Annual Review 2018/19

ROYAL ACADEMY OF ENGINEERING

Strategic priorities

Engineering matters. It underpins our daily lives, drives economic growth, plays a critical role in addressing major societal challenges and helps ensure our readiness for the future, from providing a sustainable supply of food, water and clean energy, to advancing healthcare, and keeping us safe and secure.

As the UK's national academy for engineering and technology, the Royal Academy of Engineering brings together the most talented and successful engineers – our Fellows – to advance and promote excellence in engineering for the benefit of society.

We harness their experience and expertise to provide independent advice to government, to deliver programmes that help exceptional engineering researchers and innovators realise their potential, to engage the public with engineering, and to provide leadership for the profession.

Drawn half from business and half from academia, and from all branches of engineering including areas of emerging technology, our 1,600 Fellows give their time and expertise voluntarily.

We have three strategic priorities:

- Make the UK the leading nation for engineering innovation and businesses
- Address the engineering skills and diversity challenge
- Position engineering at the heart of society

We bring together engineers, policymakers, entrepreneurs, business leaders, academics, educators and the public in pursuit of these goals.

Engineering is a global profession addressing global challenges, so we work with partners across the world to advance engineering's contribution to society on an international, as well as national scale.

Front cover photos:
Top: Lucy Richardson, Dyson Technology and *This is Engineering* protagonist
Bottom: Mama-Ope, Africa Prize shortlist 2017 © Brett Eloff

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"The Academy has led inclusive partnerships in many areas and these are enabling us to increase the range and impact of our work."

Dame Ann Dowling OM DBE FREng FRS
President

September 2019 marks the end of your five-year term as Academy President – what have you been most proud of during that time?
In my term at the Academy I have been particularly pleased to see an increase in collaborative working across the engineering profession. The Academy has led inclusive partnerships in many areas and these are enabling us to increase the range and impact of our work. For example, after leading two important pieces of policy work on behalf of the engineering profession, we have sought to embed that collaborative way of working through the establishment of the National Engineering Policy Centre. Similarly, by pooling resources with EngineeringUK and industry partners, our *This is Engineering* campaign has grown to reach a significant proportion of UK teenagers – the online films have been viewed 35 million times.

One area where I've really seen change in my time at the Academy is how high diversity and inclusion now are on the agenda, not just for the Academy, but for the engineering profession as a whole. We have seen a great willingness to work with us on this and our D&I programme is working with close to 100 businesses.

I'm also really pleased about our progress in supporting research and innovation. In little over five years our Enterprise Hub has grown from nothing to supporting 50 SMEs and over 100 engineering entrepreneurs, helping them to develop ideas into investable, high-growth companies.

We have secured further investment from government that has enabled us to treble the size of our research programmes, significantly expanding our support for excellent researchers. Our Chairs in Emerging Technologies scheme now provides 10 years' support for world-leading visionary researchers, who are developing emerging technologies that could deliver major economic and societal benefit to the UK. Progress is being made against the recommendations made in my government-commissioned review of business-university research collaboration too, with research collaborations being embedded in the government's industrial strategy.

One of my most important responsibilities as President has been to oversee the appointment of our new Chief Executive. Philip Greenish CBE stepped down after 14 years as Chief Executive at the end of 2017 and I'm very pleased that the Fellowship voted to express our gratitude to him and to recognise his many achievements through election to an Honorary Fellowship last year. I am really delighted with Hayaatun's progress as our new Chief Executive. She is doing much to drive the Academy's further development and I know that she and President-elect Professor Sir Jim McDonald FREng FRSE will make a great team.

You mentioned the National Engineering Policy Centre, which is an ambitious partnership led by the Academy to bring together 39 organisations representing the profession to provide expert engineering advice to policymakers. Why was the Centre established and how do you think it will develop in years to come?
Policymakers face increasingly complex challenges, often with strong technical elements, such as upgrading energy and digital infrastructure, or mitigating the effects of climate change. Engineering expertise has never been more relevant, particularly at a time when the UK's relationship with the world is changing. But the scope and diversity of the engineering profession can make it confusing to navigate for policymakers, and many of the significant challenges they face cannot be addressed by one engineering discipline alone – they require interdisciplinary systems thinking to identify solutions. The Centre brings together this expertise, from across our Fellowship and the professional engineering institutions, to provide excellent evidence-based policy guidance.

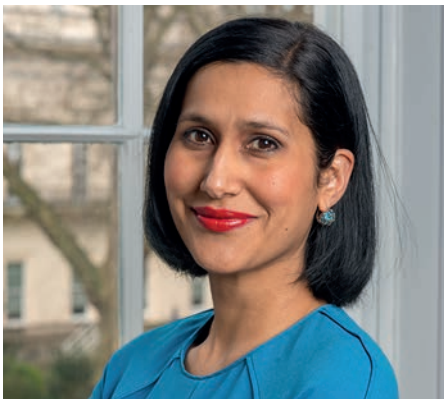
Our ambition is that the Centre will become a trusted partner for policy makers as the source of engineering expertise to inform policies that ultimately drive social and economic benefits.

The Academy received significant additional investment in its research programmes this year – how would you like to see the relationship between research and industry develop?
Just last year the Academy heard from Chief Technology Officers, the people who make the decisions about business R&D, that collaboration with UK universities is one of the reasons they invest in the UK. This kind of collaboration is so valued because it de-risks R&D investment and facilitates access to cutting-edge research, world-class expertise and research networks, at a relatively low cost to the company. Naturally, I would like to see more collaboration enabled.

Our challenge, now that the UK's relationship with the world is changing, is to ensure that our research base remains internationally competitive, so that businesses continue to invest in the UK and in collaborative work with academia. To facilitate that we need research and innovation to remain fully integrated into industrial and sectoral strategies, renewed focus on increasing investment in R&D from both government and businesses, and an efficient and transparent immigration system that welcomes researchers and innovators from across the world.

Effective collaborations between businesses and academic researchers can have measurable and transformative impacts, not only on those involved in the partnership but also on the UK economy.

"Substantial uplifts in funding have enabled us to support more talented people and collaborations that will deliver impact."



Dr Hayaatun Sillem
Chief Executive

More than a year has passed since you took up your post as CEO. How has the Academy increased its impact in this period?
2018-19 has been a period of significant growth for the Academy, with substantial uplifts in funding secured for our research, enterprise and international activities. These have in turn enabled us to support more talented people and collaborations that will deliver impact on areas ranging from non-invasive therapies for neurological disorders to quantum detectors.

We have also worked hard to develop new and stronger partnerships that will enhance our ability to deliver impact. In addition to the partnerships embedded in the National Engineering Policy Centre, over the past year we've worked very closely with EngineeringUK and the government's Year of Engineering team to bring more coherence to efforts to promote engineering to young people, as well as launching an exciting £15 million partnership with the Lloyd's Register Foundation to advance global engineering safety.

This is Engineering has been a great vehicle for delivering impact via social media and we are now boosting our digital communications capability so that all parts of the Academy can benefit from better digital engagement. More generally, this has been a strong year for media coverage, particularly broadcast, which has helped us raise our profile among new audiences.

Finally, it is important that as we grow we make sure we invest in our people, systems and processes. The past year has seen significant investments across all of those areas, including the appointment of our first Director of Operations and Finance, innovations in the way we support staff professional development and the initiation of several key IT projects to modernise our systems.

***This is Engineering* has been running since January 2018. How is it going, and what's next?**
I am delighted with the progress we've made this year. *This is Engineering* campaign films have already been viewed 35 million times and are having a measurable impact on young people's willingness to consider an engineering career. Whereas 39% of teenagers surveyed before the campaign launched said they would consider a career in engineering, this had risen to 72% by the end of 2018 among those who had seen the campaign.

While we will continue to generate the high-quality video content that has powered the campaign so far, we are now going to broaden out the campaign so that we can reach new audiences, including parents and teachers and others who influence the career choices of young people.

The Academy runs the D&I leadership programme for engineering. How are we responding to the fact that the headline diversity stats have remained stubbornly low?
Our diversity and inclusion programme works with both engineering employers and professional engineering institutions to stimulate action towards a profession that inspires, attracts and retains people from different backgrounds. We have benefited from great engagement from many engineering employers and professional institutions but there is still much to do. The fact that we have a profession that comprises 12% female and 8% black and minority ethnic engineers remains a real source of concern.

Over the past year, we have produced a range of practical tools and insights to help employers improve D&I. We published a framework for D&I measurement in engineering, commissioned detailed analysis of the gender pay gap in engineering to advance understanding of how the gap can be closed, and initiated the development of a D&I toolkit targeted at startups and SMEs. In the coming year we intend to shift the balance away from developing new resources towards encouraging adoption and implementation of what's already available.

It's also important to say that while gender has understandably been a focus of much engineering D&I work, we are just as concerned about other dimensions of diversity, including LGBTQ+, race and ethnicity, socioeconomic background and disability.

The Academy's international activities have grown significantly in recent years. Why is this?
The expansion has been partly driven by the UK government's interest in supporting science and engineering capacity building partnerships with developing and emerging economies. We became a delivery partner for the two new funds created to support this – the Newton Fund and the Global Challenges Research Fund – and as a result have been able to ensure that innovation and engineering are well represented within their portfolio of activities.

More generally, there is very strong demand from partners around the world to work with the Academy, including from our sister academies overseas, reflecting both the quality of our programmes and the high regard in which UK engineering expertise is held. Of course our international work also provides us with important learning and insights that can inform our UK-based activities. Ultimately, engineering is a global endeavour and many of our most pressing societal challenges simply cannot be addressed without strong international collaboration.

The Academy supported **144 researchers**

Research Fellow Dr Lidia Galdino explores capacity-approaching, ultra-wideband, nonlinear optical fibre transmission systems

Make the UK the leading nation for **ENGINEERING INNOVATION AND BUSINESSES**

The Academy supports the development of successful engineering research, innovation and business in the UK to create wealth, employment and benefit for society. This is delivered through a range of Academy programmes, from the Enterprise Hub to support for researchers, and includes building links and partnerships with engineers and engineering institutions across the world.

World-leading **RESEARCHERS**

Over the past year, the Academy's research programmes have benefited from significant investment. The programmes – including Chairs in Emerging Technologies, Research Chairs and Senior Research Fellowships, and Industrial Fellowships – promote engineering excellence in the UK by supporting aspiring and world-leading research talent and enabling strategic partnerships with industry.

In 2018, the Department for Business, Energy and Industrial Strategy (BEIS) made a substantial investment in the Academy through the Investment in Research Talent fund, which has grown the research programmes by 200% and allowed the Academy to expand the number of grants awarded. One of the programmes that expanded as a result of this funding was the Chairs in Emerging Technologies scheme. In 2018/19 it supported 13 global research visionaries to lead on developing emerging technology areas with high potential to deliver economic and social benefit to the UK, for a period of 10 years.

In April 2018, Professor Sriram Subramanian, a professor of informatics at the University of Sussex, was among the researchers who were awarded funding through the Chairs in Emerging Technologies scheme. His research focuses on interactive technologies using metamaterials. The £1.3 million funding is allowing him to develop a centre of excellence, as well as build and maintain contacts with industry and other partners to accelerate commercialisation.

The award has encouraged researchers from across the world to visit Professor Subramanian's research group or apply for postdoctoral opportunities at the University of Sussex. He has also been able to attract additional funding from other sources.

Although it is still early days for the group's research, it has established a startup, Metasonics, to explore commercialising its outputs – integrating physics and microfluidics with display technology and computer science. The company aims to create a controllable device, known as a spatial sound modulator, that could be used in parametric audio and medical therapeutics. "The Academy is also helping me organise an event in Brighton about metamaterials and emerging materials," Professor Subramanian adds. "This is a way for us to showcase some of the activities around this topic in the south-east and help develop the overall research atmosphere at Sussex."

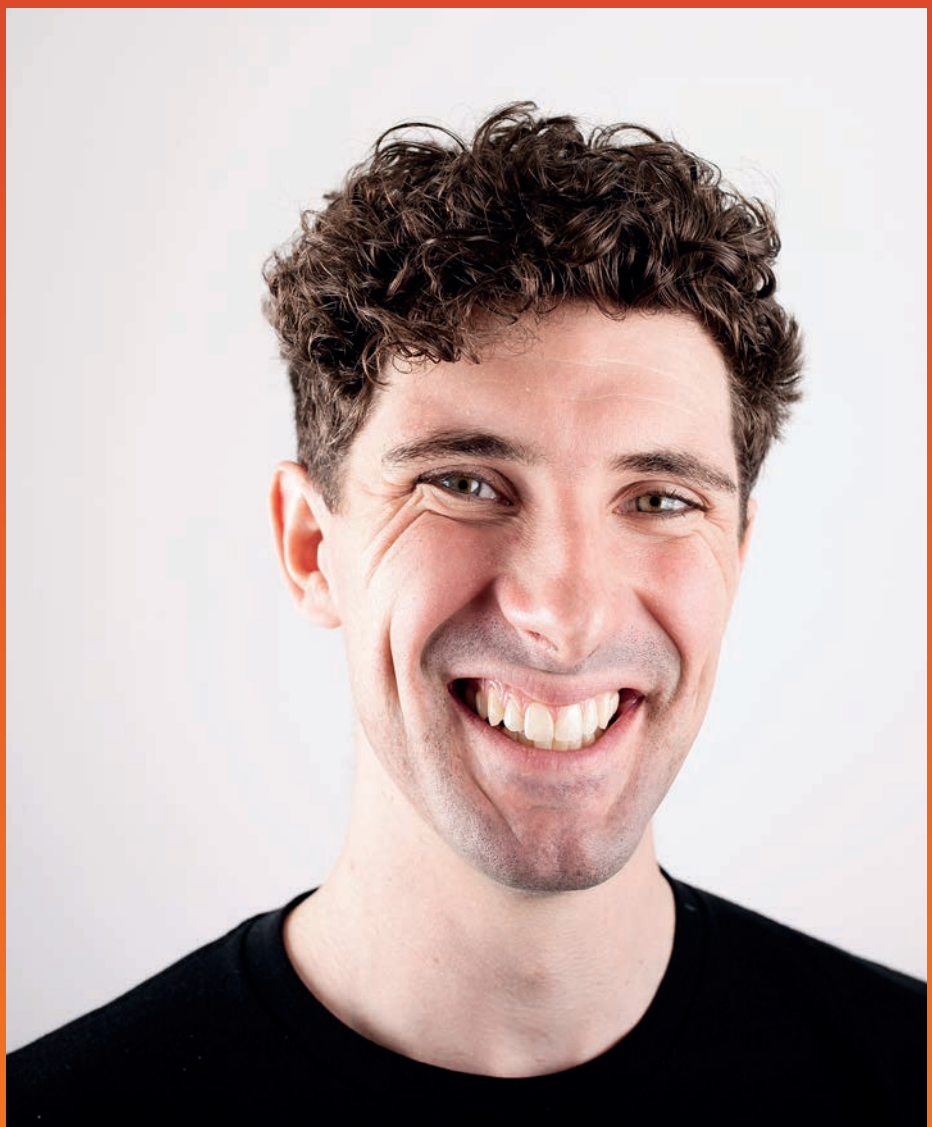
The award is not the first time that the Academy has recognised Professor Subramanian's research. In 2016, it awarded him and two co-founders the Colin Campbell Mitchell Award for their startup Ultrahaptics, which uses ultrasound and complex mathematics to project virtual objects in mid-air. Since receiving the award, the company has grown to over 150 employees across three continents, works with several FTSE 500 companies and closed a Series C funding round in November 2018, which was oversubscribed. It is now valued at over £250 million. Professor Subramanian believes that he has benefited from his link with the Academy: "Promoting the quality of engineering at Ultrahaptics has helped the company to attract business partners and investors. The biggest benefit is the Academy's reputation and willingness to work on challenging research ideas with a view to bringing them to commercial fruition. I am always amazed to learn how flexible and nimble the Academy is in responding to an emerging opportunity while maintaining its high standards and royal charter."

"My affiliation with the Academy through the award has helped my group to launch a world-leading research facility that is ambitious, self-sustaining and focused on pursuing frontier research," says Professor Subramanian. "Specifically, it has allowed me to dedicate 100% of my time to research, which has meant that I can develop my activities by being available to my team. In the last 12 months, my research group has expanded from 10 people to 25 – and we still have capacity to grow."

From
ENGINEERS TO ENTREPRENEURS

The Academy continues to support engineering innovation through the Enterprise Hub. Over the past six years, it has helped increase the number and quality of high-growth UK engineering and technology companies that solve some of society's most pressing challenges. Hub members are founders of startup and spin-out companies and leaders of small businesses. Their innovations span sectors including healthcare and space, robotics and AI, as well as clean energy. At present, there are 168 Hub members who have started 114 companies, creating more than 430 jobs. Since becoming Hub members, they have attracted £90 million in follow-on funding for their startups, spin-outs and SMEs. For every £1 of grant funding received, Enterprise Fellows have secured a further £21 in additional investment.

Members join the Hub through the three following programmes of support. The Enterprise Fellowships, which offer the university academics and recent graduates commercialisation support – funded by BEIS, The Royal Commission for 1851, and the ERA Foundation. The SME Leaders Award is a programme that supports the development of leadership skills through training courses, workshops, coaching and mentoring. The Launchpad Competition offers commercialisation support to entrepreneurs aged 18 to 25, funded by the Gammon Family.



Enterprise Hub member George Wright, Founder and CEO of Vochlea Music

The Enterprise Hub has

168

Hub members

Developing successful startups

In 2017, George Wright was awarded an 1851 Royal Commission Enterprise Fellowship to develop the skills to commercialise his music technology company, Vochlea Music. The company's audio engine understands vocally produced sounds, such as humming and beatboxing, and uses machine-learning algorithms to transform them into recordings of rhythms and melodies.

Since joining the Hub, Vochlea Music has expanded to become a team of four people and the Royal Commission 1851 Enterprise Fellowship has had a significant impact on the company's success. "The mentorship combined with the wider support network means I've always had someone in my corner," George says. "From the struggles of fundraising to the more mundane aspects, such as finding the right accountant, the mentors at the Academy have provided invaluable assistance on my journey so far. That, coupled with the financial support and access to great resources at the Hub's physical base, the Taylor Centre, really sets the Enterprise Fellowship far and beyond other enterprise support programmes."

Over this time, George has also exhibited, demo'd and pitched at international events, and built relationships with industry experts such as Abbey Road Studios and Universal Music. Vochlea Music has appeared in several publications, including *WIRED*, *The Observer* and *The Sunday Times*.

Vochlea Music launched its first product, Dubler Studio Kit, in March 2019. It allows musicians to lay down beats vocally (below) while simultaneously playing another instrument, or to manipulate and modulate sounds based on vocal timbre.

The Academy provided business training and mentoring to **236 engineering entrepreneurs** from **19 countries**

Supporting **GLOBAL INNOVATORS**

As a national academy with a global outlook, the Academy also supports researchers and innovators from across the world. It does this through programmes and awards such as Frontiers of Engineering for Development, Leaders in Innovation Fellowships, Africa Catalyst, Higher Education Partnerships in sub-Saharan Africa (HEP SSA), and the Africa Prize for Engineering Innovation.

The Academy's international activities have increased significantly over the past year, which has led to the team being restructured to focus on two separate areas: international partnerships and sustainable development. This arrangement improves the robustness of management and oversight over a larger and more complex portfolio. It also ensures a more equal balance between the partnership and development aspects of the Academy's international activity.

The international partnerships team looks after activities that support the UK engineering profession's global outlook. This includes the development and delivery of international mobility and multinational partnership programmes to support engineering innovation and skills.

At the beginning of 2018, the Lloyd's Register Foundation asked the Academy to implement three programmes to: build engineering skills where they are most needed; improve safety at the end of engineered life; and improve safety of complex systems. This resulted in the formation of a new department within the international partnerships team, with three new employees recruited to manage the programmes.

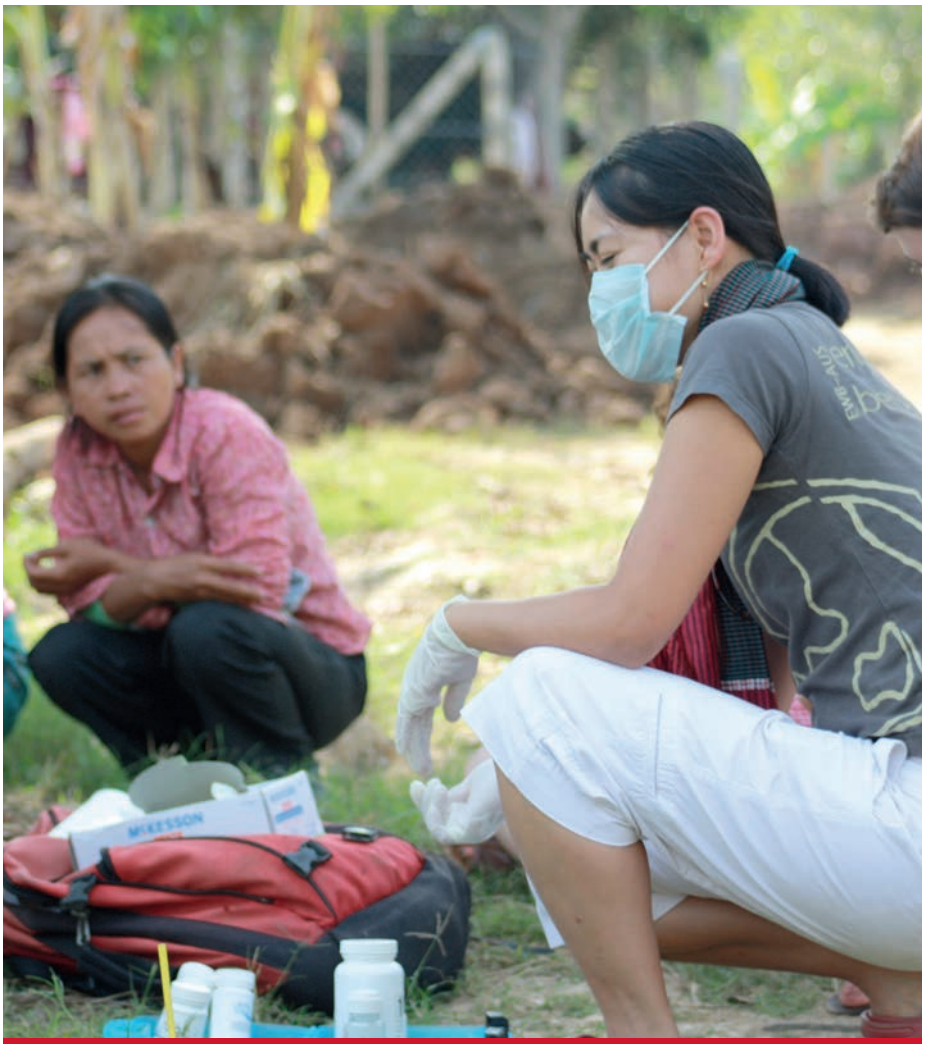
The skills programme has commissioned The Economist Intelligence Unit to conduct a Global Engineering Capability Review, mapping skills to current and projected demand for countries across the world. Later, in 2019, the safer complex systems programme will hold a workshop to scope and identify case studies of global failures and successes. The Academy will also lead a global review on safe decommissioning. The study will map global engineered waste flows and assess the relative safety of decommissioning practices. This review will identify unsafe hot spots for each sector, which the Academy will then address with relevant stakeholders. It will identify challenges through thematic workshops and fund collaborations.

Meanwhile, the sustainable development team delivers a range of capacity-building programmes focused on advancing engineering's contribution to a safer, healthier, more prosperous world for people in developing countries and emerging economies. Its current priorities are:

- Fostering innovation and entrepreneurship: seed funding, training, mentoring and profile-raising via Newton Fund Leaders in Innovation Fellowships and the Africa Prize for Engineering Innovation.
- Engineering capacity building in sub-Saharan Africa: grant funds, partnership provision and networking via the Global Challenges Research Fund (GCRF) Africa Catalyst and the Higher Education Partnerships in sub-Saharan Africa (HEP SSA) programme.
- Connecting early- to mid-career researchers: seed funding and interdisciplinary, international networking symposia on development challenge themes via the Frontiers of Engineering for Development and Frontiers of Development programmes.

© Kit Oates

Over the past year, HEP SSA has funded six new partnerships between engineering faculties in the UK and countries in sub-Saharan Africa. Four interdisciplinary symposia have been held globally, resulting in 27 seed fund awards to support new, collaborative research.



"Studies have shown that 'context' – the 'why you are doing something and for whom?' – is just as important as the 'content' – the 'what you are doing' – to bring greater diversity into engineering," explains Dr Tran. "Humanitarian engineering (engineering for development) has benefited enormously from the Academy's support and its drive to find sustainable solutions to alleviate poverty and protect the environment."

Addressing the UN's Sustainable Development Goals

Launched in 2016 and funded by the Global Challenges Research Fund, Frontiers of Engineering for Development's (FoED) interdisciplinary symposia bring together 60 exceptional early-career researchers and engineering leaders from industry and academia to tackle global development challenges. Attendees at the events are encouraged to collaborate on projects that will address the UN's Sustainable Development Goals, and to apply for seed funding to take those projects forward.

Dr Anh Tran, a senior lecturer in humanitarian engineering at Coventry University, has attended three of the symposia in Cambridge, Pretoria and Ho Chi Minh City. As an early-career researcher, Dr Tran was keen to gain experience in research project management and to coordinate challenging research in a development context. "Attending FoED has enabled me to connect to a wider network of innovators in development and has supported my research directly through ring-fenced seed funding," she says. "Academics are under immense pressure to research, teach and engage with communities and having this grant has allowed me to dedicate more of my time to research. Being part of three seed-funded grants, both leading and contributing as a team member, has enabled me to develop my research career. It has expanded my international networks and allowed me to focus on research at my academic institution. Travel and networking opportunities have allowed me to build trusting relationships with practitioners on the ground."

Dr Tran has since secured a further £1.5 million of funding for research projects to develop sustainable solutions to alleviate poverty and protect the environment directly and indirectly from the collaborations she has developed through the Academy. She has also been invited to sit on FoED's steering committee to provide strategic leadership for the programme. "I believe with my extensive experience on the programme, I can contribute to the discussion from an early-career researcher perspective as well as a woman, international, minority background engineer," she adds. "The Academy is at the forefront of advocacy for greater diversity in engineering: it doesn't just talk-the-talk, it actively promotes 50:50 panels and provides opportunities for non-traditional career paths."

Visitors to the Academy's stand at The Big Bang Fair

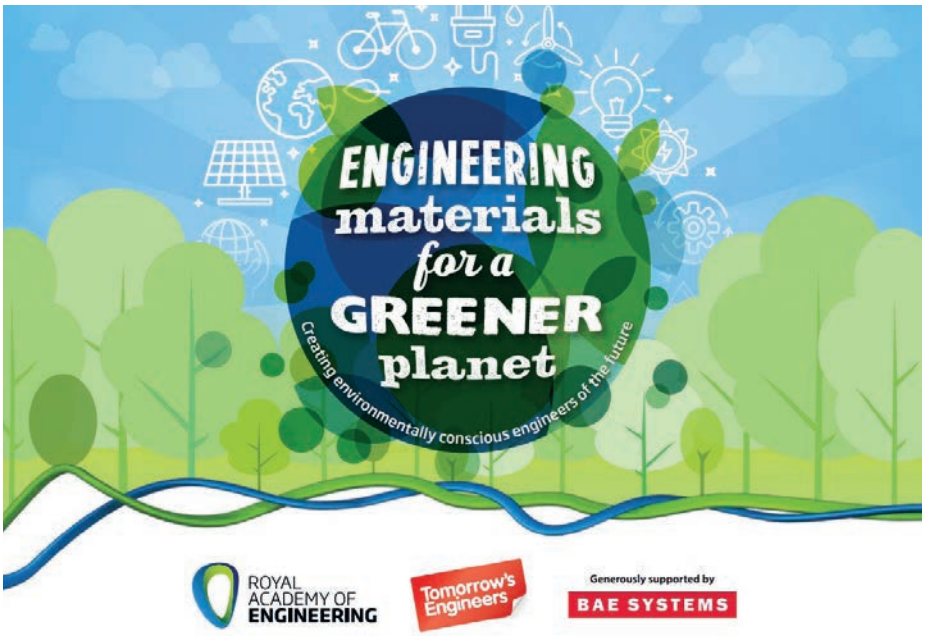
Address the **ENGINEERING SKILLS CRISIS**

The UK is not producing enough high-quality engineers to meet its needs. To address this, the Academy's education and diversity and inclusion (D&I) activities are working to develop an education and skills system that inspires and motivates young people from all backgrounds to study STEM subjects and take up careers in engineering. Academy education projects have worked with hundreds of schools, colleges and educators to strengthen the quality of engineering education. It also works to equip young people with the skills needed to address current and future societal challenges and positively impact the economy.

The Academy's flagship Connecting STEM Teachers programme continues to support and train teachers across all STEM subjects, giving them the confidence to deliver a practical, hands-on engineering-based STEM curriculum for primary and secondary pupils. In the past year, teacher coordinators have led 185 regional network meetings that were attended

Over
1,000
STEM teachers from
700 schools
attended network meetings

The Academy supports **108 engineering undergraduate students** through its Engineering Leaders Scholarship scheme



Engineering Materials for a Greener Planet is number 13 in a series of themed resource boxes. It features real-world engineering activities that put the environment at the heart of learning. Each challenge is linked to the Engineering Habits of Mind, which explores ways to create better and more engaging learning opportunities for would-be engineers.

by over 1,000 STEM teachers from 700 schools. It is estimated that nearly 84,000 students, 48% of whom were female, benefited from their teacher attending these training sessions.

As part of this support for STEM teachers, the Academy has continued to develop engineering-based, curriculum-linked STEM learning and teaching resources that bring real-world engineering into the classroom. The Academy has developed a new resource to support the BAE Systems, Royal Navy and Royal Air Force Schools Roadshow. *Are we connected?* explores engineering through the technology we communicate and interact with. Students work together through engaging activities that promote discussion about connecting and communicating using mobile phones, GPS and AI technology, programming and coding, encryption, and cybersecurity. Nearly 8,000 resource boxes, with associated training, have been provided to primary and secondary schools across the UK in the last year alone. The resources are free to download on a variety of platforms and have been downloaded nearly 50,000 times, with 5,000 of these in the last year.

The Academy's regional STEM support programmes in Barrow-in-Furness and the Welsh Valleys, which provide long-term, targeted interventions in areas of high socioeconomic deprivation, continue to go from strength to strength. Together, they have supplied more than 10,000 STEM learning opportunities to students from 15 primary schools, 14 secondary schools and three post-16 colleges in the last academic year, with a gender ratio of exactly 50:50. The Welsh Valleys project, supported by the Panasonic Trust, delivers the Panasonic Trust Future Engineers Awards. These support students from secondary schools to study either vocational engineering courses or STEM A levels at local colleges, before eventually going on to study engineering at university. In 2018, nine awards were made to promising future engineers. These students have taken on an ambassadorial role, going back to their schools to support teaching and learning and encourage other prospective engineers.

In higher education, the Academy continues to support engineering undergraduate students through its Engineering Leaders Scholarship scheme. In 2018, it awarded an additional three enhanced scholarships worth £10,000 each to students from underprivileged backgrounds with the launch of the Sir Ralph Robins Scholarship fund. These students will receive additional support, mentoring and internship opportunities from Rolls-Royce. All the scheme's students receive £5,000 for personal development, which will put them on an accelerated path to leadership positions within engineering, usually within five years from the end of their awards.

Introducing **INDUSTRY TO ACADEMIA**

In the last year, the Academy's Visiting Professors (VP) programme supported 78 leading engineers from industry to deliver 1,250 taught sessions to engineering undergraduates in 42 different universities across the UK, including nine post-1992 universities. The programme imparted real industrial knowledge, experience and insights into cutting-edge technology, enhancing the learning experiences of more than 15,000 undergraduate engineering students.

In 2017, materials engineer Dawn Bonfield MBE was appointed as a VP in inclusive engineering at Aston University. The goal of the appointment was for Dawn to support the university in becoming a UK leader in embedding inclusivity into the engineering curriculum by using her experience in D&I – developed during her time working with the Women's Engineering Society.

Key to this was her work to engage heads of department and programme directors of all engineering and applied science schools at the university. During this time, she delivered inclusivity content to two student groups and had advanced bookings to present to 250 engineering students in the second year of her tenure. She was also a founder and steering group member of Inclusive Aston, which brings together a variety of inclusion activities to maximise impact across the campus. She was also instrumental in setting up the Women's Engineering Society student group.

In her second year, Dawn developed a half-day training course on inclusion for final-year students. Other activities included the development of materials for students, covering areas such as inclusive product design, current legislation, standards and codes of practice, inclusive engineering tools and practices, diversity benchmarking, measures and targets, and case studies with industrial speakers. With Aston staff, she delivered two masterclasses, a final-year option for engineering and applied science, as well as incorporating inclusivity material into three modules.

Longer term, Dawn is keen to ensure that inclusion is understood and promoted throughout the engineering profession. This is based on it being embedded in engineering education: "There is a need to ensure that the profession these new recruits are attracted into is fully inclusive. An inclusive profession will produce inclusive products and services that have greater potential to enhance productivity and creativity in the sector."

Dawn Bonfield MBE

Encouraging
YOUNG PEOPLE INTO ENGINEERING

The Academy has been working with EngineeringUK to simplify and streamline the whole engineering community's outreach to schools. There are many excellent programmes aimed at doing this, however, these are not having an effect at the scale needed. The connections with schools are complicated, with more than 600 organisations involved in STEM education. Too many options can make it difficult for schools to find out what is on offer and can limit the opportunity to transfer best practice.

Both the Academy and EngineeringUK are focused on repositioning the Tomorrow's Engineers programme to bring greater coordination and coherence to the STEM activity landscape in schools. The programme is centred around a new web platform that will promote a suite of high-quality, engineering-focused activities to teachers. Providers that wish to be included on the platform will be expected to meet a minimum set of requirements for careers messaging, evaluation of impact, D&I, and safeguarding/health and safety.

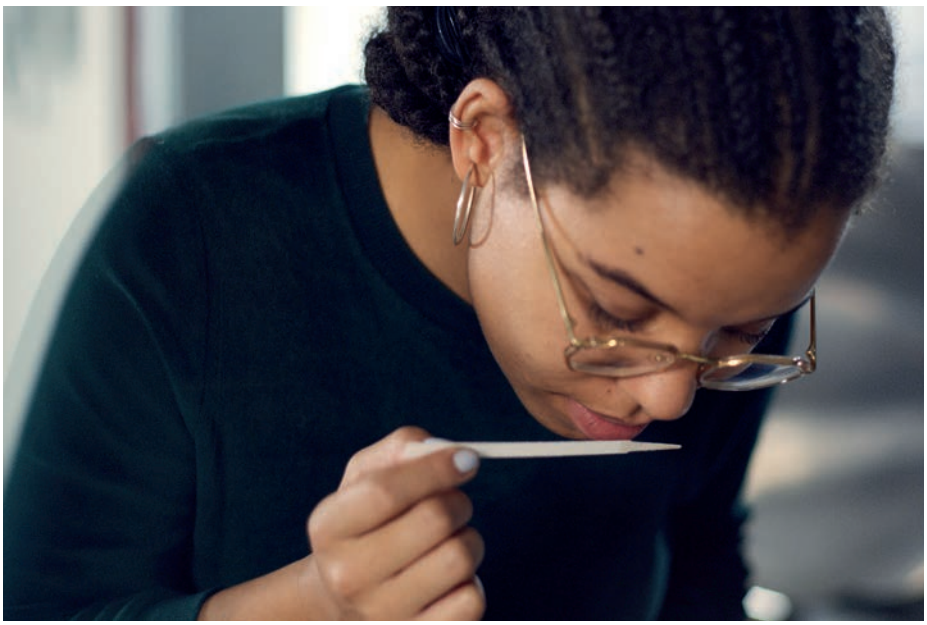
A progression framework will be developed to encourage providers to continuously improve their activities with more robust models of evaluation, deeper embedding of careers messaging and D&I. A beta version of the web platform is being developed for a year-long pilot of the programme beginning in June 2019. The full roll-out of the new website and Tomorrow's Engineers programme is expected in September 2020.

Running alongside this work, the second and third seasons of *This is Engineering* have outperformed initial expectations and the films have been viewed more than 35 million times. These have been shown at an increasing number of events each year: in 2018 the films were shown at the Academy's *This is Engineering*-focused stand at *New Scientist* Live as well as featuring prominently at the Big Bang Fair, both on the Academy stand and the main stages.

The Academy carries out rigorous quantitative evaluation after every season launch to test campaign effectiveness among the target audience of 13 to 18 year olds. The last exercise showed that the campaign:

- is reaching the target market – 23% of the sample recall seeing the campaign
- raises understanding about engineering – 67% of those who have seen it say that they understand what engineers do, up from 36% before its launch
- raises the prestige of engineering – 66% of those who have seen the campaign believe that engineering is a prestigious career, up from 47% before its launch
- is encouraging young people to consider engineering careers – 72% of those who saw the campaign say that they would consider a career in engineering, up from 39% before its launch.

The fourth season will launch in September 2019. A key component will be *This is Engineering Day* on 6 November, during Tomorrow's Engineers Week. The day will bring together a range of partners and brands to celebrate the engineers who often work behind the scenes and publicly showcase what engineers and engineering really look like, in order to challenge the stereotype.



Olivia Sweeney, a chemical engineer working for cosmetics company Lush, who featured in season three of *This is Engineering* films

Embedding **D&I IN ENGINEERING**

The Academy is committed to increasing D&I across engineering, not only to attract more underrepresented groups into the profession to address the skills gap, but to harness the positive impact it has – on individual engineers, financial bottom line, innovation and creativity.

The Academy's D&I programme has developed tools to help engineering organisations address the lack of diversity within the profession – just 12% of engineers are female and 8% are from ethnic minority backgrounds[1]. In June 2018, the Academy launched an Inclusive Recruitment Toolkit developed by the D&I Leadership Group (DILG). The toolkit aims to help employers refine their recruitment processes so that they are more inclusive and reduce opportunities for bias. This was followed in November 2018 by the *D&I Measurement in Engineering* booklet. This provides a framework for organisations to measure D&I from an employee lifecycle perspective. The guide looks at leadership, recruitment and attraction, retention and progression. The group is also developing a toolkit for diversity allies and a set of training modules focused on inclusive team working, which will be available by the end of 2019. These respond to recommendations from the September 2017 report, *Creating cultures where all engineers thrive*.

Speakers at an Academy D&I event to launch the *D&I Measurement in Engineering* guide

As well as assisting employers to improve D&I in engineering, the Academy continues to support engineers from a range of backgrounds. Following the successful pilot of the Graduate Engineering Engagement Programme, the Academy launched a full programme in June 2018. The first set of events took place between September and December 2018. The programme's aim is to increase employment opportunities for underrepresented groups in engineering, focusing on students from the post-1992 universities.

During 2018/19, 184 students attended Graduate Engineering Engagement Programme events: **28% were female, 91% were from ethnic minority backgrounds** and **80% were from newer universities or socioeconomically disadvantaged backgrounds**

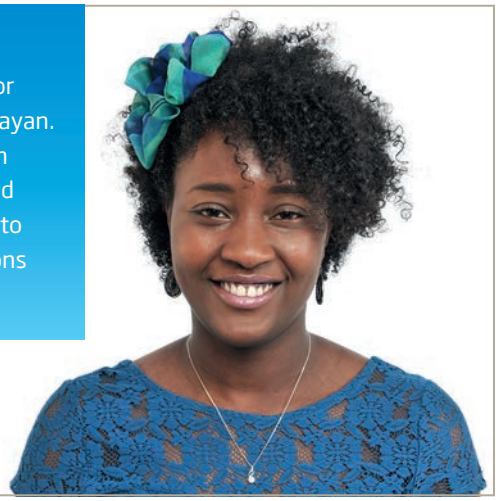
1 *Engineering UK 2018: The state of engineering*, page 13

Amplifying inclusivity

During October 2018, the Academy celebrated Black History Month by showcasing some of the leading black, Asian and minority ethnic (BAME) engineers it has worked with. The stories told included personal accounts of how they engaged with engineering, their career highlights, and what more needs to be done to encourage people from diverse backgrounds into the profession.

One of the engineers profiled was Dr Nike Folayan, Technical Discipline Leader–Communications and Control (Rail) at WSP Global and Founder and Chair of the Association for Black and Minority Ethnic Engineers (AFBE-UK). "In 2007, when AFBE was founded, there were fewer BAME people in engineering," Dr Folayan adds. "Since then, there has been an increase from 6% to 7.8%, with D&I recognised as a key component in filling the skills gap and in improving innovation. That said, more research is required to understand which ethnicities are actually represented in engineering as BAME communities are not homogeneous. Although it is encouraging to see the increase, the engineering industry needs to recognise that the UK's ethnic minority population is projected to make up 30% of the population by 2050. As such, much more needs to be done to engage and retain BME groups within engineering in order to secure the future skills requirement."

"Over the years, the Academy has amplified the inclusivity message for ethnic minority groups," says Dr Folayan. "This has had a significant impact on the way our message is received and has encouraged the wider industry to engage with grassroots organisations such as AFBE-UK."



Dr Nike Folayan

The Academy works closely with AFBE-UK, providing support through sponsorship, jointly organised events and activities, research avenues and direct engagement. Dr Folayan has also been involved in several Academy initiatives such as the Engineering Leaders Scholarships and the D&I steering group as well as supporting the Africa Catalyst project.

EDUCATION POLICY REPORTS

April 2018
Career Framework for University Teaching: background and overview
An open-access resource to help universities evaluate and reward academic staff teaching achievements.

July 2018
Designing inclusion into engineering education
A fresh, practical look at how diversity impacts on engineering and strategies for change within the education system.

October 2018
Learning to be an engineer: the role of school leadership
A look at the critical role of school leadership teams in the delivery of engineering education.

October 2018
Tinkering for learning
Learning to teach engineering in the primary and Key Stage 3 classroom building on previous work identified in the *Engineering Habits of Mind* report.

December 2018
Engineering and manufacturing T level: Common core content
Academy guidance for employers who are drafting the content of the engineering and manufacturing T level.

December 2018
Engineering the future: training today's teachers to develop tomorrow's engineers
Explored the potential for supporting university students training to become primary teachers in computing, D&T and science, to better understand engineering.

January 2019
Engineering skills for the future
This report revisited the 2013 Perkins Review to provide an overview of the current engineering skills landscape and make recommendations for improvement.

February 2019
Evaluation of university technical colleges (UTCs): final report
This evaluated project-based learning and employer-informed curriculum development and delivery aspects of university technical colleges between January 2017 and December 2018, in order to understand effective practice and broader challenges.

Bradford Science Festival, where engineers supported by the Academy's public engagement scheme *Ingenious* delivered workshops

Position engineering **AT THE HEART OF SOCIETY**

Much of the work that the Academy carries out aims to improve public awareness and recognition of the crucial role engineers play, both in the UK and internationally. The Academy's Fellowship is a hugely valuable resource and ensures that the voice of engineering is heard and heeded in the public domain. The Fellows' expertise is harnessed to provide authoritative policy advice and enables the Academy to lead the profession in the UK and beyond.

The beginning of 2019 saw the launch of the National Engineering Policy Centre, an ambitious partnership led by the Academy with 39 different engineering organisations. The Centre allows partners to work collaboratively on issues that affect, or should be informed by, the whole profession, while respecting the distinct expertise of each institution.

The Centre will provide evidence-based policy guidance, informed by unparalleled industry, academia and practitioner expertise. It is facilitated by the Academy as the UK's national Academy for engineering. Early work has included policy studies on the ethics of autonomous systems and sustainable housing infrastructure.

The National Engineering Policy Centre represents

450,000

UK engineers

The Centre will also build relationships between policymakers and engineers, growing mutual awareness and enabling policy advice to respond to the needs of both. By working together, the profession can deliver more impactful and agile work on the issues that matter, while providing policymakers with a streamlined route to engineering expertise.

The Academy has been piloting other complementary approaches to share its thought leadership with industrialists and policymakers. A pilot programme for a network of Policy Fellows – senior civil servants and policymakers – will allow them to explore pressing policy questions facing them and their departments. It aims to increase their understanding of engineering and strengthen their propensity to engage with the technical community in the development of policy.

Thought Leadership events were also added to the Academy's existing events programme. These support its development strategy, brand positioning and values, as well as helping provide wider social and networking opportunities. These events are designed to attract stakeholders and build new relationships. Themes for each event are primarily aligned with major policy work.

Over the year, the Academy has also published several of its own policy reports. In partnership with the Royal Society, in September 2018, it published *Greenhouse Gas Removal* (GGR), a report that presents an ambitious plan for the UK to lead the way in deploying GGR methods to avoid the devastating impacts of climate change. The report has influenced the Department for Business, Energy and Industrial Strategy's *Carbon Capture Utilisation and Storage Action Plan* and encouraged research funding. In October 2018, this was followed by *Increasing R&D investment: business perspectives*, which was based on findings from interviews with engineering chief technology officers. The findings were brought together to ensure that engineering businesses are contributing to the debate about how the UK can achieve its ambitious target of reaching 2.4% of GDP invested in R&D by 2027.

The Academy's first online policy resource *Towards trusted data sharing* uses a series of 10 case studies to illustrate emerging examples of data sharing and some of the key enablers and constraints, including governance, business models, technologies and regulation. Drawing on learning from the case studies, a practical checklist for organisations was developed to support better data sharing in the public and private sectors.

The Academy has over **248,000 followers** across its social media channels and its posts are seen more than **1.4 million** times every month

Participants at the National Engineering Policy Centre's plenary session explore potential areas of work

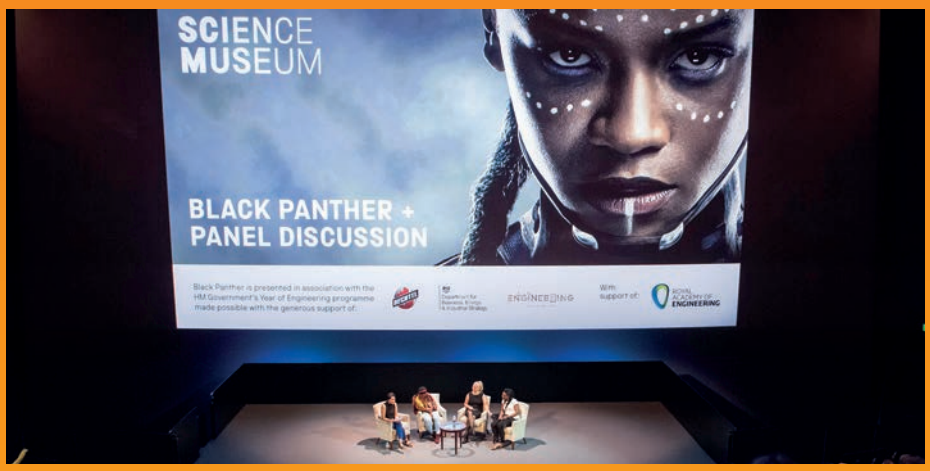
The Academy received **2,215** media mentions in 2018, averaging **184** pieces per month. This included **189** broadcasts on radio and TV

Public engagement **WITH ENGINEERING**

The Academy continues to grow its public engagement activities. At the core of these is its *Ingenious* scheme, which funds creative public engagement with engineering projects and aims to motivate engineers to share their stories and expertise with wider audiences. The projects that are awarded grants are those that focus on underserved communities, including women and girls, BAME groups, and communities in socially deprived areas.

Throughout 2018, the Academy was an active partner in the Year of Engineering, the government-led initiative to inspire the next generation to become engineers. The initiative built successfully on a multitude of national and regional initiatives that already promote engineering and associated skills. These included some of the Academy's own activities such as *Ingenious*, education programmes and STEM learning resources.

In June 2018, the Year of Engineering and the Academy organised a screening of *Black Panther* at the Science Museum to mark International Women in Engineering Day. The event celebrated the role of Shuri, a female engineer in the film, and



The *Black Panther* screening at the Science Museum

before the screening, Angela Saini, science journalist, engineer, and author of *Inferior: How Science Got Women Wrong*, chaired a panel discussion. The panel of real-world engineers and media experts discussed how engineering is bringing technology ever closer to that used in the Marvel world, and how films can influence young people in their career choice.

One of the Year's highlights was a national service of thanksgiving at Westminster Abbey to celebrate engineering. Representatives from across the engineering community, engineering charities and government attended the event, which celebrated great UK engineers of the past and present, and included an address from Academy President, Professor Dame Ann Dowling. Students from local schools also attended the ceremony.

The Year of Engineering resulted in measurable improvements in public perceptions of engineering, especially among young people. The *This is Engineering* campaign will provide a legacy for the Year, building on its success and delivering the sustained engagement needed.

As part of its drive to build engineers' capacity to engage with the public, the Academy ran a communications training pilot for engineers and STEM professionals in collaboration with the Trans-Pennine STEM Ambassadors Hub. Between June and October 2018, it held workshops in Bradford, Manchester and York. In total, nearly 40 engineers and STEM professionals attended the workshops, which covered topics including: understanding your audience; language and use of images; and planning an engagement activity. Delegates were then invited to participate in public engagement events being organised by the STEM Ambassadors Hub to put their learning into practice. The Academy is now assessing options for taking forward the learning from this training, potentially partnering with other organisations to consolidate resources and best practice.

Celebrating **INNOVATION**

One of the highlights in the Academy's calendar is its annual Awards Dinner, which recognises and rewards some of the best engineers and engineering in the UK. At the event in June, Academy President Professor Dame Ann Dowling and HRH The Princess Royal presented the MacRobert Award, the UK's longest-running and most prestigious prize for innovation in engineering, to a team from Owlstone Medical. The company has developed a non-invasive procedure that aims to identify a range of diseases through a simple, quick and painless breathalyser test. It has the potential to save hundreds of thousands of lives and over £1 billion in healthcare costs globally.

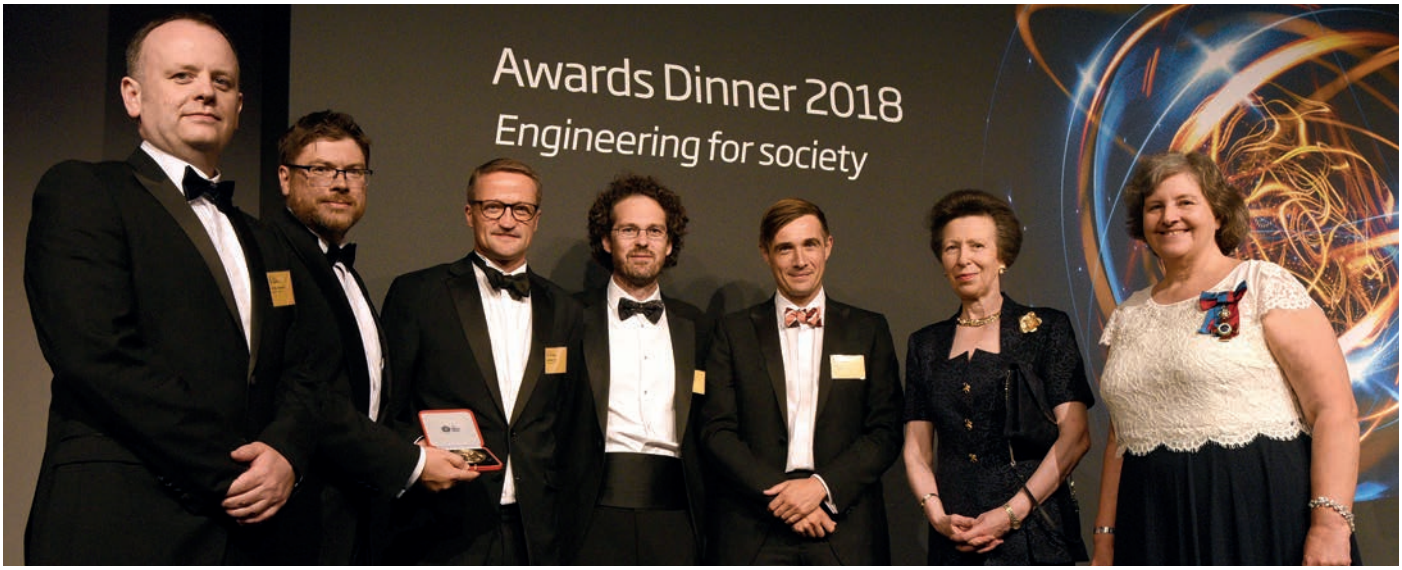
Dr Dame Sue Ion DBE FREng FRS, Chair of the MacRobert Award judging panel, said "Owlstone Medical stood out because of the extraordinary engineering its breath sampler, and the associated Breath Biopsy platform, required to bring these technologies to life. The company has demonstrated exceptional innovation at every stage of development."

The Owlstone Medical team was up against Oxford Space Systems for its new generation of origami-inspired, innovative and cost-competitive satellite antennas and structures. The other finalist was Williams Advanced Engineering and Aerofoil Energy, for aerodynamic shelf-edge technology that significantly reduces energy consumption in supermarket and convenience store fridges. Both companies were presented with a certificate recognising their successful development of innovative ideas in UK engineering.

Owlstone Medical received extensive media coverage in outlets including the *Daily Mail*, *The Daily Telegraph* and *Metro*, local radio and newspapers, and engineering trade press. The finalists also generated interest with coverage in Reuters, local media and trade publications.

Mishal Husain, news anchor and broadcaster, hosted the ceremony at which several other Academy awards were presented. The Major Project Award was presented to the team behind the Ordsall Chord, a new railway line connecting Manchester's Piccadilly and Victoria stations for the first time. HRH The Duke of Kent presented Lucien Bronicki, from Ormat Industries Ltd, with the Prince Philip Medal for his contribution to cost-effective power recovery by successfully developing power plants using organic fluids.

The Silver Medals, which recognise outstanding personal contributions to engineering in the early stage of awardees' careers, were presented to: Dr Jade Alglave, Reader in Computer Science at University College London; Dr Iain Scott, Capability Manager at Leonardo; and Professor Chris Sutcliffe, Professor of Additive Manufacturing at the University of Liverpool and Research and Development Director at Renishaw.



The MacRobert Award-winning Owlstone Medical team with HRH The Princess Royal and Academy President, Professor Dame Ann Dowling

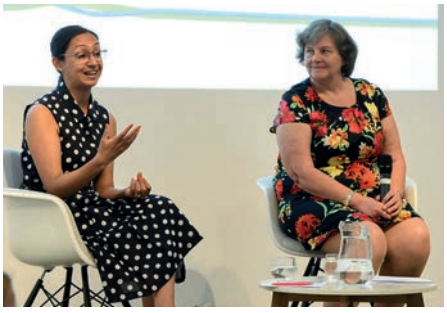
Event HIGHLIGHTS

April 2018
Cutting crime: the role of forensic engineering science – East Midlands regional lecture by Professor Sarah Hainsworth FREng, Pro-Vice-Chancellor and Executive Dean, Professor of Materials and Forensic Engineering, Aston University.

April 2018
To Mars and beyond: engineering our future in space – part of the *Ingenia live!* series hosted by *Ingenia* editor-in-chief Scott Steedman CBE FREng (centre) and with presentations from (L–R) Professor Guglielmo Aglietti FREng, Director of Surrey Space Centre; Anita Bernie, Director of Exploration Missions and Institutional Relations, Surrey Satellite Technology Ltd; Abbie Hutty, Platform Delivery Manager, Airbus Defence and Space; and Shefali Sharma, Business Development, Oxford Space Systems.

Ingenia live!

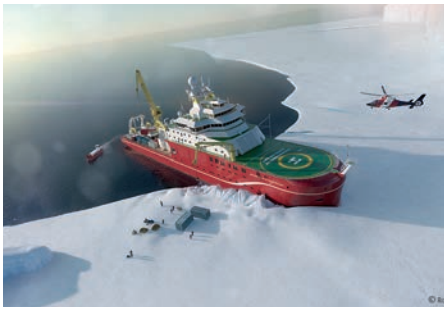
May 2018
The design and construction of Queensferry Crossing: A unique three-tower cable-stayed bridge – the 25th anniversary of the Royal Society of Edinburgh and the Academy's joint lecture, given by Naeem Hussain, Arup's Global Bridge Design Practice Leader and lead designer of the Queensferry Crossing.


Engineering a workplace for women

June 2018
Engineering a workplace for women – inaugural signature lunch for International Women in Engineering Day established to provide a platform for early-career women engineers to meet with senior industry leaders to share advice, experiences and encourage participation from both sides. The event also featured Roma Agrawal MBE in conversation with the Academy's President.

July 2018
Summer Reception – inaugural informal event for Fellows and their partners to network and socialise with each other and to meet outstanding awardees and grant holders funded by the Academy.

October 2018
Extreme Engineering: Antarctica – Fiona Harvey, Environment Correspondent at *The Guardian* in conversation with Captain Tim Stockings, former Operations Director, British Antarctic Survey, about the engineering behind the RRS *Sir David Attenborough*.


Extreme Engineering: Antarctica

November 2018
Why am I a Fellow of the Royal Academy of Engineering? – Hinton Lecture delivered by Dame Stephanie Shirley CH DBE FREng.

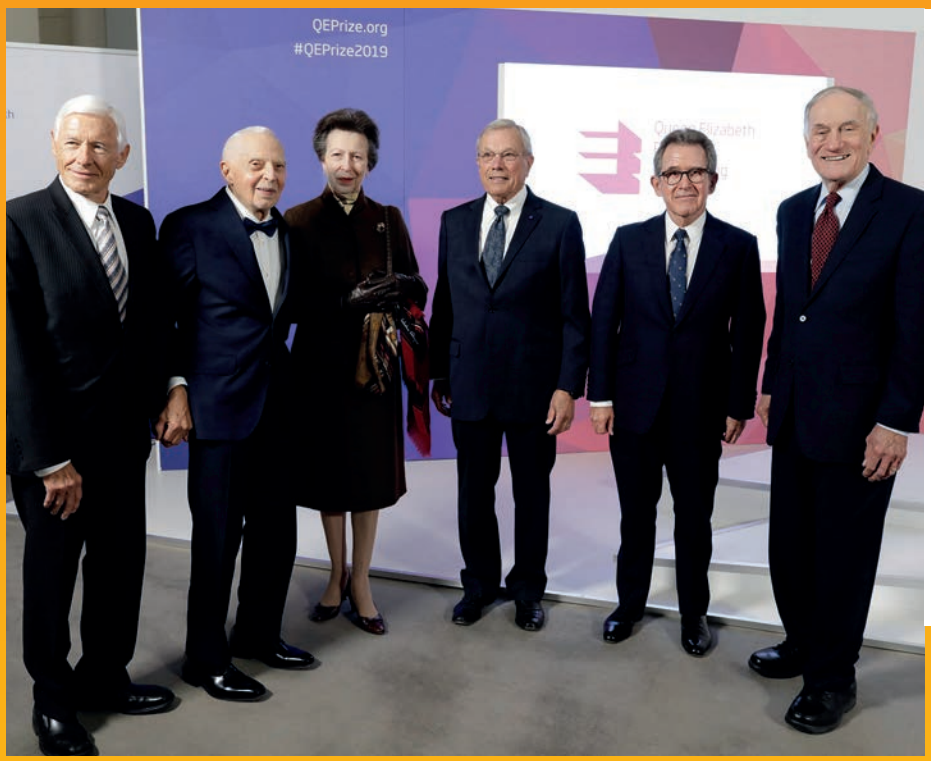
Celebrating
ENGINEERING INTERNATIONALLY

In February, the 2019 Queen Elizabeth Prize for Engineering (QEPrize) was awarded to the four engineers responsible for creating GPS – the first truly global, satellite-based positioning system. The four winners, Dr Bradford Parkinson, Professor James Spilker, Hugo Fruehauf and Richard Schwartz, received the £1 million prize, which celebrates groundbreaking, global engineering innovations that are of benefit to humanity. Their pioneering work has given free, immediate access to position and timing information to over four billion people around the world. This is the fourth time that the prize has been awarded.

The announcement was made by Lord Browne of Madingley FREng FRS, Chair of the Queen Elizabeth Prize for Engineering Foundation, in the presence of HRH The Princess Royal. One of the prize's key aims is to inspire the next generation of engineers, and attendees included leading young engineers who are QEPrize Ambassadors, as well as primary and secondary school students aged between 9 and 13, and business leaders from the QEPrize's donor companies.

The QEPrize announcement received remarkable worldwide media coverage, reaching an estimated 2.4 billion people and increasing awareness of the prize across the world. The announcement, and the work of the 2019 winners, was featured by a range of global media including the BBC, and was covered in *The Times*, *The Daily Telegraph*, CBC, *Forbes*, Mail Online, *Financial Times*, and *The Economist*. It was reported across the UK, US, Canada, France, Germany, Italy, Japan, Korea, Argentina, and Australia.

The winners will be formally honoured at a ceremony later in 2019, when they will also receive an iconic trophy designed by the 2019 Create the Trophy competition winner Jack Jiang, from Hong Kong. The competition, open to those aged between 14 and 24, saw record engagement from over 50 countries around the world. Jack's trophy impressed the expert panel of judges with its complexity and balance, combining traditional trophy shapes with elements of modern wind turbines.



(L–R) Hugo Fruehauf, Professor James Spilker, HRH The Princess Royal, Dr Bradford Parkinson, Lord Browne and Richard Schwartz

Professor Sir Christopher Snowden FREng FRS, Chair of the QEPrize Judging Panel, said about the 2019 winning innovation: "The global positioning system epitomises what the QEPrize stands for; starting with an almost impossible challenge, GPS is now universally accessible and benefits billions of people around the world each day. Over time, its varied applications have profoundly transformed how society operates, and its impact will only continue to grow. This is exactly the type of groundbreaking engineering achievement that inspires young people to become tomorrow's engineers."

Academy employees gather to celebrate International Women in Engineering Day

Enhance the **ACADEMY'S DELIVERY CAPABILITY**

The Academy's credibility with its partners, funders and the engineering community is underpinned by its ability to deliver. To ensure that it has the Fellows, employees, partners, funding and influence to contribute substantially to the UK economy and society, it aims to:

- elect an engaged Fellowship of outstanding engineers who reflect the full diversity of society and the profession
- be an organisation that the best people want to work for
- continue increasing the numbers of partners and supporters
- raise more funding from government and third parties
- embed its values in staff, Fellows and partners, particularly relating to D&I
- ensure that programmes complement those of funders and draw on the Academy's unique capabilities
- routinely evaluate work and measure progress.

The Academy's staff team has transformed and significantly grown over the past year, with the creation of several new roles to accommodate its increasing activities. The number of employees has increased from 92 to 111 and changes have been made across the Academy to incorporate these growing staff numbers. The Academy has implemented a new online HR system to provide a more coherent, centralised HR function and to streamline processes for all employees and managers.

Other significant IT improvements have been made during the year, including a complete overhaul of the IT systems infrastructure, migration of many services to a private cloud, increased cybersecurity and new hardware rolled out across the Academy. Funding for future investment has been allocated to streamline and improve data and contacts management across the Academy through its customer relationship management (CRM) platform. The Academy will also develop a new website to enable improved digital communications, and allow greater integration to the CRM and other systems.

In March 2019, Chris Boyle joined as the Academy's first Director of Operations and Finance. This new role has been created to strengthen focus on operational excellence, accelerate adoption of digital technology and maximise the Academy's resource base.

RAE Trading Limited is a wholly owned subsidiary of the Academy, which partners with CH&Co to provide room hire and catering services, including fine dining, at Prince Philip House. Profits made by RAE Trading Limited are gift-aided to the Academy and are an important source of unrestricted funds.

An inclusive **ACADEMY**

As it grows, the Academy continues to focus on its D&I activities and aims to achieve a Disability Confident rating of level two by the end of 2019. The Disability Confident scheme recognises organisations that are playing a leading role in changing attitudes, and helps potential employees, stakeholders and other businesses identify employers who are committed to equality in the workplace. The Academy is committed to removing barriers to participation to its programmes, in which everyone at the organisation has a role to play: it has an internal D&I strategic plan and each team has its own D&I action plan.

The Academy uses a checklist for organising events that includes reminders about making the event inclusive. In 2018, the Academy published a building accessibility booklet that gives information on the facilities at Prince Philip House to ensure its internal and external meetings and events are fully accessible to everyone. The document includes the building's mobility features, available support for hearing and visual impairments, and information on catering services. Over the past year, braille business cards have been introduced and electronic door buttons fitted.
The Academy and in-house events management team CH&Co encourage delegates to inform event organisers about any adjustment needs at different points in the registration process. For instance, joining instructions for delegates include information on special assistance, accessibility, disabled parking and more. Post event, delegates are asked to rate their experience in terms of venue accessibility, signage, lighting and pre-event communication.

For Black History Month, the Academy profiled leading minority ethnic engineers. Christopher Caulcrick is a researcher in Imperial College London's biomechatronics lab, and features in the *This is Engineering* campaign

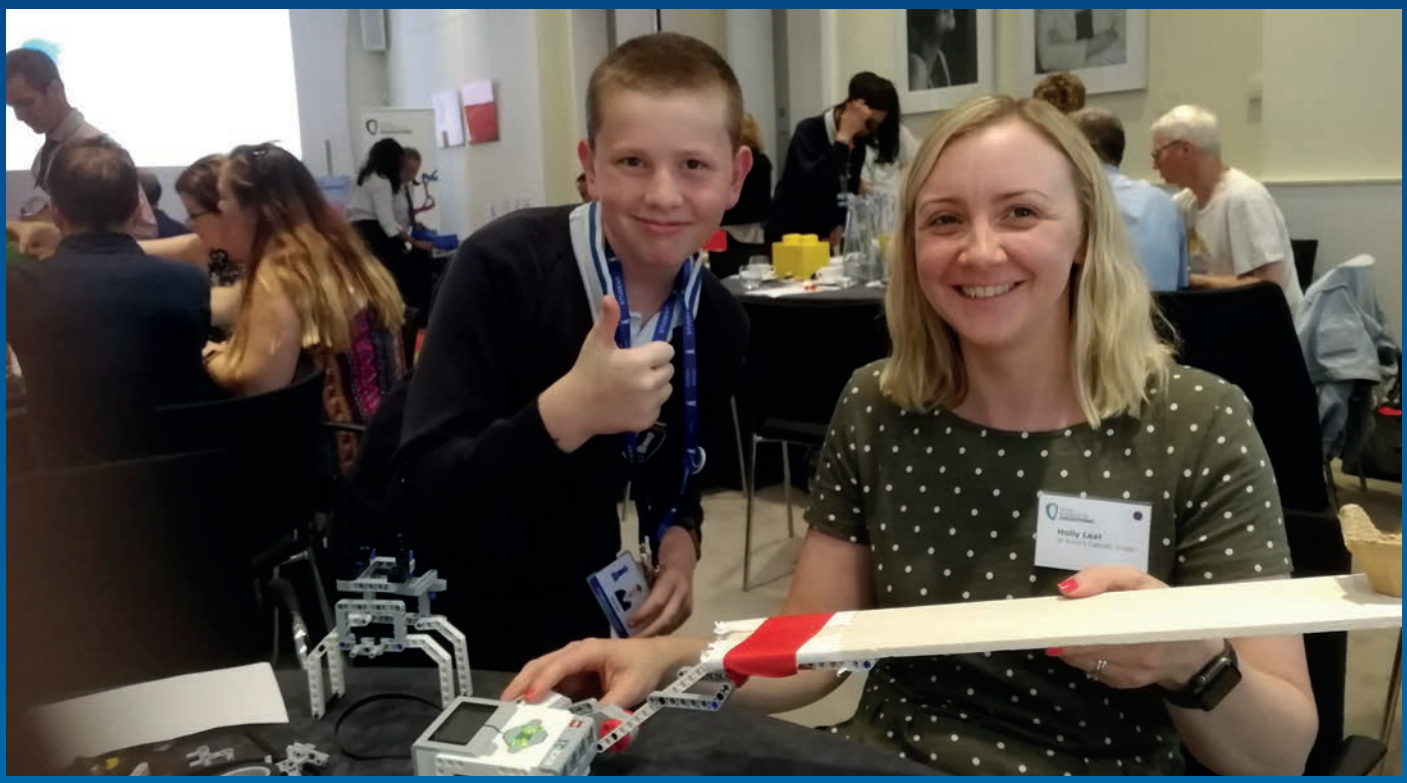
This helps the Academy monitor progress and ensure its events are as disability-friendly as possible. Speakers at Academy events receive briefings that encourage the use of accessible fonts, sizes and images.

Over the past year the Academy has boosted its HR capacity, and organised sessions for employees on topics such as inclusive communication, inclusive selection, disability and mental health in the workplace. The Academy held campaigns for International Day for People with Disabilities, Black History Month, International Women's Day and LGBT History Month. It has also implemented a wellbeing programme for employees, including mindfulness and relaxation classes, monthly coffee mornings and film nights. The Academy benefits from a very active and engaged Staff Consultative Committee, which has supported much of this work.

In a further effort to drive cross-Academy collaboration and provide informal training, the Academy has held monthly 'Insight sessions' on topics as diverse as mentoring, charity law and battery technologies. These hour-long sessions are always well-attended and generate much discussion.

It has been pleasing to see the emerging change in workplace culture with stronger cross-departmental collaboration and partnership, a stronger induction programme for new starters and a wider range of training and development opportunities for staff.

FUNDRAISING



The Academy's education programmes, including Connecting STEM Teachers, benefited from significant support over the past year

In the last year, the Academy secured £18.1 million in new funding commitments for its programmes from industry, charitable trusts and individual donors. A significant contribution of £15 million of funding commitment was provided by the Lloyd's Register Foundation. The foundation is creating a partnership with the Academy to address critical challenges in engineering safety around the world. The Connecting STEM Teachers programme continued to thrive with support from Shell, Petrofac plc, Boeing UK and the Helsington Foundation.

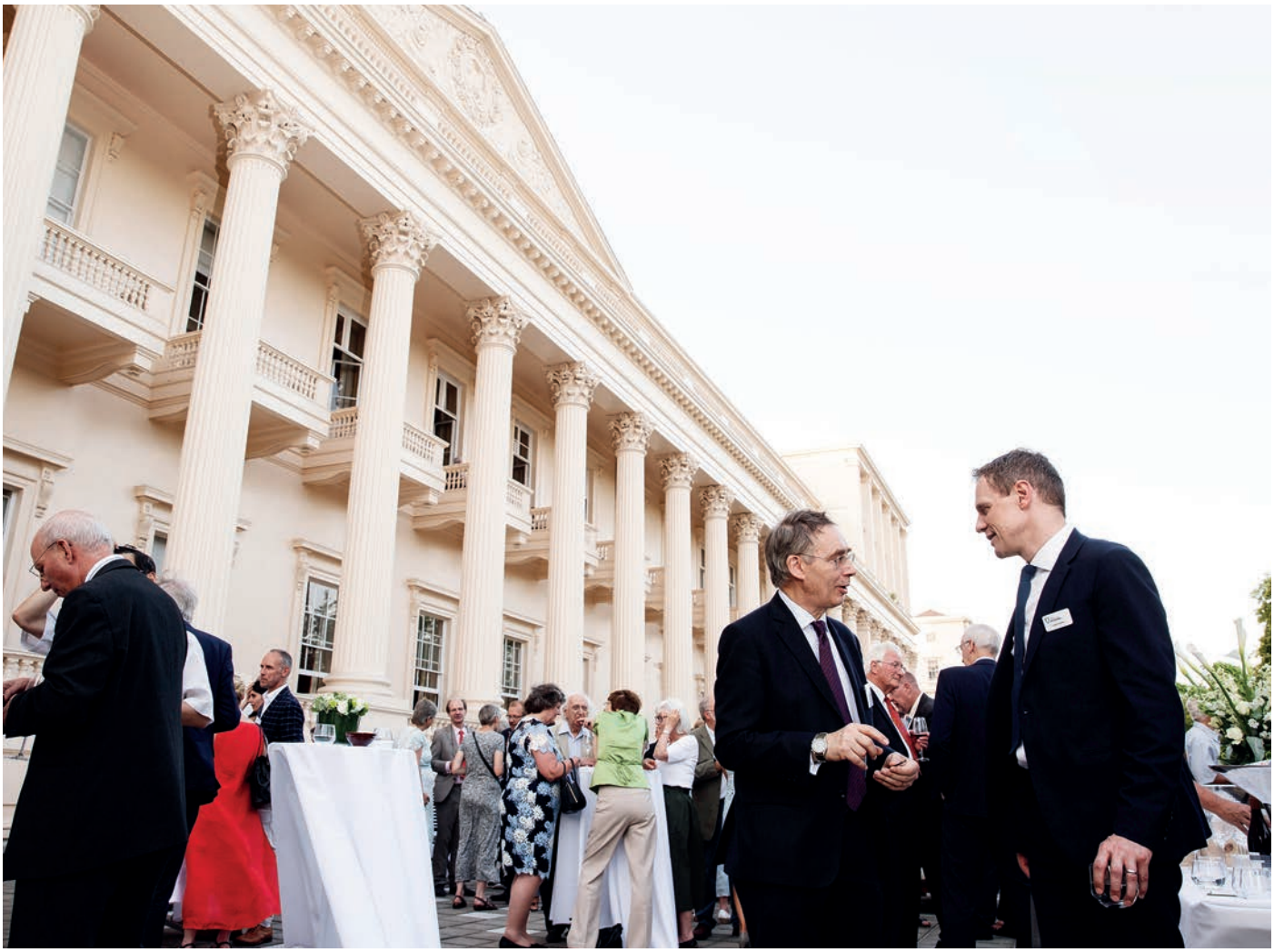
The Academy's Barrow Engineering Project received a seventh consecutive year of support from the Sir John Fisher Foundation. The Welsh Valleys Engineering Project attracted extra support from the Waterloo Foundation and the David Family Foundation, adding to ongoing major support from the Panasonic Trust. The Blavatnik Charitable Foundation renewed its longstanding support of the Enterprise Hub with a further four-year grant commitment. The Royal Commission for the Exhibition of 1851 confirmed major additional support to expand the graduate Enterprise Fellowships programme.

The Academy is grateful to Fellows who contributed to the 2018 Annual Fund and to those who have pledged to leave the Academy a legacy. During the year, generous legacies were received from the late Herbert Clements CBE FREng and Lady Brenda Rooke, widow of Sir Denis Rooke OM CBE FREng FRS, Academy President between 1986 and 1991. During the year donations from friends and colleagues of Sir Ralph Robins DL FREng FRS, former chairman of Rolls-Royce, helped fund a scholarship programme and medal – the latter to be awarded by the Royal Aeronautical Society – to celebrate Sir Ralph's many achievements in engineering and business.

The Academy has continued its efforts to encourage regular giving from Fellows; support from newly-elected Fellows has been especially welcomed. In March 2018, Academy President Professor Dame Ann Dowling hosted the first annual President's Dinner, to thank the Academy's major supporters.

Fellowship **ENGAGEMENT**

The Fellowship is at the heart of the Academy, with Fellows' broad range of expertise underpinning and giving credibility and authority to its activities. Focus continues to be placed on broadening the regional footprint of Academy activity. Fellows' lunches and dinners have been held across the UK, with enhanced communication from the Trustee Board, regional lectures and visits, and the annual Fellows' Day, which invites Fellows to Prince Philip House to learn about Academy activities and meet Trustees, other Fellows and Academy staff. The Academy also introduced new events for Fellows during the year. This included a special lunch for 24 nonagenarian Fellows, hosted by the President, and attended by three of the Academy's Founding Fellows. The President thanked the Fellows for the contribution that their collective knowledge and expertise has made to society and to the Academy's growth and development. The Academy also hosted the first Fellows' summer drinks reception at Prince Philip House, which will become an annual event. Over 140 guests attended, providing the opportunity for the Fellowship to meet in a social setting and for the President to thank Fellows for all that they do. Guests enjoyed drinks and canapes on the Academy's terrace overlooking St James's Park.



Networking at the Fellows' Summer Reception serves to advance the Academy's aims and objectives

Trustee **BOARD**

The Trustee Board comprises 12 Trustees elected by and from the Fellowship and is chaired by the President, Professor Dame Ann Dowling.

Chair
Professor Dame Ann Dowling OM DBE FREng FRS
President

Vice-Presidents
Professor Iain Gray CBE FREng FRSE
Vice-President for Committee Coordination

Naomi Climer CBE FREng
Vice-President for Fellowship Engagement

Members
Professor Colin Bailey FREng
Dr Martin Grant FREng
Dame Judith Hackitt DBE FREng
Dr David Hughes FREng
Professor Peter Goodhew CBE FREng
Dr Bob Joyce FREng
Professor Geoffrey Maitland CBE FREng
Professor Liz Tanner OBE FREng FRSE
Professor Stephen Williamson FREng
Professor Stephen Young FREng

Chief Executive
Dr Hayaatun Sillem

Secretariat
Sylvia Hampartumian

New
FELLOWS 2018

The Academy's Fellows represent the nation's leading engineering researchers, innovators, entrepreneurs, and business and industry leaders. Each year, 50 Fellows are elected by peer review from nominations made by existing Fellows. They are distinguished by the title Fellow of the Royal Academy of Engineering and the postnominal FREng. These were the new Fellows announced at the Academy's AGM in September 2018; their titles were correct at the time of their election.

Fellows

Professor Guglielmo Aglietti
Director, Surrey Space Centre, University of Surrey

Dr Paul Atherton
Chairman, Nexeon Ltd; Phase Focus Ltd; FungiAlert Ltd

Professor Christopher Atkin
Professor of Aeronautical Engineering, City, University of London

Mark Bennett
Strategy Director – Government, BAE Systems Applied Intelligence

Fawaz Bitar
Head of Global Operations, BP plc

Sir George Buckley
Chairman, Stanley Black & Decker Inc; Smiths Group plc

Dr Mark Buswell
Vice-President and Head of Discovery, GSK

Mark Carne CBE
Former Chief Executive, Network Rail

Professor Judith Driscoll
Professor of Materials Science, University of Cambridge

Professor Hugh Durrant-Whyte FRS
Chief Scientist and Engineer, NSW Government

Professor Robert Dwyer-Joyce
Professor of Lubrication Engineering, University of Sheffield

Trevor Gill
Telecommunications consultant

Air Marshal Susan Gray CB OBE
Air Officer Commanding No. 38 Group, Royal Air Force

Professor Timothy Green
Director of the Energy Futures Lab, Imperial College London

Professor Yike Guo
Director of Data Science Institute and Professor of Computing Science, Imperial College London and Shanghai University

Professor Christopher Hewitt
Pro-Vice-Chancellor, Executive Dean and Professor of Biological Engineering, Aston University

Dr Graham Hoare OBE
Director – Global Engineering Operations, Ford Motor Company UK

Professor David Johnson
Director, DGauge Ltd

Professor David Jones
Pro-Vice Chancellor Education and Students, Queen's University Belfast

Dr Raouf Kattan
Managing Director, Safinah Ltd

Dr Niel Kempson CB
Director General for Capability, UK government

Professor Robin Langley
Professor of Mechanical Engineering and Head of Division of Mechanics, Materials and Design, University of Cambridge

Professor Barry Lennox
Research Director Dalton Cumbrian Facility and Professor of Applied Control, University of Manchester

Professor Andrew Lewis
Director of Research and Development, Innovation, Biocompatibles UK Ltd

Peter Lomas
Director of Engineering, Norcott Technologies Ltd

Professor Kwai Man Luk
Chair Professor of Electronic Engineering, City University of Hong Kong

Professor Rebecca Lunn MBE FRSE
Professor of Civil Engineering, University of Strathclyde

John MacArthur
Vice-President Group Carbon, Shell

Professor Ricardo Martinez-Botas
Professor of Turbomachinery, Imperial College London

Paul McKinlay
Senior Vice-President and Head of Broughton Plant, Airbus UK

Hilary Mercer
Vice-President Pennsylvania Chemicals, Shell Global

Professor Andrew Neely
Pro-Vice-Chancellor for Enterprise and Business Relations, University of Cambridge

James O'Callaghan
Founding Director, Eckersley O'Callaghan

Brian Palmer
Chief Executive Officer, Tharsus Group Ltd

Professor Thomas Rodden
Deputy CEO, Engineering and Physical Sciences Research Council (EPSRC); Professor of Computing, University of Nottingham

Nicholas Rogers
Executive Director, Product Engineering, Jaguar Land Rover

Rob Spurrett
Founder and Director, Cherry Space Ltd

Alasdair Stirling CBE
Director Engineering Services, Naval Marine, Babcock International Group

Dr Peter Thompson
Chief Executive Officer, National Physical Laboratory

Professor Rachel Thomson
Professor of Materials Engineering and Pro-Vice-Chancellor for Teaching, Loughborough University

Professor Marco Viceconti
Professor of Biomechanics, University of Sheffield

Professor Jiangzhou Wang
Professor and Chair of Telecommunications, University of Kent

Dr Andrew Ward
Chief Technology Officer, Ubisense Ltd

Professor Rachel Williams
Professor of Ophthalmic Bioengineering, University of Liverpool

Professor Graham Wren OBE
Director of Major Projects and Special Adviser to the Principal, University of Strathclyde

David Wright
Director, Electricity Transmission, National Grid

Dr Richard Yemm
Director, Quoceant Ltd

Professor Paul Young
Professor of Geophysics, University of Toronto

Professor Ken Young
Technology Director, Manufacturing Technology Centre

Professor Zhibing Zhang
Professor of Chemical Engineering, University of Birmingham

International Fellows

Professor Frances Arnold
Linus Pauling Professor of Chemical Engineering, Bioengineering and Biochemistry, California Institute of Technology

Professor Zhenya Liu
Chairman, GEIDCO, Beijing

Dr Harry Shum
Executive Vice-President – AI and Research, Microsoft Corporation

Professor Ji Zhou
Honorary Chairman, Governing Board of Chinese Academy of Engineering

Honorary Fellows

Philip Greenish CBE
Chair of Council, University of Southampton

AWARDS

2018 MacRobert Award

The premier award for innovation in UK engineering, with a £50,000 prize, awarded annually to a team of engineers for an exceptional engineering innovation that has been both commercially successful and delivers benefits to society. The MacRobert Award is supported by the Worshipful Company of Engineers.

Awarded to:
Owlstone Medical for its breath biopsy platform, a non-invasive procedure that aims to identify a range of diseases through a simple breathalyser test.

2018 RAEng Engineers Trust Young Engineers of the Year and Sir George Macfarlane Medal

These awards recognise the potential of engineers working in the UK who have demonstrated excellence in the early stage of their career. The overall winner receives the Sir George Macfarlane Medal.

Awarded to:
Khouloud El Hakim, Project Manager at Bechtel Ltd
Winner of the Sir George Macfarlane Medal
Simon Bowcock, Lead Materials and Corrosion Engineer at BP
Dr Christopher Donaghy-Spargo, Assistant Professor of Electrical Engineering at Durham University
Dr Robert Hoye, Junior Research Fellow at the University of Cambridge
Chetan Kotur, Executive Assistant to the CEO at Polestar

2018 RAEng ERA Foundation Entrepreneurs Award

Awarded to early-career UK university researchers who demonstrate considerable entrepreneurial promise.

Awarded to:
Jack Pearson, CEO, EngX

2018 Silver Medals

For an outstanding personal contribution to UK engineering by an early- to mid-career engineer resulting in market exploitation. Up to four medals may be awarded in any one year.

Awarded to:
Dr Jade Alglave, Reader in Computer Science at University College London
Dr Iain Scott, Capability Manager at Leonardo
Professor Chris Sutcliffe, Professor of Additive Manufacturing at the University of Liverpool and Research and Development Director at Renishaw

2018 President's Medal

Awarded to an Academy Fellow who has contributed significantly to the Academy's aims and work through initiative in promoting excellence in engineering.

Awarded to:
Professor Sir William Wakeham FREng

2018 Prince Philip Medal

Awarded biennially to an engineer of any nationality who has made an exceptional contribution to engineering.

Awarded to:
Lucien Bronicki, Founder of Ormat Industries Ltd

2018 Sir Frank Whittle Medal

Awarded to an engineer resident in the UK whose achievements have had a profound impact upon their engineering discipline.

Awarded to:
John Bartlett CBE FREng

2018 Major Project Award

The award recognises the contribution of a team of up to five UK-based engineers who have delivered a major engineering project that has had a substantial impact on society.

Awarded to:
Ordsall Chord, Great North Rail Project

2018 Colin Campbell Mitchell Award

For an engineer or small team of engineers who have made an outstanding contribution to the advancement of any field of UK engineering.

Awarded to:
University of Nottingham and Teledyne e2v

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