies, has a positive influence on research integrity. Extending the sense of community beyond research groups is also encouraged through other initiatives set out in section two.

Within the Faculty, responsible research is monitored via the Faculty Research Committee. Our PGR students and new academics receive dedicated training on governance and integrity as part of their induction, delivered by RED. Collectively we work towards the highest standards of ethical, scholarly and professional integrity, fully endorsing the Commitments of the Concordat to Support Research Integrity as identified in the Institutional Statement (section two, point four). We adhere to the framework of policies, regulations and guidance developed by the University, including an [Ethics of Research Policy and Procedure](#) and a *Research Governance and Integrity Policy*.

The Faculty Ethics Committee ensures that research projects are conducted professionally and ethically and undertakes the process in a constructive, supportive and facilitative way in dialogue with the researchers. UoA12 has seen the number of new ethics applications grow from 36 in 2013 to 140 in 2019. The SPHERE project (**Example 4**) has contributed significantly to the increase in this number of ethics applications, as the example below explains.

**Example 4 – managing the research ethics of engaging end users in research:** *SPHERE is a suite of custom IoT technologies aimed at detecting a range of healthcare issues. By placing sensors in people's homes, the technology aids early diagnosis, lifestyle change and the ability of patients to live at home. As this study involved healthy volunteers as well as NHS patients, applications also needed to be made to the NHS research ethics service and other approval processes such as Health Research Authority (HRA). For some of the researchers, this was their first exposure to navigating the mandatory regulatory approvals processes for research involving human participants. Researchers had to ensure that participant rights, dignity, health, safety and*



privacy were protected. To do so, researchers worked with the Research Governance Team in RED to ensure that all regulatory approvals were in place before any data was collected.

## 2. People

**Our engineers want to make a positive impact and change the world for the better. To enable them to excel in their endeavours, we are working to remove any barriers they might face.**

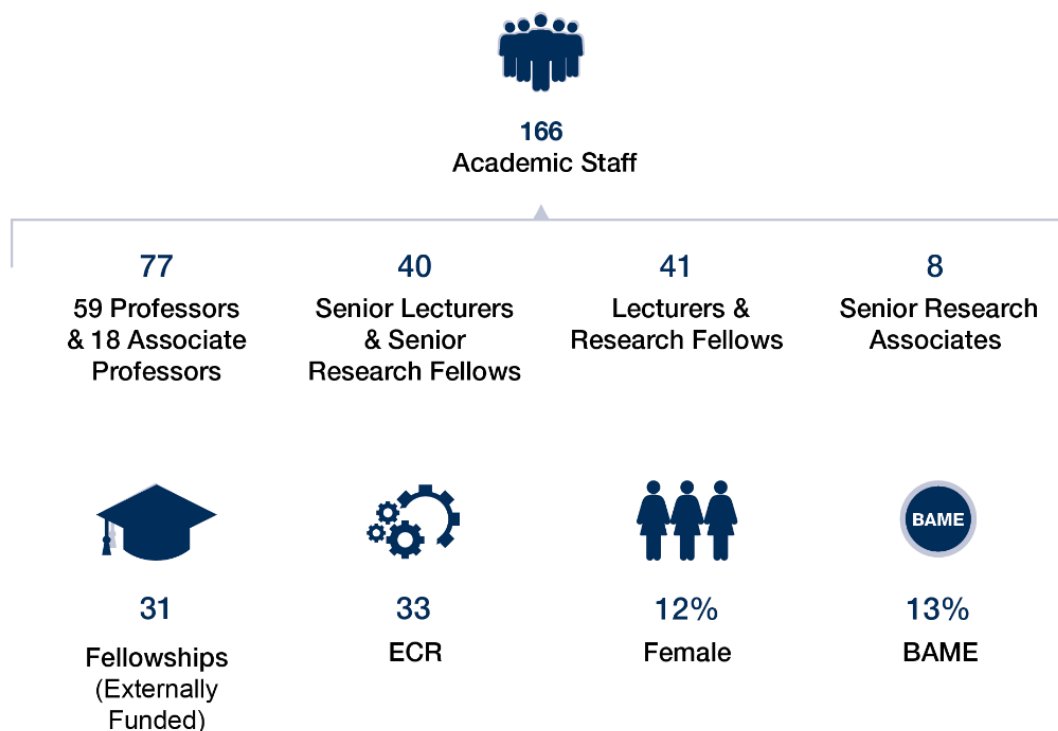
We want people to feel proud to be a part of a Faculty where they can see that no one is excluded so we are striving to improve equality, diversity and inclusion. We acknowledge that we have not historically demonstrated such diversity, and we are committed to facilitating a more inclusive environment. Based on our strategy (Section 1), we have made many changes to how we work to improve the experience for our students and staff. We are altering how we are structured as well as our approach and mindsets as individuals, to include the greatest range of individuals as possible.

The example below shows how we are trying to improve the culture and inclusivity of our community through pro-active promotion of positive case studies and best practice.

**Example 5 – Working towards a more inclusive and positive work culture:** *[‘Engineering Includes Me’](#) is an initiative launched in May 2020 by the Dean as result of direct feedback from RAs and ECRs as well as results from the University staff survey. The aim is to bring together all the people and action groups striving to make our Faculty a more diverse, equitable and inclusive place to work and study as well as raise awareness of what they are doing. A blog features a wide range of resources, ranging from information about who the maternity, paternity and adoption champions are, induction details, promotion process, and Faculty social events which are happening, to case studies to inspire both staff and their line managers to embrace different ways of developing careers, and how to go about finding the right support to help achieve their ambitions. One case study shows how two colleagues have job-shared since 2002, allowing them both to be promoted first to senior lecturers and then to associate professors, as well as being joint heads of the Fluids and Aerodynamics research group. Other case studies discuss the benefits of mentoring, from the perspective of the mentees and the mentor, whilst another describes how an academic career is balanced with bringing up a family.*

### Staffing Strategy

In 2015, the University decided to grow the Faculty of Engineering due to our sustained track record of research excellence, attractive teaching and training environment for top-quality students, and a national engineering skills shortage. To maintain our success, we must recruit and retain a diverse and inclusive engineering research community that is motivated, inspired and well-supported through effective leadership and management.



**Figure 7: Staffing Profile for UoA12 membership**

Figure 7 shows our staffing profile. Our recruitment strategy balances senior and early-career appointments to maintain strong leadership whilst supporting career development and succession planning. Schools feed into the Faculty's annual workforce review, identifying where new teaching posts are needed, PhD provision and research areas for strategic growth. For example, two Professors of Practice (Knowles and Howard) brought experience from industry and government, Thomsen and J Barton were recruited to replace two retiring senior academics in Composites and Pregnotato was brought in as an ECR to strengthen work in civil infrastructure.

Since the last REF period, 35 permanent staff have left the UoA: 12 professors (7 FTE), 13 senior lecturers/readers (13 FTE) and 10 lecturers (9.8 FTE). Over the same period, we have recruited 11 professors (11 FTE), 11 senior lecturers/readers (11 FTE) and 24 lecturers (24 FTE). Internally we have promoted 17 staff to professorial level resulting in a net gain of 16 professors over the period.

### Staff Recruitment Processes and Policies

Since 2014, our recruitment and selection procedures have focussed on excellence at all levels and increasing diversity. Actions have included:

- formal consideration of part-time and job share applications for all posts
- improved job information packs which detail our working environment and flexible working arrangements
- piloting female search panels and separate female shortlisting for academic staff recruitment
- improved mandatory training (including EDI) for staff involved in recruitment
- gender- and role-diverse interview panels



- exploring EDI-related attitudes and experience at interview.

**Staff Development**

Recognising the pressures and challenges associated with an academic career, we have increased support for academics in their research endeavours and career progression. These complement University-level initiatives (see Institutional Statement, section three) and include:

- protecting one afternoon a week for focussing on research
- mentoring and peer buddying
- ensuring line managers provide a quality induction to new staff
- an online repository of induction and personal development materials for all staff
- regular training on grant writing
- mock panels and interviews arranged for major grant applications
- introducing study leave (see below).

All staff have annual reviews conducted by their line manager. Academics are managed by Department Heads (who are managed in turn by Heads of School). Project-funded RAs are managed by the Principal Investigators of the projects. The 'Concordat to Support the Career Development of Researchers' outlines responsibilities for managers and we are adopting these approaches. See also **Example 5** above.

**Promotions**

Our improved promotions process provides additional guidance through annual 'Demystifying Promotions' sessions delivered by HR and the Dean, anonymised summaries of successful professorship applications, and example metrics/evidence of success. Advice is provided on how to present the impact of any EDI-related issues on research activity to ensure cases can be judged appropriately by the Promotions Committee.

Across the Faculty, seven women (two in UoA12) have been promoted to professor in this REF period and all female staff who sought promotions have been successful. The number of women applying for promotion has also increased.

**Nurturing ECRs and RAs**

New staff receive a welcome package and early-career academics are given a 50% teaching load in their first year (and 80% in their second) to help them initiate their research activities. They are expected to be active members of research groups and are given priority for PhD studentships and for research committee funding for pump-priming new activities, conference attendance and building industrial links. ECRs (including RAs) are encouraged to apply to the Faculty summer internship scheme, giving them an opportunity to supervise undergraduate students and attract potential PhD applicants.

An ECR representative works closely with the Faculty (Ting) and School Research Directors (Trask and Houghton (UoA-11)) to identify barriers facing new academic staff and ways to reduce or remove them. Two RAs are members of each school Research Committee. An RA's network, led by the RAs themselves and supported by the Research Directors, provides opportunities to meet engineering colleagues outside their research groups and learn about the many support functions across the University. Feedback from the RA and ECR communities was instrumental in the creation of the 'Engineering Includes Me' initiative described in **Example 5**.

## Unit-level environment statement (REF5b)

Through mentoring and management, ECRs are encouraged to consider their career aspirations, identify development opportunities in skills and experience and seek appropriate funding to support their plans, including fellowships and New Investigator awards. Research support staff and Research Directors help to identify fellowship funding schemes for applicants and prepare them for the process. Where fellowship candidates are invited to interview, we organise external interview training and mock panels with senior colleagues. Whilst the national success rate for EPSRC fellowships 2015 – 2020 was 21%, the Faculty of Engineering has had a success rate of 36% over this REF cycle.

13 EPSRC First Grant/New Investigator grants have been awarded through this REF period. It is testimony to the quality of our staff and the support they receive that so many of them have progressed rapidly in their careers, as shown below.

**Example 6 – Career Progression of ECRs:** *Conn received his first grant in 2017, became Senior Lecturer and a co-Investigator on a Platform Grant led by UCL in 2018 and became co-Investigator on a Programme Grant led by Rossiter in 2020; Kim held his first grant in 2017, secured a standard grant in 2018 as PI, as well as co-founded iCOMAT based on his technology and was promoted to Reader in 2020; Jiang completed his first grant in 2019 and was awarded an EPSRC fellowship in 2020.*

## Training

The Faculty benefits from a wealth of University training opportunities (see Institutional Statement). Staff are encouraged to include training in their personal development (see also EDI section page 22). We provide Faculty-level courses on unconscious bias and wellbeing. In 2020 we developed an in-house, bitesize management training series (leadership and management, leading teams remotely, HR processes, recruitment) which moved online due to COVID-19.

## Study Leave

In November 2019, we responded to staff survey feedback with a study leave policy to be implemented from September 2021 (delayed by COVID-19). Eligibility is based on an applicant's contributions in terms of teaching, research and admin/citizenship. Proposed outputs, in particular how study leave fits in with the individual's development/ambitions/career plans and with broader department/research group/school/faculty strategy/objectives will be considered. We are confident that study leave will enhance the research environment and quality of research outputs by allowing academics to focus on more ambitious research projects. Having previously supported study leave for research at other HEIs or in industry, we hope a formal approach will encourage staff to be more ambitious in their applications.

## Stimulating and Facilitating Exchanges between Academia and Business

We have a proactive and positive attitude towards facilitating exchange between academia and business/other organisations to maximise our staff development and research impact, these include but are not limited to:

- Knowledge Transfer Secondments: Rolls-Royce, Sony, North Bristol NHS Trust, Bristol City Council, Trameto Ltd, BAE Systems, Keysight Technologies, Renault Sport Racing, Airbus, Arup, GKN, and many more.
- Craddock seconded to the role of Managing Director of Toshiba Research Labs between 2011-2019.

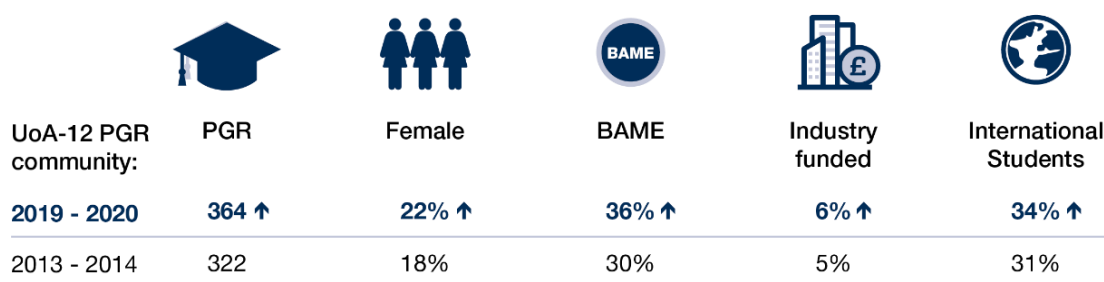
- Industry sponsored/supported PhD students spending time with their sponsor company (up to 75% for EngD students).
- Industry partners co-locating with our researchers (e.g. Thales and Rolls-Royce) to remove barriers to collaboration.
- RAEng Chairs and Fellows (Cooper/Airbus, Yuan/Safran, Mostafavi/UKAEA, Allegri/Rolls-Royce) spend considerable time with the partner organisation.
- Honorary and Visiting Industry Fellow status (RAEng funded) recognises our industrial collaborators and allows industrialists to spend time with academics (this route supported both Haine and Thomas leading to the £2.23m Secure Wireless Agile Networks (SWAN) with Beach (2020-2025).
- A Relationship Manager facilitates interactions between the Faculty and NCC, focussing research pull-through to impact.
- The Nuclear Hub Engagement Manager builds connections with the nuclear sector and government to increase research and innovation opportunities.

### Facilitating and Rewarding impact

Academics at UoB must demonstrate research impact as a prerequisite for promotion. Our programme of seminars and training assists ECRs develop skills and ideas for research impact as well as signposting them to relevant support and funding. Faculty and University support for impact activities is outlined in Section one (page 10). Academics who can demonstrate significant research impact are invited to exhibit and present at showcase events for industry.

### Research Students

**We equip engineering leaders of the future with the breadth and depth of technical expertise to problem-solve creatively, be enterprising and communicate their research widely. Our graduates can implement solutions successfully to make a positive impact in the world.**



**Figure 8:** Summary of our UoA12 PGR Community (PGR = PhD + MRes)

Figure 8 provides a snapshot of the growth in our PGR community, against key measures, during this REF cycle.

Our research students are passionate about making a difference. They seek out opportunities to make an impact, which include spinning out companies, winning multiple awards for their research (e.g. the Queen's Award in Enterprise Innovation and The Engineer: Collaborate to Innovate awards), co-chairing prestigious international conferences and numerous best paper prizes –

examples are given in section 4. **Example 7** highlights the career progression of just two of our PGR students – one who followed a career in academia and one who went into industry.

**Example 7 – Attracting and training excellent students:** *In a project funded by Airbus and GKN, Composites CDT student Rainer Groh was awarded the Ian Marshall Award for Best Student Paper at the 17th International Conference on Composites Structures (ICCS17) in 2013, the AIAA/Collier Research Best Structures Paper in 2015, and the Clean Sky Academy Award for the Best PhD Thesis in Applied Science and Engineering for Aeronautics in April 2018. He became a visiting researcher at NASA Research Centre in Langley (2015 -2017) before returning to Bristol as a Royal Academy of Engineering Research Fellow in 2018. He received the Philip Leverhulme Prize in 2019.*

*Communications CDT student Paul Harris worked on the MaMIMO Prototyping System, leading to a Collaborate to Innovate (C2I) Award (2017) during his studies before developing part of the 5G standard. His PhD included secondment to the US and post-PhD he worked in the US for a start up, then returned to the UK initially working as SDR Business Development Manager for National Instruments and now working on 5G and beyond wireless standards for Vodafone.*

## Funding

We recognise the far-reaching benefits of training postgraduates in cohorts and our track record in training the next generation of engineers resulted in exceptional success in both 2013 and 2019 EPSRC Calls for Centres for Doctoral Training. EPSRC investment in training has totalled >£65m since 2014.

We were awarded four CDTs in 2013, and partnered in a further three:

- Advanced Composites Centre for Innovation and Science (£4.9m, 2014-22)
- Future Communications: People, Power and Performance (£3m, 2016-23)
- Future Autonomous and Robotic Systems: FARSCOPE (£4.9m, 2014-22)
- Composites Manufacture IDC (£3.7m, 2014-22)
- Quantum Engineering (led by Faculty of Science; £4.9m, 2014-22)
- Water Informatics Science and Engineering (WISE) (led by Exeter University; £5.3m, 2014-22)
- Quantitative NDT (led by Imperial College; £3m, 2015-22).

We were awarded six CDTs in 2019, with a further two being led in other Faculties or Universities:

- Digital Health and Care (£6.3m, 2019-27)
- Future Innovation in Non-destructive Evaluation: FIND (£4.2m, 2019-28)
- Future Autonomous Robotic Systems: FARSCOPE-TU (£4.8m, 2019-28)
- Composites Science, Engineering and Manufacturing (£6.4m; 2019-28)
- Trust, Identity, Privacy and Security in Large-scale Infrastructures [UoA-11] (£6.2m, 2019-27)
- Interactive Artificial Intelligence (£6.8m, 2019-27) [UoA-11]
- Quantum Engineering (led by Faculty of Science; £5.5m, 2019-28)
- Nuclear Energy Futures (led by Imperial College; £6.2m, 2019-27).

We also partner in other institution-led Centres including NERC Centre for Doctoral Training in Freshwater Biosciences and Sustainability (GW4 FRESH CDT) led by Cardiff.

## Unit-level environment statement (REF5b)

The Faculty is the main beneficiary of UoB's EPSRC Doctoral Training Account (DTA). Currently ten of these DTA studentships are allocated annually to support industrial and international partnerships. Matched funding (50%) is sought to gain added-value from UKRI funds. The University has gradually increased its intake of talented students funded by the Chinese Scholarship Council. In addition to UKRI-sponsored studentships, new industry partnerships forged by CDTs have created additional studentships. The University has invested in 47 additional studentships over the life of the UoA12 CDTs during this REF period.

### Recruitment

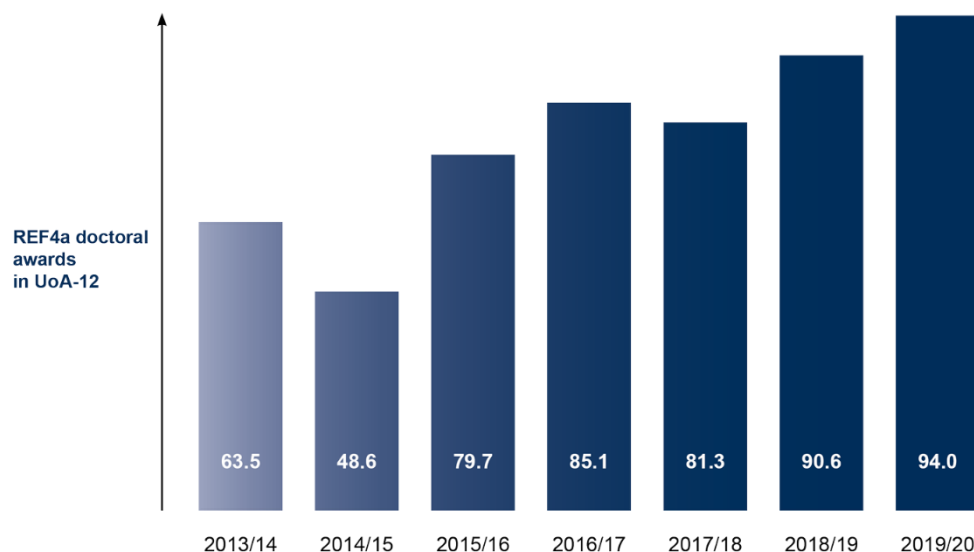
The Faculty PGR Director (Howden) and the CDT Directors oversee recruitment, supported by two School PGR Directors (de Luca and Marshall (UoA11)) and five Deputy PGR Directors. Each application is reviewed by three academics (including a Deputy PGR Director for non-CDT applicants or CDT Director for CDT applicants). Once studentships are offered, candidates are ranked by the CDT Director/School PGR Director and representatives from the relevant Research Committees to allocate funded places. Studentships are allocated primarily on applicant quality, with secondary consideration given to protected characteristics and strategic Faculty priorities, such as PGR students for early-career academics. As shown in Figure 8, page 18, our commitment to increasing diversity has seen the proportion of female students rise over the REF period. We are aiming for 30% by 2030, in line with our stated Faculty goal. The proportion of BAME students has increased from 30% to 36% (3% of students did not declare ethnicity) and 7% of our students have declared a disability (up from 6%).

### Monitoring and Support

All students have regular one-to-one meetings with a primary and secondary supervisor who provide intellectual and pastoral support. A third member of academic staff undertakes annual progress meetings, provides independent guidance on the research and helps resolve any difficulties arising between the supervisors. For non-CDT students, Deputy PGR Directors provide pastoral support and students can confidentially involve the PGR Director for additional support or independent guidance. In the CDTs, Directors organise the annual review process although CDT students are also able to access the dedicated CDT Managers and Deputy PGR Directors for advice should they require it. School Graduate Administration Managers provide administrative and professional support for PGRs who require funding extensions, suspensions, or special assistance. Wellbeing advisors are specially trained to support PGR students. The Faculty PGR Staff-Student Liaison Committee includes PGR representatives and Faculty Officers (PGR Directors, Faculty Manager, Faculty Technical Manager) and meets three times each year. The Faculty PGR Senior Representative ensures that all student queries and issues reach the appropriate people and are dealt with accordingly.

### PhD Numbers and Completion Rates

Over this REF period, 543 PhD awards have been attributed to UoA12. Figure 9 below shows our steady growth in doctoral awards. Our research is highly collaborative, and our students are often co-supervised by a research team of colleagues across other UoAs and other faculties. This collegiate supervisory approach maximises the intellectual environment and research training experience for the student. For students starting a PhD during the REF period, 94% completed in under five years. Only 45% of students who started their PhD within the REF period completed in under four years, but this is not surprising given the large number of CDT students we have who receive four years of funding, with the first year being mainly taught.



**Figure 9:** *Number of UoA12 doctoral awards over the REF period*

### Research Training

Mandatory talks and practical sessions cover induction, EDI, safety, facilities and lab practices. Our CDTs open their courses to non-CDT students where practicable. Best practice in the Faculty and particularly the CDTs is disseminated through Centre Managers and the Bristol Doctoral College.

### Postgraduate Skills and Careers Development

As detailed in the Institutional Statement, the Bristol Doctoral College provides wider skills and careers training for postgraduate students. The personal and professional development programme of workshops, seminars and online resources offers professional support through the different stages of their postgraduate research degrees, including personal development and well-being; professional and career development; responsible research; systems and software; teaching; and working with others.

The University Careers Service Postgraduate Employability Advisor provides dedicated advice to PhD students on career options and the world of work. PGR students are encouraged to get involved with the Bristol PLUS award, designed specifically to enhance student employability.

### Entrepreneurship

PGR students benefit from the Basecamp Enterprise Team, who support start-ups and help develop entrepreneurial skills. The University's strategy towards entrepreneurship is captured in the Institutional Statement (section 2, Strategy). Students can pitch for start-up funding via the New Enterprise competition and UoB is part of the award-winning global accelerator and incubator SET-Squared. Many CDTs provide bespoke enterprise and entrepreneurial training; **Example 8** highlights this approach where PGR students have used these new skills and the facilities and expertise available to them through the University to spin-out their research into a viable commercial product.



## Unit-level environment statement (REF5b)

Some entrepreneurial students elect to join QTEC (see [Example 3](#)) after graduation, which provides a twelve-month salaried fellowship, offering them a safe environment to explore the commercial potential of their technology ideas. They are trained in the skills needed for a successful technology start-up and expert mentors support each fellow through the start-up process. Spin-out companies iCOMAT, FluoretiQ, ForeFrontRF and QLM Ltd came out of the QTEC programme.

**Example 8 – Supporting student enterprise:** *Actuation Lab was founded by three Composites CDT students who came up with the idea for rugged, servicing-free components after recognising the excessive maintenance and servicing costs associated with operating machines in corrosive conditions. The trio were awarded a 12-month SET-Squared membership in 2018 after pitching at the University's New Enterprise Competition and were then awarded a £300k Innovation to Commercialisation of University Research (ICURe) grant to explore the potential of the new technology with wider industry. Dr Bates, CEO, said "We have received fantastic support from the University and the SET-Squared network."*

## Equality, Diversity and Inclusion

**Advancing equality, diversity and inclusion is at the heart of our Faculty strategy. To make everyone feel that they belong demands individual and group commitment to align behaviours and actions. In all aspects of our work, this is our collective responsibility.**

To demonstrate our commitment to EDI:

- Our EDI Committee, chaired by the Dean, has wide-ranging representation from academia, technical and professional services, the student body, BAME, LGBT+ and women and non-binary networks and from the unions. Where possible, representatives for specific EDI protected characteristics are Chairs or co-Chairs of the relevant staff networks to represent wide-ranging views. Five EDI action groups focus on: future and current students; new and existing staff; flexible working and organisational culture.
- EDI champions (Tzemanaki and Philamore) sit on School Senior Management Teams.
- We ensure female representation on all promotion panels, and focus on research quality rather than quantity, to help ensure that parental leave and flexible working patterns are properly considered.
- We prioritise use of Faculty research funding to support early career academics and Faculty summer internship funding to support female academics and students.
- External Advisory boards bring outside perspectives on culture and share experiences of the interventions made by their organisations and the impact those interventions have had to help inform our approach.
- Women are supported to participate in the Aurora, WISE Skills4UK, Bristol Female Leaders Initiative and Bristol Leadership programmes, as well as the Bristol Women's Mentoring Network. Of the 61 Faculty staff members who have completed leadership courses in the last three years, 35 (57%) have been women.
- We developed a radar system for reporting micro-aggressions and produced a training video for staff and students on being an active bystander.



**Gender and Ethnicity**

While acknowledging the scale of the challenge we face in improving the diversity of our community over the current REF period we have made clear progress:

- BAME representation of submitted staff increased from 11% to 13%.
- 18% of academic and research staff are female (14% in 2014/15).
- Female staff submitted to UoA12 increased from 7% to 12%.
- UoA12 has six female professors, three female associate professors, five female senior lecturers and four lecturers.
- 9% of Faculty technical staff are now female (up from 0% in 2014/15), as a result of major overhaul of our technical services structures.
- 32% of Faculty Board members and 33% of School Management Team members are women.
- Female academics in School, Faculty and University senior leadership positions:
  - Associate Dean Temple Quarter Research & Enterprise (Liu – UoA-11)
  - Associate Dean Temple Quarter Education & Programmes (Cater – UoA-11)
  - Faculty Research Director (Ting)
  - CAME School Research Director (Ting until 2020)
  - Head of Department (Doufexi)
  - Director of Smart Internet Lab and Co-Director of Bristol Digital Futures Institute (Simeonidou)
  - Heads of Research Group (Berthoud, Marucci, Gaitonde)
- We pay tribute to the achievements of staff and students, e.g. in the University's Inspiring Black Engineers and Scientists Awards recognised the efforts over the past years of PhD students Selim Tudgey (FARSCOPE CDT) and Eileen Atieno (Composites CDT).

**Supporting Staff to balance the demands of work and personal life**

Recognising that fixed-term contracts can generate considerable stress for research staff and prevent them feeling truly included and valued members of the Faculty community, we are no longer using them as standard practice. We are providing RAs with more opportunities to build skills and experience beyond their projects to enhance employability, whether they choose to remain in academia or move into industry (both career choices encouraged as equally valid). This includes student supervision, teaching, and running their own research projects (e.g. summer internships).

Staff returning from parental leave are given particular support, with access to a Returning Carers grant. We have delivered additional in-house training to Line Managers on supporting staff returning from maternity, paternity, shared-parental, adoption and compassionate leave in 2019 and 2020, with information now easily accessible on the intranet. More recently, guidance on supporting staff returning from family-related or compassionate leave during and after the COVID-19 pandemic has addressed specific issues facing staff. A detailed process for returning staff and students includes a phased approach and involving occupational health to provide the best possible outcome.

For staff experiencing long term ill-health or with caring responsibilities, we promote a flexible working approach, and since the COVID-19 lockdown, are more confident than ever that line managers understand its benefits and can support staff to implement it.

In addition to covering the usual expenses associated with conference attendance, those with caring responsibilities for children or vulnerable adults can claim the additional costs of care that would be needed to enable attendance.

**Creating a Positive Working Environment**

We want our people to enjoy coming to work and feel supported in managing their own well-being as well as their research, impact and teaching activities. We have protected Thursday afternoons that are kept free from meetings and instigated personal well-being workshops led by an award-winning healthcare professional to supplement regular social activities such as weekly yoga sessions, wellbeing walks, lunch/coffee catch ups, events for charity, family-friendly summer and winter parties and, during lockdown, virtual quizzes.

We have improved the physical work environment. New teaching spaces have triple hearing loops, desk and lectern risers and automatic doors to make them fully accessible. We have better-equipped toilets for people with disabilities, gender-neutral toilets and baby change spaces. A lockable wellness room is now available where staff can express milk or breastfeed, pray or rest (for those with long-term health conditions). Major investment has provided new café spaces, meeting spaces, lifts and refurbished staff common rooms.

**EDI considerations for REF submission**

The primary goal of this submission is to showcase our research excellence. Impact case studies were selected on the strength of the evidence available and the magnitude of the impact. The secondary criterion was to demonstrate a good cross-section of our research. Only then were any protected characteristics of the academics involved considered. In contributing to the development and ensuring the application of the University's high-level code of conduct, we fully explained and supported the process for assessing independence to potential applicants. Heads of research groups have been a first port of call for informal advice for ECRs. Additional Unconscious Bias training was provided by RED to the UoA Coordinator, and this was used to design the necessary internal review process for outputs.

<b>3. Income, infrastructure and facilities</b>
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**Our people change the world for the better. We provide them with world-class facilities, dedicated technical and project management services and support them in securing funding to achieve their research ambitions, whether that is through a fellowship, collaborative endeavour or an industrially-focused project.**

**Research Funding and Strategies**

Our UoA12 total research income of £289m reflects our success in building a portfolio of research activity supported via funding for people, projects, training, equipment and infrastructure. Our strategy for research funding incorporates:

- obtaining funding from a range of different funding bodies including direct industry funding
- capitalising on calls and opportunities aligned with our research strengths
- creating ambitious collaborative research programmes
- targeting fellowships for both developing and established research leaders
- securing rolling investment in infrastructure, equipment and facilities
- cultivating our research talent pipeline through Centres of Doctoral Training.

We have achieved this through:

- each research group developing their own research strategy, aligned with the broader Faculty and University strategies, identifying relevant funding opportunities on the horizon which align to their areas of interest and expertise and where appropriate, who is best placed to lead the project or programme.
- Research Directors and Heads of Research Group encouraging and mentoring individuals with leadership potential to apply for externally-funded fellowships to realise their research vision. Application and interview preparation support are provided by RED and professional interview training is offered to all academics invited to interview.
- maximising the leverage achieved by significant grants by investing in equipment purchase, academic posts, research support posts, studentships, and technicians.
- providing internal pump priming and "Idea Accelerator" funding to researchers exploring new research ideas or directions to underpin future grant applications, for example by supporting conference travel or small equipment purchases.
- the implementation of a pre-submission process which enables the Senior Management Team to agree space, technical and project management support, as well as any funding leverage. It also provides an opportunity for internal peer review to ensure the highest possible standard for all applications prior to submission.
- using RED to provide advice on major funding bids (including CDTs, Prosperity Partnerships), interview training and mock panel interview for fellowships, equipment bids and programme grants. Where funding schemes have institutional limits on application numbers, an open and transparent selection process involves peer review and EDI considerations and gives opportunities to early-career staff.

Evidence for the success of this strategy can be found in the following achievements:

- An EPSRC investment in postgraduate training of >£65m since 2014, including 6 CDTs led by the Faculty (see section 2, page 19), to create excellent and distinctive training environments and experiences for the next generation of engineers and to contribute to the vibrancy of the research environment in the Faculty.
- Our EPSRC research portfolio includes 5 Programme Grants as lead institution, involvement in 4 Platform Grants (1 as lead); 3 Prosperity Partnerships (2 as lead University); Interdisciplinary Research Collaboration funding; Future Manufacturing Hub, as well as involvement in 2 National Quantum Hubs and the National Centre for Nuclear Robotics.
- A funding portfolio including significant grants from Global Challenges Research Fund (GCRF, 2 grants, £3m awarded); Research England (1 grant, £29m awarded); West England Combined Authority (1 grant, £35m awarded); Local Enterprise Partnership (1 grant, £15m awarded); Department for Culture, Media and Sport (1 grant, £5m awarded); IUK-ATI (1 grant, £18m Airbus led – Bristol £2.4m); ERC (18 grants, £9.1m awarded); and EU (28 grants, £12m awarded).
- Long-term industry funding includes Rolls-Royce UTC (2007- 2022, £39.9m); EDF PLEX/GSV projects (2008 - 2021, £7.5m); EDF High Temperature Centre (2008 - 2023, £3m); Safran URC (2015 – present, £1.1m); JLR (2015 – 2018, £690k).
- We have hosted 31 external fellowships funded by Royal Academy of Engineering (10), EPSRC (16), NERC (1), EU (1) and Leverhulme (2). In addition, we have had four Royal Society Wolfson Merit awards (Simeonidou, Weaver, Drinkwater and Wagener) and two ERC Starter Grants (Windsor and Balram).

- Capital and equipment funding to underpin our current and future ambitions include a Research England RPIF bid which secured £29m of capital funding for the Bristol Digital Futures Institute and the EPSRC UKCRIC programme which secured £9.6m of EPSRC funding for a new Soil Interaction Facility. A further £450k of EPSRC funding was secured for core equipment for the Faculties of Science and Engineering and £775k towards the development of a state-of-the-art experimental Fluid Structure Interaction (FSI) test Facility.

**Infrastructure supporting research and impact**

The Faculty has secured £30.2m of outside investment for our research and training facilities during the REF period, £23.1m of which relates to this UoA.

*Estate:* Due to the Faculty's significant expansion both in student numbers and research activity during the REF period, major investment has been made - and continues to be made - to our estate. We have outgrown the two main buildings associated with the Faculty and are now moving research activities to upgraded facilities in other parts of the University estate as well as maximising access to the National Composites Centre (extended in 2014) and Bristol Robotics Laboratory (based at UWE). A new wing (>£19m) was added to one of the two main Faculty buildings in 2017, enhancing both its teaching and research spaces, followed by a refurbishment of other parts of the building, including investing £400k in the Non-Destructive Testing Lab and Faraday Cage, £60k in the Nano Engineering Lab, £500k in the Electrical Lab, £200k in the Propulsion Lab, and £250k to develop a student Hack Space. The David Smith building was refurbished in 2015 (£1.5m) to create a home for the South West Nuclear Hub; the Digital Health group, along with research groups in UoA-11 have benefitted from brand new office and research space in a newly acquired building in 2019, with more groups due to move there in 2020. The UKCRIC SoFSI facility (with £2.3m investment from the University alongside the EPSRC funding) will be based at the University's Langford site from March 2021 and the Faculty has acquired another building (re-named the Ada Lovelace building) on the University precinct to house the Engineering Maths department from Autumn 2020. The Faculty investment in capital for UoA12 over the REF period totals £20m.

*Infrastructure investment:* Our building and refurbishment programme is matched by our world-class, equipment and specialist infrastructure. Our facilities and equipment are predominantly financed through University investment and equipment grants from EPSRC, however the extension and refurbishment of the Queen's Building benefitted from significant philanthropic donations, including from Faculty alumni, of the order of £1.3m. Our industry partners have also contributed to our facilities, particularly those which benefit our students, to help them raise brand awareness to support recruitment. For example, Boeing invested £30k in the Satellite Lab and Airbus have supported equipment for the student hackspace.

In addition to the major investment in the SoFSI facility highlighted above (£12m in total), the following experimental facilities have benefited from significant funding over the REF period, particularly pertaining to our Centres of Excellence:

In 2014, £28m of InnovateUK and High Value Manufacturing Catapult investment led to the opening of Phase 2 of the National Composites Centre, doubling its capacity. EPSRC-funded equipment (part of a £3.1m capital grant, Wisnom) was subsequently placed at the NCC to facilitate interaction and collaboration between University and NCC, as well as with NCC's industry partners. The University-based Composites Manufacturing, Test and Characterisation Lab was

## Unit-level environment statement (REF5b)

also developed via three other EPSRC equipment grants totalling £926k. The experimental lab is essential for research in advanced composites, sustainable composites, nano-reinforced materials and energy materials and underpins our partnership with Rolls Royce and Offshore Renewable Energy Catapult whilst supporting our students and promoting entrepreneurship (as noted in **Examples 1, 3 and 7**). This facility has led to and supported new grants valuing over £23m in total over this REF cycle.

We have invested £300k in deploying a 5G capability in Bristol city centre focusing on the convergence of fibre infrastructure and 5G wireless access by creating a multi-technology testbed connected via a city-wide fibre ring and several active switching nodes. The core network is located at the Smart Internet Lab at University of Bristol, with the majority of the access technologies located at Bristol's Millennium Square and MShed (part of Bristol Museums) for outdoor coverage and "We the Curious" (Science Centre) and MShed for indoor coverage. This capability was critical in securing £3m of DCMS 5G Testbed funding and underpins several EU and EPSRC grants in the Smart Internet Lab. The Smart Internet Lab plays a critical leadership and technology development role in the Bristol Digital Futures Institute which has secured a total of £118m investment (£29m of capital funding from Research England and £89m of leveraged funding from industry partners).

QETLabs secured £4.6m of EPSRC capital funding in 2016 for QuPIC, a Quantum Photonic Integrated Circuit Facility which provides access for the academic and industrial communities to the very specific needs of integrated quantum photonics systems and to enable photonic-circuit test and measurement solutions at room and cryogenic temperatures. The facility is focused on the silicon-on-insulator platform as this is the most cost effective to access and accounts for the majority of design and manufacturing experience within QETLabs. QTIC, our new innovation centre, secured £15m of LEP funding in 2017 and £20m of WECA funding in 2019.

An EPSRC capital investment of £1.2m in 2017 has further developed Bristol Robotic Laboratory's state-of-the-art flying arena and three Vicon 3D positioning systems which helped secure the funding continuation of the CDT in Future Autonomous Robotic Systems: FARSCOPE-TU (£4.8m).

We are developing a new Fluid Structure Interaction (FSI) test Facility to be a world-renowned experimental resource for across the fields of aerospace, wind power, unmanned air vehicles (UAVs) and wind engineering (bridges and tall buildings). We have invested over £1.3m in our Aeroacoustic Wind Tunnel, graded as a National Wind Tunnel Facility in 2018, as well as securing £350k of external funding, to develop and diversify our academic team and industrial partners resulting in securing 12 grants valued over £6m in total to date.

*Impact:* The combination of cutting-edge facilities and access to leading researchers attracts many industry partners. As well as the use of our facilities, they benefit from the knowledge exchange that happens naturally when they choose to co-locate with us. Where we carry out work directly for industry partners, for example the RR-UTC and Thales Prosperity Partnership, researchers and industry staff are based in dedicated offices. This helps to build stronger working relationships and more effective collaboration, whilst protecting potentially commercially sensitive work. This model has been rolled out for the South West Nuclear Hub to actively encourage industry and University partners interaction in the recently renovated David Smith Building.



**Unit-level environment statement (REF5b)**

We receive regular enquiries from industry requesting access to our facilities, which we accommodate where they are not being fully utilised by research activity. The unique capabilities of our Shaking Table, 5G Testbed and Wind Tunnel Facilities coupled to our research expertise are in demand, having been used by over 40 companies.

*Financial Sustainability:* The financial sustainability of our estate and infrastructure is crucial for our long-term ambitions. We enable this through TRAC-compliant large-scale facilities, which recover running costs (for the equipment and staffing costs) direct from research and teaching users. More than 90% of costs are underpinned in this way. Industrial income and Faculty underwriting allow us to explore new projects and support ECRs in using the facilities, thereby strategically stimulating growth in research activities.

**Operational and Scholarly Infrastructure Supporting Research and Impact**

*Technical Services:* Our students and staff benefit from the expertise and dedication of a large team of technical specialists (67.4 FTE). They keep our state-of-the-art equipment fully operational, help us put theory into practice and ensure our teaching and research is industry-relevant. In 2016, following an extensive review of the Faculty's technical services, a re-organisation of the team took place, alongside significant investment in new management, specialist and apprenticeship roles. New leadership, training, upskilling and updating of protocols has led to a transformation of the service and enhanced experimental support.

*Industrial Liaison Office (ILO):* This professional services team includes a network of 44 research support professionals providing project administration for major research activities, a four-member team delivering a variety of student-industry engagement activities (mentoring, internships, placements and technical talks) and two industrial liaison managers supporting the development of collaborative relationships for Faculty research activities. The research support roles are generally funded through external grant income or a specific institutional contribution to a major grant (such as an EPSRC Prosperity Partnership and UKCRIC), but the Faculty has invested in senior research manager posts for 4 of our Centres of Excellence (see section 1) to support ongoing research activities and to support the development of new research projects.

*PGR Support:* CDT managers and Graduate Administration Managers sit within the School structures to support PhD students, whilst further support and skill-enhancing opportunities are provided by the Bristol Doctoral College.

*Central Services:* Support for research and impact is also provided through RED, which is home to Policy Bristol and Bristol Doctoral College as well as experts in public engagement, contracts, knowledge exchange and impact. The Research Development team provide crucial advice and expertise on the preparation of grant proposals, as well as organising mock interviews and panels for major grants and fellowships.

*Advanced Computing Research Centre:* Academics have access to High Performance Computing facilities through the UoB's BlueCrystal clusters. Following a further investment by UoB (£16m), Phase four now has more than 16,000 cores and a theoretical peak performance of 617 Teraflops, which ranked it 398 within the world's top 500 fastest computers (June 2017). As a central University facility, it is provided free at the point of use with each staff member also having 5TB of data storage space.

**Use of Cross-HEI UK/Overseas Research Infrastructure**

- BRL (one of our five centres of excellence) operates a shared equipment pool between UoB and UWE, which has benefitted from a nationwide EPSRC capital grant for the UK Robotics and Autonomous Systems network (£700k, 2017). Recent Bristol-Manchester collaboration on EPSRC AGILE project (EP/M019454/1, 2015-2021) have benefited from this national capability.
- As part of the UK's High Value Manufacturing Catapult, our researchers use the NCC to facilitate interactions with other Universities, including through the EPSRC Future Manufacturing Research Hub and visiting Fellowships - Potluri (Manchester) and Day (Glyndwr).
- ARCHER is the UK National Supercomputing Service and is used by the Fluids and Aerodynamics research group to run their computational fluid dynamics simulation.
- QETLabs is part of the UKRI National Quantum Technologies Programme and a member of two of the four Research Hubs.
- National Dark Fibre Facility is a shared facility between Bristol, UCL, Southampton and Cambridge universities. This enabled the building of the UK 5G testbed and UK national quantum network for research in 5G (EPSRC Program Grant TOUCAN).
- Through the EU project Seismology and Earthquake Engineering Research Infrastructure Alliance for Europe (SERA), the EQUALS laboratory at Bristol has allowed transnational access to major European research groups for co-design and co-perform seismic qualification testing of large experimental infrastructure.

**EDI Issues in Accessing Relevant Infrastructure**

Our School and Faculty Research Committees regularly evaluate how researchers, particularly early-career academics, are given access to research infrastructure and support. Interventions over the REF period in order to enhance access have included:

- Prioritising dedicated support from Research Development Associates for academics applying for New Investigator Awards, early career fellowships (including mock interviews) and Impact Acceleration Account funding, recognising the need to help these individuals to develop and hone their grant-writing skills.
- Providing training for ECRs on writing grant applications.
- Encouraging mentoring within research groups.
- Using the pre-award process to internally peer review grant applications prior to submission.
- Using school research funding to pump-prime early-career academics' research plans.
- Using the pre-award process to ensure appropriate research support is included in grant applications, making sure that academics get the right help managing their projects.
- Holding open calls for equipment requests to be considered by the Faculty Space and Equipment Committee so all academics have an opportunity to acquire equipment needed for their research.



**4. Collaboration and contribution to the research base, economy and society**

**Collaboration underpins our vision to make a positive impact in the world. Our open, creative and multidisciplinary approach to research allows us to take on the major challenges that face society. As silos of single-subject specialisation diminish and digitalisation, sustainability, resilience and social responsibility permeate all our research endeavours, we reach out to others to help us find the most creative and innovative solutions to the problems that face us.**

### **Enabling Collaborations**

We work together, within and across research groups, across Faculties, with other institutions and organisations both nationally and internationally as we recognise that collegiality, collaboration and partnership-working is at the heart of impactful research. Our approach to interdisciplinary research is discussed in section one. To meet our research (and education) ambitions, by benefiting from diversity of thinking, we aim to work best-with-best, wherever people are based. We capitalise on dedicated funding opportunities both within the University (such as the Institute of Advanced Studies Benjamin Meaker Distinguished Visiting Professorships – see below for awards) and from external funding bodies (such as H2020 and Global Challenges Research Fund) to facilitate collaborations with academics and industry partners based outside of the UK. Research project managers play a critical role in facilitating collaboration for major research activities, particularly those which include partners from other institutions. They are a first point of contact and they arrange networking and engagement activities for the project team.

### **Staff Interactions and Leadership with Key Research Users, Audiences and Beneficiaries**

The ILO links industry partners to academic expertise. By mapping our research capabilities across relevant sectors and applications, the ILO facilitates new collaborations as well as providing stewardship of key partner relationships, where long-standing collaborations already exist. These partners include Leonardo, Safran, Vestas, Rolls-Royce, Thales, EDF, Airbus, BT, Toshiba, Renishaw, Arup and Boeing. Engineering research showcase events enable existing and new industry contacts to engage with our leading academics and learn about our latest research.

External advisory boards are used by Schools and Departments to shape planning and ensure that our teaching and research continue to meet the needs of our key beneficiaries. Dedicated advisory boards are common in major research activities (e.g. Programme Grants) and training (e.g. CDTs), their role being to constructively challenge the team, evaluate progress and optimise the direction of travel. Workshops and conferences are also commonly used to engage with existing and new industry partners during research projects.

We undertake research embedded in our community. For example, the SPHERE project (see section 1) uses digital sensors to build a picture of how we live at home to help better manage long-term health conditions. A vital element of the project is to test the system of sensors in real homes so through concerted engagement with the local community, sensors have been deployed in 50 local homes, gathering a globally unique dataset.

Engineering plays a key role in humanitarian and development work worldwide and we reciprocally share knowledge and expertise with partners in developing countries to enable the UN Sustainable Development goals to be met. By working collaboratively with these partners, we can accurately frame our research so that it can truly benefit those that it is intended to help and have maximum

## Unit-level environment statement (REF5b)

impact. We have research strengths in Engineering for International Development, including natural disasters, resource security, sustainable energy and health in developing countries. Two GCRF grants attest to our expertise in natural disasters (PREPARE, MacDonald and SAFER, Sextos) alongside a Newton Fund/ National Natural Science Foundation of China funded project (RESIST, Han).

Examples of how longstanding partnerships with research users have been developed over the REF period have been referred to earlier in the document – Rolls-Royce UTC (see [Example 1](#) and Impact Case study), EPSRC Prosperity Partnerships (detailed in ‘Delivering Impact’ Section 1, page 10) and RAEng Fellowships (in ‘Learned Societies’ page 34). Our involvement in the EPSRC Research Centre for Non-Destructive Evaluation (RCNDE) through Director Smith and Research Director Wilcox, as well as the wider NDT group, facilitates collaboration with industry partners and ensures that research is relevant to the medium-to longer-term needs of the industry. Similarly, as one of the 12 university members of the EPSRC Centre for Power Electronics, through Mellor and Yuan, our fundamental research in power electronics can be fed into the Centre’s expanding application areas.

Our collaborations inform our future plans and growth, for example the Smart Internet Lab’s extensive network of industrial partners and contacts (>40) was crucial to the creation of the Bristol Digital Futures Institute in 2019, which relies on £89m of leveraged funding from those partners to bring together academia, industry, charity and government to work on digital technologies and how they will impact on and be utilised by society.

## Wider Contributions to Economy and Society

Our nine UoA12 Impact Case studies give a flavour of the wider contributions to the economy and society of our research. Our research has impact through the 10 spin-out companies generated during this REF period, including Inductosense ([Example 9](#)) and by informing policy (see [Example 10](#) in later section).

**Example 9: Contribution to the economy:** *Inductosense (Wilcox, Croxford) has developed a wireless ultrasonic sensor that improves the accuracy and cost-effectiveness of Non-Destructive Testing in industrial plants. Since 2015, the patented technology has been widely deployed across the oil and gas, chemical, and nuclear sectors, including in the US, Malaysia, and Australia. Inductosense has grown to 16 employees in Bristol, with over £3.3m in investment, £1m turnover, and a global customer base including BP, Chevron and Petronas. These customers have embraced and adopted this technology as it enables less skilled, non-technical workers to take accurate measurements, significantly decreasing costs while raising performance.*

Other examples of where our research is making a positive difference include: BDFI will enable the University to exploit opportunities within the UK digital sector projected to be worth £200bn by 2025; the enabling of widespread adoption of electric cooking in developing communities, focusing on mini-grids in Nepal; development of a new method for building earthquake-proof schools in Nepal; development of small and robust prototype acoustic devices that have the potential to detect Leishmaniasis, a deadly disease; creation of wearable soft robotics for independent living; and greener, quieter transport options.

Perhaps often missed is the impact of individual research staff, who are trained to a high level of technical ability and then go out into industry to disseminate those skills. This supports tech transfer and contributes to the economy.

### **Engaging with diverse communities and the public**

Sharing our passion, understanding and concerns for our future is at the heart of our community and underpins all of our public engagement and outreach efforts. Engagements are coordinated via our Academic Outreach Officers, CDT Outreach Officers and Professional Services staff, including a Faculty Public Engagement Associate based in the University's Public Engagement (PE) Team. We carry out outreach by: supporting staff, undergraduate and postgraduate students who want to participate with relevant training (delivered in-house by the Faculty's PEA and Widening Participation Officers); hosting a range of events in our laboratories; and working in collaboration with external organisations to co-design and deliver specific activities. For example, Airbus have sponsored and co-delivered several outreach visits to the Faculty to introduce school children (and particularly girls) to aerospace engineering and encourage them to consider engineering subjects in their higher education choices.

Driven by our desire to enhance the diversity and inclusivity of our community, our strategy has a major focus on widening participation in engineering within local schools, particularly those serving disadvantaged areas. Our Faculty Engagement Officer and Academic Widening Participation Officer run a series of activities including engineering taster days for Year 12 students; workshops in schools and work experience for Years 10 and 11; CreatorsXX, a summer school targeted at females in years 10 and 12 to experience all aspects of engineering first-hand through taster lectures, visiting world-leading research labs and taking part in hands-on practical workshops; Changemakers course for Years 9 to 12 (breaking down stereotypes and highlighting the excellent opportunities available to young women in technology-related careers); Royal Institution Engineering Masterclasses for Year 9. Our CDTs have a strong funded outreach component, and their students play a major role in delivering our outreach offering, contributing with displays and demonstrations. We support students' societies, such as Robogals, to be active in School outreach.

In terms of wider public outreach, we organise exhibits related to our research at large festivals of music, science and culture, many of which regularly attract tens of thousands of attendees per day. Examples from the REF period include: Royal Society Summer Exhibitions (2017: Olympic winning bicycles (REF Impact Case Study); Quantum Computing; and Non-Destructive Testing; 2019: EDF-funded project on Extending the Lifetime of Nuclear Plants (REF Impact Case Study)); Green Man (2019: EU-funded project SABRE, Woods); Cheltenham Science Festival - several groups exhibit each year; Bristol Open Door's event 2018 in which people explore buildings around the city which aren't usually open to the public – the public attended viewings of the Shaking Table in action. The Smart Internet Lab has facilitated a number of ambitious public engagement events including the Layered Realities weekend at Bristol Harbour in 2018 (the world's first public 5G showcase), Orchestrating the Orchestra (which virtualised a three-part musical concert over the 5GUK Test Network) and a 5G music lesson with Jamie Cullum, both in 2019.

Our Faculty "We are Engineering" blog is used to engage with a public audience as well as prospective students. It showcases the research and the research community, highlighting major research impacts and the people who make them happen. We engage with the media to raise the profile of our work. A few examples being Simeonidou (BBC Click), Trask (BBC Nature's Weirdest

## Unit-level environment statement (REF5b)

Events) and Drinkwater (BBC One Show, Inside Science and the PM News Programme on Radio4).

### National and International Leadership

Where our expertise aligns, we proactively respond to national and international priorities. The Smart Internet Lab provides a good example (**Example 10**) of how our research leaders are participating in setting the national agenda.

**Example 10: Showing leadership in National Government Strategy:** *In 2016, the Government, through the Department for Digital, Culture, Media and Sport (DCMS) established the Future Communications Challenge Group (FCCG) and posed the question ‘what should the UK do to be a world leader in 5G?’. FCCG membership was drawn from wireless and communication network experts from industry, academia (including Beach) and government agencies, producing the report Next Generation Mobile Technologies: A 5G Strategy for the UK. Based on these recommendations, DCMS made the decision to investment £16m (2017) in the 5GUK Test Network, culminating in the first 5G Urban Showcase, ‘Layered Realities’. Building on this success, DCMS had the confidence to invest a further £200m through multi-staged investments to engage the vertical industries in the use of benefits of 5G. Simeonidou has worked closely with DCMS throughout the last three years as well as providing evidence to the UK Parliament’s Select Science and Technology Committee inquiry into the ‘UK telecommunications infrastructure and the UK’s domestic capability’ (June 2020), and was subsequently appointed into the UK Government Telecom Diversification Taskforce to advise on a strategy for the UK’s future telecom supply chain. The UK Government 5G supply chain diversification strategy, arising from the latter, was published on 30 November 2020, with an initial investment of £250m to ensure that the supply chain to the UK telecoms infrastructure will grow as well as ensuring it is resilient to future trends and threats.*

### Evidence of the Wider Influence of our Research Community

Members of the UoA serve and lead the community in a number of ways:

#### Editors and Editorial Boards

We provide Editors-in-Chief for journals such as: Materials Science (Eichhorn), MDPI Geoscience (Pregmolato), Geohazards and Georisks (Pregmolato), Nuclear of the IChemE: Process Safety and Environmental Protection (Thomas), Multifunctional Materials (Trask).

We provide Associate Editors for journals such as: Aeronautical (Cooper), ASCE Structural Engineering (Sextos), AIAA (Weaver), Experimental Mechanics (J Barton), Journal of Hydrometeorology (Rosolem), Smart Materials and Structures (Trask). Intelligent Material Systems and Structures (Neild).

#### Conference Chairs

We have chaired international and national conferences including: ICEM (2014), Experimental Mechanics (2014), ICCM20 (2015), IEEE Vehicular Technology Conference (2015), BINDT (2015 and 2016), LES: Richtmyer-Meshkov/Kelvin-Helmholtz (2016), NI RF Roundtable (2017), GoInc (2018), British Society for Strain Measurement Annual Conference (2018), ACP (2019), Royal Aeronautical Society's Aircraft Structure Conference (2014, 2016, 2018,2020), IEEE PIMRC (2020).

**Advisory Roles**

National advisory roles include: President of the Royal Aeronautical Society (Cooper), President of the Hellenic Association for Earthquake Engineering (Sextos), President of the Heat Transfer Society (Quarini), President for BiNDT (Smith), CEO of the Royce Institute (Knowles), Director of the UK Research Centre in Nondestructive Evaluation (Smith, 2018 – onward), EPSRC ICT Strategic Advisory Team (Simeonidou), EPSRC Engineering Strategic Advisory Team (Eichhorn), The Royce Institute Board (Eichhorn), Accreditation Board Chartered Institution of Water and Environmental Management (Howden, Chair), Non-Executive Director for the UK Knowledge Transfer Network (Lieven), Future Communications Challenge Group member advising HM Government on 5G testbeds (Beach), UK Government Telecom Diversification Taskforce (Simeonidou), Non-Executive Board Member for Mobile VCE (Beach), Henry Royce Institute Strategic Facilities Advisory Board member (Eichhorn), Cross-Research Council Energy Strategic Advisory Committee member (Ting), Membership of Women's Engineering Society (Eichhorn, Pregnalato).

International advisory roles include: Expert scientific advisor to the International Atomic Energy Agency of the United Nations (Rosolem), UK Ambassador to the International Advisory Group on NDE 4.0 (Smith), Member, External Faculty, Complexity Science Hub, Vienna, Austria (Hogan), Member of the EU Committee for the evolution of the Eurocodes (Sextos), Member of the Complexity Science Hub, Vienna, Austria (Hogan).

**Visiting Professorships**

During the REF period we have hosted international experts through the University's Benjamin Meaker Distinguished Visiting Professors scheme:

- Charles Luce (US Forest Service in Boise, Idaho) hosted by Woods (13/14)
- Christopher Duffy (Pennsylvania State) hosted by Wagener (13/14)
- Carlos Cesnik (Michigan) hosted by Cooper (13/14)
- Amin Elshorbagy (Saskatchewan) hosted by Wagener (14/15)
- Solomon Tersfamariam (British Columbia) hosted by Goda (15/16)
- Pascal Hubert (McGill) hosted by Wisnom (16/17)
- Barry Trimmer (Tufts) hosted by Rossiter (16/17)
- John Montgomery (Auckland) hosted by Windsor (16/17)
- Francois Birgand (North Carolina State) Howden (16/17)
- Ignasio Ngoma (Malawi) hosted by Goda (17/18)
- Tom Gleeson (Victoria) hosted by Wagener (17/18)
- Arthur Levy (Laboratoire de Thermique et Energie de Nantes) hosted by Kratz (17/18)
- Douglas Pancoast (School of the Art Institute of Chicago) hosted by Tryfonas (17/18)
- José Darío Aristizabal (National University of Colombia) hosted by Jiang (17/18)
- Benjamin Baran (National University of Asuncion, Paraguay) hosted by Simeonidou (18/19)
- Jonathan Stewart (California) hosted by Mylonakis (18/19)
- Dan Moore (British Columbia, Canada) hosted by Woods (18/19)
- Salvador Ivorra (Alicante) hosted by Mylonakis (19/20).

**Learned Societies**

We are proud of colleagues elected as Fellows to the following Learned Societies during the REF period: Royal Society (Rarity), Royal Academy of Engineering (Cooper, Simeonidou, Wisnom), American Chemical Society Cellulose and Renewable Materials Division (Eichhorn), American Institute of Aeronautics and Astronautics (Cooper), British Institute for NDT (Smith), British Society



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for Strain measurement (Barton J), Institute of Electrical and Electronics Engineers (Craddock, Simeonidou), Institute of Engineering Technology (Thomas), Institute of Physics (Smith), Institute of Measurement and Control (Thomas), Institution of Civil Engineers (Wagener), Institution of Mechanical Engineers (Hallett), International Environmental Modelling and Software Society (Wagener), Royal Aeronautical Society (Bond, Cooper, Scarpa, Wisnom)

We have served on various boards including: The Royal Aeronautical Society Materials and Structures committee (Cooper, Weaver), National Council of the British Society for Strain Measurement (Larossa), British Institute of NDT (Smith), National Composites Centre (Thomsen, Chair), Technical committee for IEEE International Ultrasonics Symposium (Wilcox).

### ***Prestigious awards and prizes***

Both established and early-career staff have been the recipients of many prizes during the REF period; of particular note are the Royal Society Wolfson Merit Awards (Drinkwater, Simeonidou, Wagener, Weaver), the Women's Engineering Society Top 50 Women in Engineering in Sustainability (Ting), European Geosciences Union Arne Richter Award for Outstanding Young Scientists (Pianosi) and European Space Agency Certificate of Outstanding Achievement for the Rosetta mission (Aplin). Further prizes and awards include:

- Alexander von Humboldt Foundation Friedrich Wilhelm Bessel Award (Wagener)
- British Institute for NDT Roy Sharpe Prize (Wilcox)
- Collaborate to Innovate UK Engineering Award (Richardson),
- Collaborate to Innovate (C2I) Award: South West Nuclear Hub wins Academic Innovator award Winner in category: Academic Innovator (Crewe, Taylor)
- Collaborate to Innovate (C2I) Award: NI, BT, Bristol and Lund 2017 Winner: Academic Innovator (Beach)
- EDF Group Innovation prize (Crewe, Taylor)
- European Geosciences Union Outstanding Early Career Scientist Award: Natural Hazards Division (Pregnolato)
- ICE SW Award (Crewe, Taylor)
- iEMSS Biennial Medal (Wagener)
- IMechE James Clayton Prize (Burgess)
- Institute of Materials, Minerals and Mining Swinburne Medal and Prize (Eichhorn)
- Institute of Materials, Minerals and Mining Leslie Holliday Award (Partridge)
- Japanese Cellulose Society Hayashi Jisuke Award (Eichhorn)
- Nesta 'Tipping Point' Essay Prize, value £5k (Hunt)
- RAEng Newton Research Collaboration Programme Award (Ibraim)
- Royal Aeronautical Society Team Bronze Medal (Booker)
- RCUK Catapult Researcher- in residence award (Coules, Kratz)
- TechWorks Awards: Research Collaboration category (Beach, Laughlin, Morris)
- University of Delaware Center for Composite Materials Medal of Excellence in Composite Materials (Wisnom)

### ***Student achievements***

We are also proud of our research students' many achievements, some of which include:

- Chenghuan Zhong, founded spin-out Inductosense (see [Example 9](#)) and is now their Chief Technology Officer
- Erik Eckstein and Rainer Groh won AIAA's Scitech Conference's Thomas Jefferson Goblet for best student paper in 2016
- Huan Doan, named Inspirational Bristol Scientist as part of Black History Month

**Unit-level environment statement (REF5b)**

- Wouter Knoben won the British Hydrological Society Peter Wolf symposium's best poster in 2016
- Ludovica Beltrame, won the British Hydrological Society Wolf Symposium's best oral presentation award in 2016
- Yiheng Chen won AOGS best student poster on "Big data and Hydroinformatics" in 2016
- Paul Harris, won NI's Wireless and Computing Award 2016;
- Francesca Cecinati, won the International Symposium of Weather Radar and Hydrology's best paper award in 2017
- Laxman Sivanathan, was presented the "Queen's Award in Enterprise Innovation" from the Prince of Wales at Buckingham Palace in 2018
- Leo Laughlin, won TechWorks' Research Collaboration category award in 2018, the research having led to the foundation of spin-out company ForeFront RF
- Joe Gregory won the best poster award of INCOSE's ASEC conference in 2018
- Giulia Giani, 39th International Conference on Radar Meteorology's best poster presentation 2019
- Abigail Bateman and Jamie Crispin, won the Deep Foundation Institute's best paper competition in 2019
- Vijay Kumar, won first prize at the European Commission's 5GCity project's first hackathon event 'Hack the 5G City' in 2019
- Anderson Peccin Silva, won the PRIMARE 2020 best presentation
- Andres Rivero Bracho won the Dyson Prize and £1000 for his work on flexible morphing wings at the 2020 STEM for Britain event at the House of Commons in March 2020
- Lina Stein, was appointed co-chair of the 2021 Gordon Research Seminar on Catchment Science in the Anthropocene.

***Invited keynote lectures***

Our invited keynote lectures included: 2015 ICCS18 Conference (Scarpa), 2016 BiNDT President's Honour Lecturer (Drinkwater), Royal Aeronautical Society Collar Lecture (Windsor) 2017 American Geophysical Union Paul A. Witherspoon Lecture, (Wagener), 2017 CFRAC (Melro), 2017 A.G.W. (Lawrie), 2017 ICAST 28 (Scarpa), 2018 Italian Association of Water Engineering Enrico Marchi Lecturer (Pianosi), 2018 American Society of NDT's Research Symposium (Smith), 2018 Fluids Network Special Interest Group (Lawrie), 2018 Research Advances in RF (60th Anniversary), Queens Belfast (Beach), 2018 RAeS Applied Aerodynamic Conference (Cooper), 2019 BiNDT President's Honour Lecturer (Smith), 2019 Italian National Conference on Earthquake Engineering (Sextos), 2019 International Conference on Maintenance Science and Technology (Wilcox), 2019 Westminster Higher Education Forum (Richards), 2019 International Conference on Composite Materials (J Barton), 2019 Technology Enablers for Secure Wireless Agile Networks (SWAN), Operating in the Future Electro-magnetic Environment Symposium, Contested Electromagnetic Environment (CEME) programme, (Beach), 2019 5GBerlinweek, Germany (Beach).

***Best paper awards***

Our best paper awards include: Géotechnique Letters (Diambra, 2014), AIAA/Collier Research Structure (Groh, 2015), Géotechnique Letters (Diambra, 2015), IEEE UFFC (Wilcox and Zhang, 2018), IMechE (Jiang, 2016), Géotechnique Letters (Diambra, 2016), ASCE (Barbosa, 2017), 11th IEEE International Symposium on Diagnostics for Electric Machines, Power Electronics and Drives (SDEMPED) (Williamson, 2017), AIAA Aviation Forum (Rendall and Allen, 2018), Earthquake Spectra. (Sextos, 2018), RAeS Bronze Award (Cooper, 2018), IEEE Ultrasonics (Wilcox, 2019), IEEE VTC (Piechocki, 2019), RAeS Gold Award (Cooper, 2019), Journal of Sound and Vibration Doak Award (Neild and Cooper, 2019).