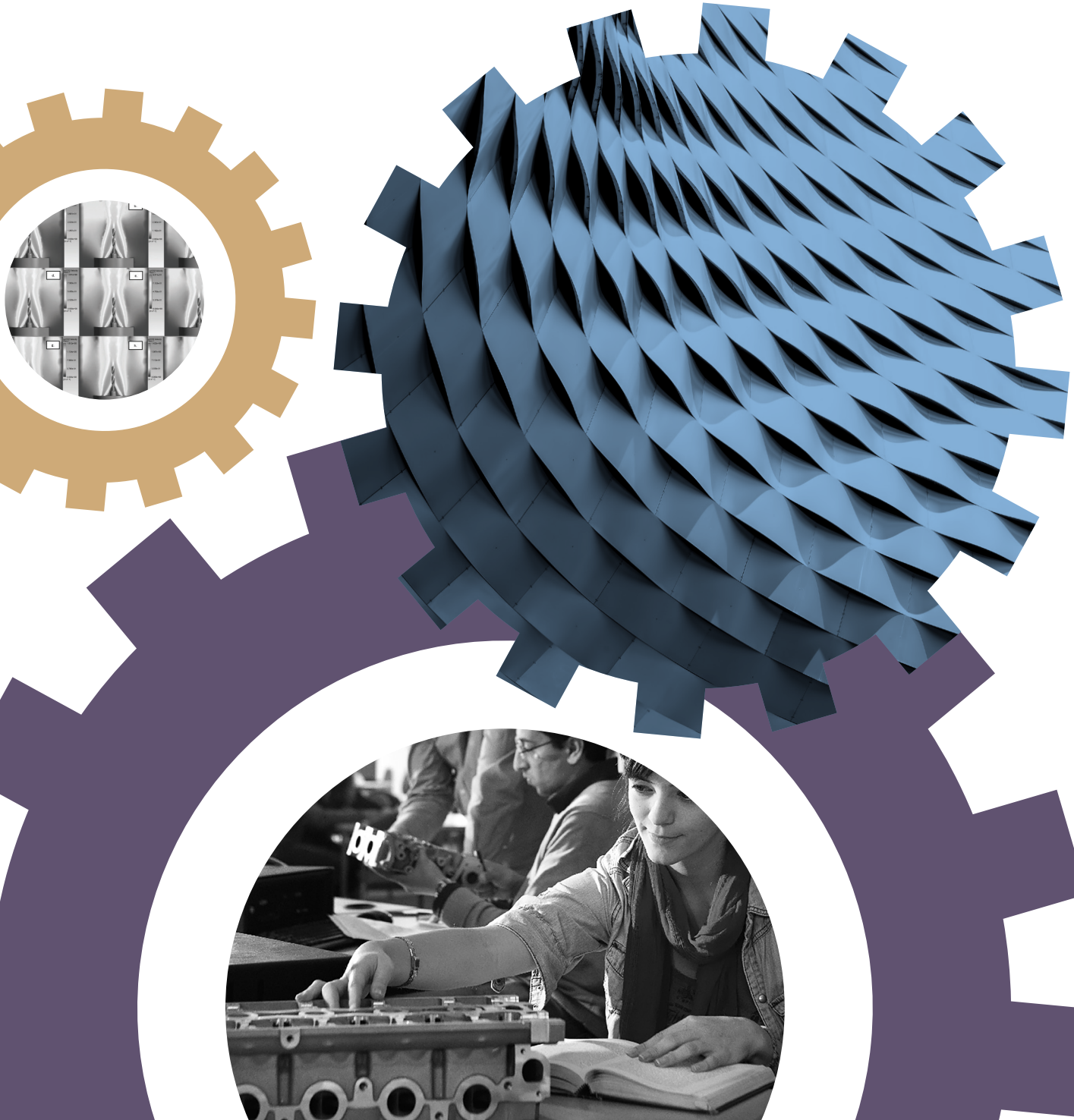
UNIVERSITY OF BIRMINGHAM

SCHOOL OF ENGINEERING

ANNUAL REPORT - DECEMBER 2022



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HEAD OF SCHOOL MESSAGE

Welcome to the first School of Engineering Annual Report. We intend to issue an Annual Report at the end of each calendar year to mark the achievements of the School. 2022 has been a great year for us here at in the School of Engineering at the University of Birmingham. Following the disruption of the pandemic, we have now settled back into "business as usual" with all staff and students back on campus.

In Summer 2021 we moved into our new School of Engineering building. Now that everyone is back, the building has come into its own. This Summer saw the opening of our Makerspace (funded by the Office for Students) which allows our students to exercise their creativity, develop innovative design and support their entrepreneurial skills. In November the Makerspace will host the Sir William Siemens Challenge – a 48 hour hackathon which will be attended by approximately 100 students from across the country.

Our staff base has grown considerably this year, with over 30 new academics and professional services staff who have already joined, or about to join. Our new staff will reinforce our existing research groups as well as allowing us to nurture new groups in sustainable manufacturing, public engagement with science and engineering, asset management, and automation.

The School saw an increase in student numbers at both undergraduate and postgraduate levels. There are now 2,268 students registered. We also launched our Level 7 (MSc) Degree Apprenticeship in Geotechnics; this joins our existing Rail Principal Engineering programme. Employability across the School now standards at 97%. We are placed 1st in the UK for employability for Electronic and Electrical Engineering and Civil Engineering, where employability is 100%.

Our REF 2021 results have been outstanding. The School is now place 10th in the UK, a huge leap from 33rd in REF 2014. Our submissions included five impact case studies from the School in areas as diverse as: Rail, Communications and Sensing, Vehicle Sensing, Quantum Technology, and Alternative Fuels.

At COP26, the Birmingham Centre for Railway Research and Education showcased the UK's first mainline approved hydrogen train with delegates being able to take trips around from Glasgow Central during the conference. Passengers included Prince Charles, Prime Minister Boris Johnson and the University's Chancellor, Lord Billimoria. In just three years the team have developed and proved that zero-emission rail passenger travel is possible.

In this annual report you will read about the exciting work that our students and staff have been doing, as well as the awards and commendations that have been won.

We very much hope you enjoy reading our inaugural School of Engineering Annual Report.

Professor Clive Roberts
Head of School of Engineering
Director, Birmingham Centre for Railway Research and Education

SCHOOL STRATEGIC VISION

The School of Engineering at the University of Birmingham was originally created in 2016, bring together the three pre-existing Schools of: Electronic, Electrical and Systems Engineering, Mechanical Engineering and Civil Engineering. The main objectives for the creation of the new School were to provide a more integrated educational offer to our undergraduate students and to encourage the development of interdisciplinary research.

Six years on, it is clear that the creation of the new School has been a huge success. Our undergraduate programmes that offer a common first year, and interdisciplinary integrated design projects in each year of study are extremely popular with prospective students and employers alike. We have more undergraduate students than ever, and our tariff points (entry grades) have risen. Overall employability is at 100% for Civil Engineering and Electronic and Electrical Engineering, with an average of 97% across all courses. Our research quality has improved significantly, and we are now placed 10th in the country.

As we move forward, we are now building on solid foundations. In our education programmes we are further embedding practical, employability, entrepreneurial and industrial skills. Our new Makerspace is revolutionising how our students are able to develop practical skills. All of our students have the opportunity to learn team building skills (either in at the University's Outdoor Education Centre on Lake Coniston or at the national Constructionarium) which they can put into practice during the numerous interdisciplinary project-based modules that feature in our courses. Our Royal Society funded Entrepreneur in Residence, as well as our four Royal Academy of Engineering Professors and eight Professors of Industrial Practice embed relevant practical content in all our courses.

Moving forward it is our intention to ensure that all students gain experiences of using virtual reality (VR) and augmented reality (AR) tools. We are changing several of our modules, so that they can make use of our new BIM (Building Information Management) Caves and VR/AR headset facilities. This will ensure that students graduate having had hands-on experience with state-of-the-art design tools.

At the postgraduate level we have helped specify new national standards for Level 7 (MSc) Degree Apprenticeships. To date we have developed two programmes – in Rail and Geotechnical Engineering, but we anticipate that we will begin to offer more programmes over the coming years.

In 2023 we will commence MSc programmes in Dubai in Railway Systems Engineering and Integration, and Advanced Engineering Management, with also a BEng/MEng programme in Computer Systems Engineering. Over subsequent years we will continue to add to our portfolio of courses by focussing on the development of new courses that have local relevance.

We are currently in the process of restructuring our research groupings. Going forward School research will be structured around a number of key Research Centres (areas of national significance where we have significant facilities, industrial strategic partnerships and sizeable research activity); Research Groups (based on fundamental engineering disciplines) that will provide line management; and Communities of Practice. We are currently investing in a number of new activities, namely: Sustainable Manufacturing; Future Transportation; Acceptance of Science and Engineering; and Quantum Engineering, while also reinforcing capability in: Automation/Robotics; Asset Management; Communications; Medical Engineering; Railway; and Power Engineering. The School's specific strengths lie in the potential to address large systems based problems that require transdisciplinary solutions – we believe that we are well placed to address the grand challenges as defined, for example, by the UN Sustainable Development Goals and EPSRC's Tomorrow's Engineering Research Challenges.

NEW BUILDINGS NEW BEGINNINGS

2022 West Midlands RICS Award for Best Public Sector Project

SCHOOL OF ENGINEERING, UK

In October 2021, we were delighted to officially open our new School of Engineering building – our new home for Civil, Electrical and Mechanical Engineering research and education.

It was lovely to see so many students, staff, academics, industrial partners, and alumni celebrate these fantastic new facilities. The essence of the building is to encourage collaboration in both education and research.

2021 marked the successful completion of the new £46.5M School of Engineering building at the Edgbaston campus. The state-of-the-art 12,000 sqm facility spans across five floors and features a double-height atrium.

The facility's design was curated specifically with agile and collaborative working between academics, researchers, students, staff, and industry in mind. The development offers open plan spaces and cellular facilities including a dedicated Student Support Hub, a new 179-capacity Design Centre, a 50-seat electronics and electrical focused projects space, 20 flexi-bays specifically allocated for staff and student interactions, three 50-seat seminar rooms, and also features 160 drop-in study spaces throughout the building.

The basement also houses a full-size set of railway points, the University's pantograph test rig and a test track for the scaled hydrogen-powered train – further expanding the University's commitment to the integration of academia and industry.

The unique development brings together many of the engineering disciplines from across the University whilst providing opportunities for successful collaboration between students, researchers, staff, academia, and industry.

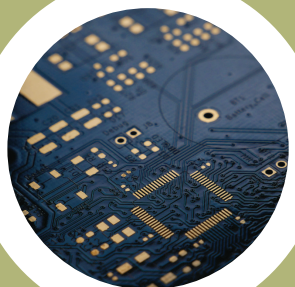
With a focus on enhancing student experience, the new School of Engineering building will encourage undergraduate and postgraduate students to contribute to cutting-edge research and develop a strong connection to the engineering industry. We look forward to welcoming so many more to our school over the coming months and years as our research and teaching grows.

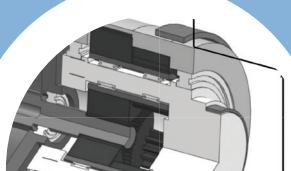
DUBAI CAMPUS

The University of Birmingham's Dubai campus formally opened in April 2022 and began teaching 11 Engineering courses. The facilities include E-Labs, Dry Labs, Wet Labs and a General Workshop allowing the campus to support up to 2,900 students currently, increasing to 4,500 in coming years.

ENTERPRISE HUB OPENS IN GOOLE

The multi-million-pound Rail Accelerator and Innovation Solutions hub for Enterprise (RaisE) business centre in Goole officially opened in May 2022. The Business Centre is committed to support SMEs within the rail sector in terms of the office, meeting rooms, and business provision available. To help fund this £8.1M capital project grant, money was secured including £1.5M from the European Regional Development Fund (ERDF) and £1M from the Getting Building Fund, via the Hull and East Yorkshire Local Enterprise Partnership (HEY LEP). Phase two of RaisE will now follow in collaboration with Siemens Mobility and the University.





SCHOOL ACHIEVEMENTS

Here are a few selected successes made by the School, showcased through awards, commendations, activities and recognition across several fields this year.

Happy Birthday to BCRRE who turned 50! Over the past five decades, Birmingham's Centre for Railway Research ad Education (BCRRE) has grown to become an internationally recognised centre with world-leading expertise in areas including railway control systems, cyber security, climate resilience and much more.

The School were delighted to host educational YouTuber, author and science presenter Steve Mould at our UKRRIN labs to film for his upcoming video on acoustic camera. You can watch it in all its glory on his YouTube channel: **www.youtube.com/c/SteveMould**

The School and the Manufacturing Technology Centre (MTC) have launched a new research group, which will lead a sustainable manufacturing revolution. The group will bring together the expertise of each institution across the R&D and product development lifecycle and working with a range of industrial partners will establish a world-leading research group firmly focused on the decarbonisation of the sector.

Four Batonbearers – three Taylor's students and one University of Birmingham member of staff – marked the Birmingham 2022 Queen's Baton Relay arrival in Malaysia. The Batonbearers ran with the Baton across the Taylor's University campus in Subang Jaya, before presenting it to British Deputy High Commissioner to Malaysia, David Thomas, in a special ceremony. The event was held in partnership with Taylor's University – Birmingham's partner campus in Malaysia – and celebrated the arrival in Malaysia of the Birmingham 2022 Queen's Baton Relay, of which the University was an official partner.

In June 2022, the School hosted the 13th World Congress on Railway Research (WCRR). With over 300 speakers, 340 unique sessions delivered and over 600 paper submissions, the event was a huge success. Delegates from across the global community saw us championing technical developments, advocating collaborations and inspiring the next generation of rail professionals to work together on common challenges.

For work undertaken in the National Buried Infrastructure Facility (NBIF), Aquapira and the University of Birmingham won the 2022 Pipeline Industries Guild (PIG) ICE Award (Inspiring Innovation, Cost-Saving and Efficiency) for our 'SmartSense' innovation & research project. The award, presented biannually, is for the best idea for increasing efficiency and reducing costs in the pipeline industry.

The Editorial Board of the IEEE Open Access Journal of Power and Energy (OAJPE) have awarded the 'Fast frequency support from wind turbine systems by arresting frequency nadir close to settling frequency' paper as the Journal of Power and Energy Best Paper Award. Great news for Dr Ying Xue, Professor Xiao-Ping Zhang and their collaborators.

The School of Engineering was awarded the CE West Midlands Client of the Year Award 2021. CE Midlands is the organisation charged with driving the change agenda within the East and West Midlands Construction industry through collaborative working.

COP26

Britain's first mainline-approved hydrogen train made its first passenger service appearance at the United Nations COP26 Climate Change Summit in November 2021, demonstrating its green credentials.

Our Engineers, with their industry partners Porterbrook, demonstrated the potential of hydrogen to transform rail transport in Glasgow.

Staff have been involved in every step of the way, from the design and development of the hydrogen technology and its application to the railway. In just three years, Birmingham's Centre for Railway Research and Education (BCRRE)'s engineers have created the first zero-emission passenger transport service.

The HydroFLEX is now ready for the next stage of its journey providing full zero-emission passenger transport services. Both His Royal Highness King Charles and Prime Minister Boris Johnson boarded the HydroFLEX train whilst at COP26 and experienced the eco-friendly hydrogen powered trains that could revolutionise our railways and make catching the train an even greener mode of travel.

STAFF ACCOMPLISHMENTS

Here is a small sample of awards and commendations our staff have received. We are very proud! We continue to strive for the best and work to push boundaries that are continuing to be recognised far and wide.

The Institution of Civil Engineering (ICE) Publishing awarded the James Hill Prize for best paper to Professor Nicole Metje, Aryan Hojjati, Anthony Beck and Professor Christopher D. F. Rogers. The paper titled 'Improved underground utilities asset management – assessing the impact of the UK utility survey standard (PAS128)' won best paper in ICE's Municipal Engineer journal for 2021. This prize is awarded each year to authors from both industry and academia who have produced work judged by their peers to be of exceptional quality and benefit to the civil engineering, construction, and materials science community.

The ICE also awarded the Richard Trevithick Fund Prize to Professor Christopher D. F. Rogers, Dr Joanne Leach, and colleagues for best paper in Engineering Sustainability in 2021. The paper was titled, 'The Liveable Cities Method: establishing the case for transformative change for a UK metro'.

Dr Jason Stafford has been awarded the prestigious Leverhulme Trust Research Fellowship by the Royal Academy of Engineering for work that promises to benefit society and the economy. Jason is working on Microfluidic metrology for processing low-dimensional materials at large scales.

Dr. Yueting Sun was recently awarded the prestigious UKRI Future Leaders Fellowship to work on the nanofluidic energy absorption of Metal-Organic Frameworks (MOFs). MOFs are a sponge-like material offering extremely small pores that are comparable to the size of water molecules. Squeezing liquid water into these tiny nanopores can create large solid-liquid interfaces and dissipate huge amount of mechanical energy. The fellowship aims to understand how liquid molecules transport inside these nanoporous materials under mechanical pressure and use such knowledge to develop future energy absorption materials and protection systems that are more efficient, controllable, and reusable.

Dr Mani Entezami won the Outstanding Impact on Innovation and Commercialisation award for the development of a system to continuously monitor rail track and trains daily, being rolled out in the UK through the spin-out MoniRail Ltd. This could lead to savings of over tens of millions annually in costs on maintenance regimes and delays. MoniRail was also awarded two Innovate UK Smart Grants for expanding the capabilities in navigation system and working with the UK highspeed network, HS1 track and Eurostar trains, to correlate the ride and track issues.

In Summer 2022, MoniRail was granted the First of the Kind award to help infrastructure to assess their track using trackside and trainborne equipment after recovery from incidents. This will be delivered by low cost, accurate, portable, and wireless systems that can easily be mounted on trains or/and vulnerable assets.

Researchers from the Civil Engineering Department at the University of Birmingham were awarded 'Highly Commended' in the Studies and Research category for the project Quantum Technology, Mapping and Map Integration for Buried Assets (QT-MIBA). This project was led by Dr Asaad Faramarzi and Professor Nicole Metje, working with their industrial partners Northumbrian Water, RSK Environment, Ordnance Survey, Rahko (acquired by Odyssey Therapeutics). The project harnesses quantum technologies to accurately locate and map buried assets, which could provide utility companies and contractors with the tools to optimise interventions, reducing costly, poorly targeted, and destructive roadworks.

The Women's Engineering Society and School congratulates our very own 'Inventors and Innovators Winner' Dr Qianyu Chen, for the 2022 Top 50 Women in Engineering (WE50) Awards. She was thrilled to attend the award ceremony in Westminster. We are extremely proud that she was recognised as one of the bravest inventors and innovators who dare to be part of the solutions that make a difference to people's everyday lives.

Dr Gurmel Ghataora received the Midland Geotechnical Society Les Nichols award. Awarded by peers for exemplary commitment to ground engineering, sound engineering judgement, embracing new ideas/processes and unquenchable enthusiasm.

RESEARCH

REF RANKING

The School of Engineering has received an outstanding vote of confidence in the quality of our research and contribution to society with the publication of the latest Research Excellence Framework (REF).

The REF is a major exercise which evaluates the quality and the broader impact of research in all universities in the UK and it has concluded that the University of Birmingham is one of the best in the country. The very best work is scored at 4* by review panels, and, on this basis, the University is ranked equal 10th amongst Russell Group universities and equal 13th in the whole UK according to Times Higher Education.

The University is ranked 10th in the Russell Group and 13th in the UK for Grade Point Average - this represents a rise from 39th in 2014.

In the Times Higher Education World University Rankings 2022, the School of Engineering was ranked:

- 10th highest institution for Engineering
- 3rd in the UK for GPA and 4* research

The University of Birmingham highlights include:

- Ranked equal 10th in the Russell Group and equal 13th in the UK for 4* research (up from 39th in 2014)
- Ranked 12th overall in the UK for Research Power (up from 14th in 2014)
- More than 50% of research recognised as 4*
- Largest rise in the Russell Group on percentage 4* and GPA
- 15 subjects ranked in the top 10 for 4*

FUNDING IN DFT TECHNOLOGY RESEARCH INNOVATION GRANT SCHEME

A new partnership between the University of Birmingham's School of Engineering and RazorSecure will enable Safe and Reliable Digital Maintenance for Passenger Train Operators. The project will design solutions to the challenges of maintaining safety while carrying out 'digital maintenance'. Researchers will investigate how access to maintenance systems can be digitally controlled, ensuring they are carried out by authorised personnel and at the right points in time. That will include, for example, making sure software updates are only carried out when the train is stationary and uncoupled. This reduces the risk of updates having unanticipated effects on other vehicles or systems.

SENSOR BREAKTHROUGH PAVES WAY FOR GROUND-BREAKING MAP OF WORLD UNDER EARTH SURFACE

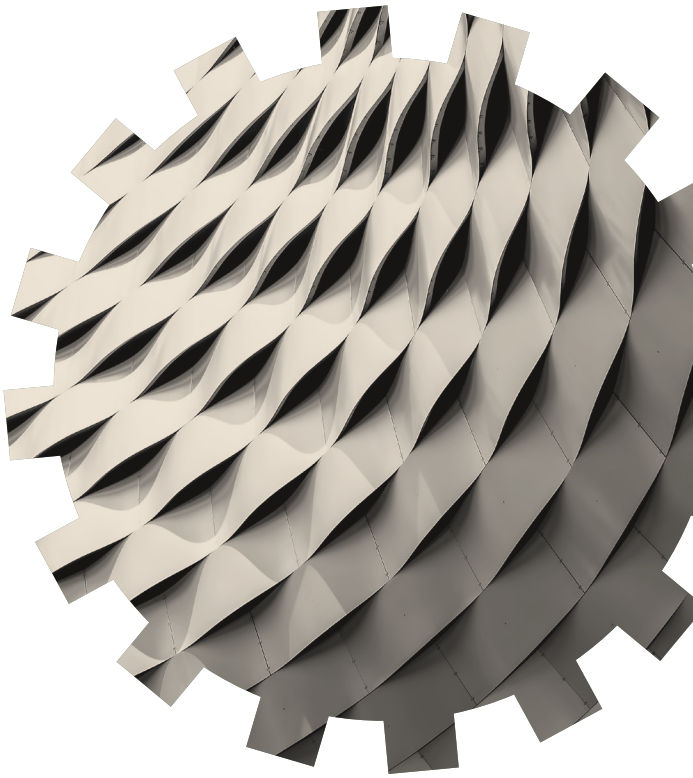
An object hidden below ground has been located using quantum technology – a long-awaited milestone with profound implications for industry, human knowledge, and national security. Our researchers from the UK National Quantum Technology Hub in Sensors and Timing have reported their achievement in *Nature.* It is the first in the world for a quantum gravity gradiometer outside of laboratory conditions. The quantum gravity gradiometer, which was developed under a contract for the Ministry of Defence and in the UKRI-funded Gravity Pioneer project, was used to find a tunnel buried outdoors in real-world conditions one metre below the ground surface. It wins an international race to take the technology outside.

INTERNATIONAL NETWORK CREATED TO TACKLE GLOBAL CHALLENGES WITH QUANTUM SENSOR TECHNOLOGY

A new International Network set up by UK Quantum Technology Hub Sensors and Timing researchers at the University of Birmingham aims to tackle global challenges, as set out in the UN Sustainable Development Goals. Since the setup of the UK National Quantum Technologies Programme in 2014, significant progress has been made in developing quantum sensor technology to accelerate productivity across the UK's sectors, but this project marks the first-time scientists will be working across the globe with policy experts and cross-disciplinary researchers.

The International Network for Sensor and Timing Applications in Quantum Technologies (INSTA-QT), which has received £500,000 in EPSRC funding, has partnered with scientists in 12 countries, including Angola, Germany, and Zimbabwe, to establish Global Virtual Workshops, specific to the different global challenges.

All involved centres will work together to take a strategic approach in linking problem areas to carefully considered solutions, with the advantage of collaborating across a collectively large number of experts across a very wide geographical breadth.



NETWORKED OVER THE HORIZON RADAR

In their final 'in-person' meeting before the first COVID-19 lockdown, SERENE (the Space Environment research group) kicked off a paper-study with the Defence, Science and Technology Laboratory (DSTL), to investigate their newly patented concept of a 'networked over-the-horizon radar' (NOTHR). Following the success of this and subsequent work, it has recently been fast-tracked to move the research from simulation to practice.

Over the horizon radars do what they say on the tin, they are radars which, taking use of the reflective nature of the ionosphere (a collection of free electrons in the upper atmosphere), let you look at targets over the horizon. Several such systems currently exist using a transmit antenna approximately 100m long, and a very long (~1 km) receiver which is typically closely located to the transmitter (with some caveats). SERENE's novel approach flips the conventional OTHR design on its head, taking use of an extremely long transmit antenna (expected to be ~2.5 km) and making use of a few small (possibly single element) receive antennas which can be distributed widely.

The beams are then formed together by processing the receive signals to form many simultaneous transmit beams (Figure 1). This NOTHR concept means that the receive system is cheap to manufacture, physically small and simple to deploy which means it could, for the first time, offer a truly relocatable OTHR design and, by operating bi-statically, can measure target velocities instantaneously rather than just speed.

To take the NOTHR concept from the computer to a field, SERENE will, in their newly supported project, build a 'mini-NOTHR' (approximately 1/5th the size of the proposed final design). This will involve working with colleagues across the School and more broadly with major industry partners on upper atmosphere modelling, antenna design, the development of waveform generators, transmit and receive systems, and the investigation, and mitigation of, MISO (multiple-input, single output) constraints.

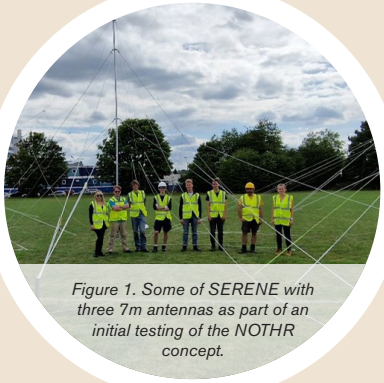


Figure 1. Some of SERENE with three 7m antennas as part of an initial testing of the NOTHR concept.

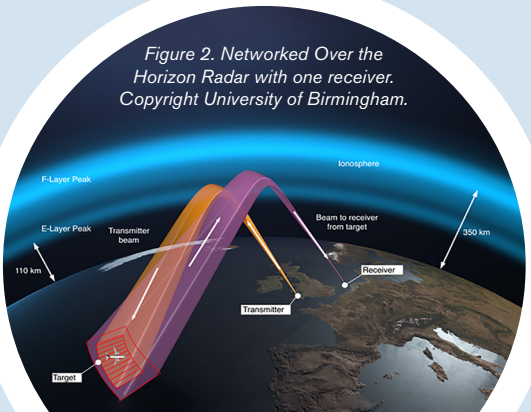


Figure 2. Networked Over the Horizon Radar with one receiver. Copyright University of Birmingham.

EDUCATION

During the academic year 2021–2022 the School of Engineering experienced much growth across our student admissions and staff recruitment. It was a pivotal academic year adjusting back to consistent practice after the global pandemic which we did so with care, efficiency, and success.

The year began with an increase in student recruitment. The School recruited well, with respect to the new intake of Undergraduate Year 1 students and also secured a good postgraduate taught (PGT) student applications standard overall.

Following the 2020–2021 introduction of the University's New Academic Teaching Year (NATY) structure that modernises the student experience and whereby students are examined at the end of each semester, exams were hosted remotely in January and took place in person in May. For both our main and supplementary examinations we received excellent External Examiner reports reflecting upon the leadership successes.

We have a dynamic student population across undergraduate, postgraduate taught and postgraduate research that forms the largest school within the College of Engineering and Physical Sciences. The rich intake of students includes Degree Apprentices. The Civil Engineering department has adopted the Degree Apprenticeship (Level 7) in Geotechnical Engineering which will commence in the academic year 2022–2023.

We have an exemplary close engagement between our two campuses, Edgbaston and Dubai. Both student cohorts can take advantage of the new study spaces. These collaborative study spaces enhance the sense of community amongst the student cohort.

Here at Edgbaston, the School successfully received funding from the Office for Students to equip the Makerspace, Student Society Space and Engineering Education Workshop.

The school is proud of the community that we foster in Engineering. Our societies make up more than half of the College Community, our Student Representatives represent the voices of over 1,200 students, and our students showcase their exceptional skills in University competitions like the Vice-Chancellor's Challenge.

Each student level has a Student Representative who is responsible for collecting feedback on any aspect of their classmates' (or groupmates') experience. The Student Voice and Representation Scheme operates as part of a partnership between the University of Birmingham's Students Union, the Guild of Students. With the addition of this and the personal tutoring system, we have multiple routes to understand the experiences of students. The feedback loop between student voice, academic and professional services staff makes a positive impact across the School and student experience.

The School has a dedicated Industrial Liaison Officer (ILO) offering one-to-one support to students relating to summer placements, industrial years and extra-curricular work experience. The ILO conduits between the students, the Industry Advisory Boards, and our industrial partners. Our Academic Partnership with the Institute of Civil Engineers has resulted in many of our students attending workshops and drop-in sessions that support the development of employability skills.

In the most recent NSS survey (2022), Civil Engineering achieved an overall satisfaction score of 77.08%, an increase of 14.39% compared to the previous year (62.69%). Satisfaction increased by an average of 11.93% on the previous year, with the highest increases being in Organisation and Management (72.57%) and Overall Satisfaction (as above).

We look forward to an exciting future including JBM Accreditation renewal outcome for Civil Engineering programmes, plus further accreditation renewals, the implementation of the Staff and Student School Guide in conjunction with the Student Handbook and Human Resources guidance, and a steady growth in student admissions.

INNOVATIVE ENGINEERING PROGRAMMES LAUNCHED IN NEW PARTNERSHIP

Two brand new civil and railway engineering programmes are being launched. The programmes are a collaboration between the University of Birmingham and the National College for Advanced Transport and Infrastructure (NCATI).

The two-year Foundation Degrees in Civil Engineering and Civil and Railway Engineering have been developed by the National College. At the end of the second year, students will have the opportunity to progress onto a third year at the University and study for a Bachelor of Engineering. In this third year, the students will take part in research projects and be taught by School of Engineering academics who are carrying out a wide range of research.

NEW BURSARIES FOR ENGINEERING STUDENTS FUNDED BY BIRMINGHAM GRADUATE, EMERITUS PROFESSOR BARRY P HUGHES

Thanks to the generosity of Emeritus Professor Barry Peter Hughes and his family, the Professor BP Hughes Bursary will support Engineering students experiencing hardship and facing unexpected financial challenges. This Bursary will provide comfort, security, and peace of mind for cohorts of engineering students across the next decade. Barry has devoted most of his working life to Civil Engineering at the University of Birmingham and spent many rewarding and enjoyable years involved in research and lecturing, encouraging and supporting students in their careers. Barry is a firm believer that a person's finances should not be a barrier to their education or start of their career.

AN INTRODUCTION TO ELECTRONIC ENGINEERING

The Electronic, Electrical and Systems Engineering department have collaborated with the UK Electronic Skills Foundation to produce an online course introducing 16–18-year-old school and college students to electronics and electrical engineering. This will be a great entry point to entice students to explore electronic technology as well as join the University and consider this as a route for the future.

OUR INDUSTRY PARTNERS

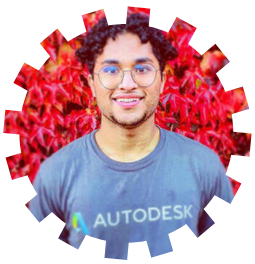
Industry partners that have engaged with our students, staff and community include the likes of Siemens, Mercedes AMG Petronas Formula One Team, Jaguar Land Rover, Johnson & Johnson, Mercedes-Benz Grand Prix Limited, Mercedes AMG High Performance Powertrains, Procter & Gamble, Arup, GE Aviation Systems Limited, Siemens Mobility UK, Balfour Beatty, Laing O'Rourke, Morgan Sindall and many more. Many of these companies have taken on over 50 industrial or summer placements which only adds value to our students and their experience of Engineering.

STUDENT PRIZE WINNERS

Three undergraduate students from the School of Engineering were awarded the Vickers Prize this summer, a Prize awarded to Mechanical Engineering students who excel academically but also make a significant contribution to their School community.

Lucie Gale (pictured) won the main prize for her contribution to the Birmingham Outreach 'Routes to Professions' scheme, acting as a mentor to 11 students in local Birmingham schools from under-represented backgrounds to encourage them to apply for Engineering at University. Lucy has also previously supported the Women in Science and Engineering (WISE) scheme, where she encouraged girls in Years 7-9 to become involved in science, technology, engineering, and mathematics (STEM) subjects.

Haider Ali was recognised for leading the Birmingham Space Society. The society built and tested rockets, including designing a Mars Rover, for which the society won a national competition. He also made time to tutor students at the University of Birmingham School, via the University's tuition scheme.



Rayyan Chowdhury (pictured) is currently on his year in Industry, but during the pandemic was actively involved with campus efforts to improve the design of facemasks for front line staff. This work resulted in an academic paper being published. He has also led efforts to train undergraduates on how to use the University Advanced Computer Facilities and mentored first year students during the pandemic lockdowns. He currently runs the University Design Society.

This year our Vice Chancellor, Adam Tickell, visited the Raymond Priestley Centre in Coniston where our Mechanical Engineering students were working on their post-exam team challenge. An annual event that is always a success and supports students to create memories and beat the course.

Prize	Winners Name
AP Jarvis Postgraduate Prize	Mikael Gagoshidze
Bernd Richardson Prize	Ahmed Abdalla
Best BEng Student in EESE Prize	Ouyn Wang
Best MEng Student in EESE Prize	Cantone Luca
Best MEng Civil Engineering with Industrial Study Prize	Bethany Brooks
British Leyland Prize	Luke Neill
Chartered Institution of Highways and Transportation Prize	Ahmed Abdalla
Civil Engineering Prize	James Jeffries
Dr John Vickers Scholarship	Lucie Gale
Frederick Barnes Weldron prize	Maxwell Porter
Geoffrey Osborne UG Scholarship	Liana George
Gilbert Walker Prize in Engineering & Economics	Sarah Soo
Gilbert Walker Prize in Mechanical Engineering & Commerce	Mirandar Sangha
Institution of Electrical Engineers Prize	Harmeet Doal
Institution of Mechanical Engineers Prize	Maxwell Porter
Institution of Structural Engineers Prize	Ismaail Khoyrattee
J Brown (Machine Tools) Ltd. Prize	Yulong Wang
J Kolbuszweski Prize	Ahmed Abdalla
John Grayson Memorial Prize (UG)	Muhammed Nurgat
John Underhill / Institution of Civil Engineers Prize	James Jefferies
Joseph Thom Carding Memorial Prize	Jack Foster
Keith Martin Jones Prize	Chi-Yin Huang
Moran Memorial Prize	Muhammed Nurgat
Paul Webb Prize	William Lubantoro
Paviors Prize	Ahmed Abdalla
Petro-Forge Design Prize	Tegan Reynolds
Petro-Forge Prize	Owen Griffiths
Professor Bakhtar Memorial Prize	Andrei Kotash
Professor Frank Wallace Scholarship	Yulong Wang
Professor Russell Undergraduate Prize	Rob Conway
Ratcliffe Prize	Humayra Ibrahim
Roger Chance Prize	Maxwell Porter
SA Tobias Memorial Prize	Rachel Keane
Samuel Alfred Roberts Award	Rachel Keane
Sir George and Lady Labouchere Prize	Maxwell Porter
Stephen Hayes Prize	Mark Cartwright Jr
Tom Essery Prize in Water Engineering	Marco Wong
West Midlands Concrete Society Undergraduate Prize	Claire Gridley
Whittaker Ellis Bullock Prize	Tz Ho
WS Atkins Prize	James Jefferies

OUR YEAR IN NUMBERS

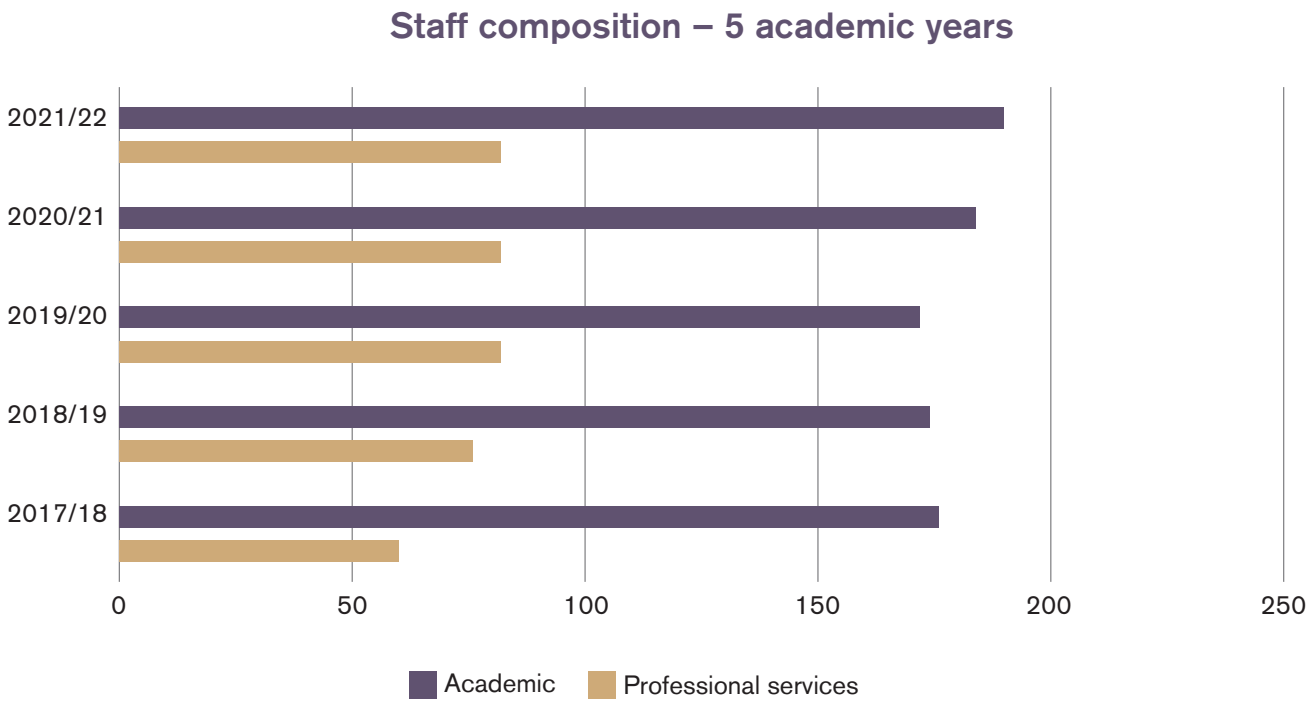
SCHOOL'S GROWTH AND STAFF COMPOSITION

Academic Staff climbed from 172 IN 2019 TO 191 ACADEMIC STAFF in 2022.
Professional services staff remained the same at 90 PEOPLE in 2022.

32 (22%)
ARE FEMALE ACADEMICS

32/90
ARE FEMALE PROFESSIONAL SERVICES STAFF

This reflects an increase in female academics at all levels including 22% AS PROFESSOR and 14% AT ASSOCIATE PROFESSOR or Reader level.



EDUCATION STATISTICS

97%

OF STUDENTS ARE IN GRADUATE LEVEL EMPLOYMENT 15 MONTHS AFTER GRADUATING

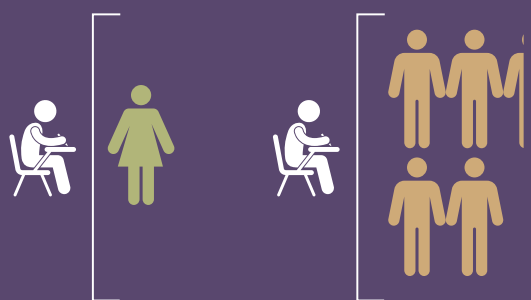
64

STUDENTS COMPLETED PhDs THIS YEAR

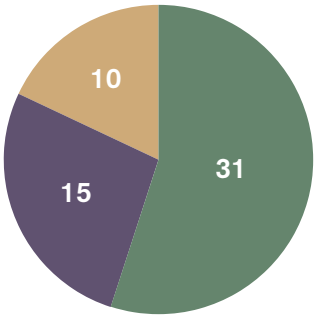
TOTAL REGISTERED STUDENTS 2021/22

2,268

STUDENT RATIO OF FEMALES TO MALES: **1:4.3**

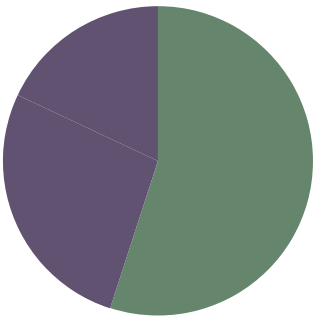


Industrial / Summer Placements



- Civil Engineering
- Electronic, Electrical and Systems Engineering
- Mechanical Engineering

Percentage of Home vs International Students

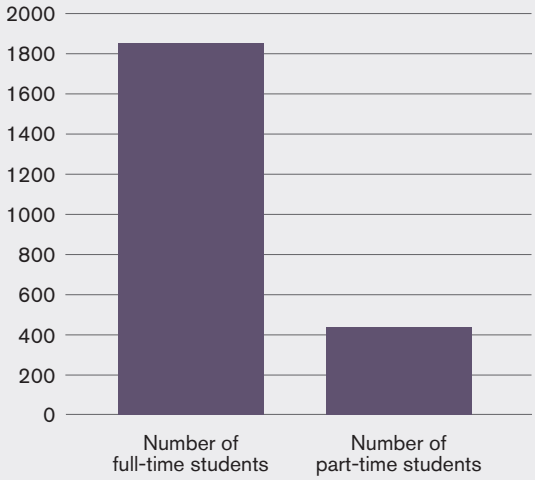


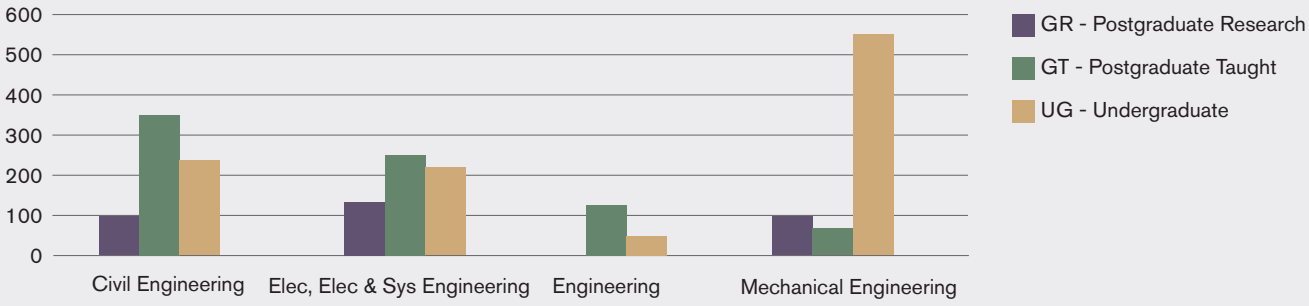
- Home Students
- International Students

Number of students per level per department

	PGR	PGT	UG	Grand Total
Civil Engineering	101	323	227	651
Elec, Elec & Sys Engineering	118	246	226	590
Engineering	110	38	148	296
Mechanical Engineering	102	50	552	704
Grand Total	321	729	1043	2093

Number of Students (study type)



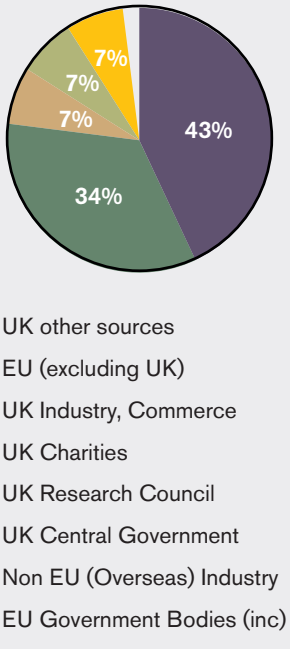


RESEARCH

Research Excellence Framework (REF2021) ranks our School of Engineering 10th in the UK (out of 157 academic institutions).

2021/22 Research Submissions	
Research Application Submissions	179
Research Application Value £km	£47,664,000

Grant Application per funder



SUSTAINABILITY

SCHOOL TO HELP DEVELOP MORE SUSTAINABLE ROADWORK INFRASTRUCTURE

The University has been selected to take part in a project hosted by HAUC (UK) and TfL aiming to reduce the environmental impact of street/road works. The School, along with EA Technology, has been selected to undertake a comprehensive study on street and road works sectors, as part of a research project launched by the Highway Authorities and Utilities Committee (HAUC UK) and Transport for London (TfL) aiming to minimise the impact of street works and road works on climate change.

Road and street works form part of the wider infrastructure sector, which is responsible for almost one-sixth of total UK emissions. This project, led by Professor Chris Rogers, aims to look at how future road works can operate with reduced congestion to support the UK's move to net zero carbon emissions. This includes exploring the deployment of zero emissions machinery, as well as studying the required business models and legislation needed to support more sustainable road works. At its close, the project will produce an action plan to help implement the changes needed to achieve net zero.

NEW EPSRC-FUNDED PROJECT WILL ENABLE GREATER SUSTAINABILITY FOR FUTURE INFRASTRUCTURE PROJECTS

A new project led by our researchers will facilitate greater sustainability for future infrastructure projects through deploying novel solutions for reusing structural steel. The project, which is titled Reuse of Structural Steel in Construction (RESTOR), has secured over £1.3M in funding from the Engineering and Physical Sciences Research Council (EPSRC) as part of the Sustainable Manufacturing call.

More than 85% of structural steel in existing buildings is recycled at the end of its service life whereas less than 15% is reused. However, steel recycling demands huge amounts of energy. RESTOR is led by Dr Samir Darir with Dr Asaad Faramarzi and Dr Marios Theofanous. The project aims to allow the material properties of used steel to be determined based on NDT measurements to minimise unnecessary recycling and optimise the repurposing of used steel by validating its structural performance for the second lifespan.

PROGRAMME GRANT IN GREEN AMMONIA FOR THERMAL PROPULSION

Battery-electrified power is predicted to become the dominant mode of propulsion in future light-duty transport. For sustainable heavy-duty applications, challenges remain around the practical range, payload, and total cost. Currently, there is no economically viable single solution. For commercial marine vessels, the problem is compounded by long service lives, with bulk carriers, tankers and container ships the main contributors to greenhouse gases. Ammonia (NH3) has excellent potential to play a significant role as a sustainable future fuel in both retrofitted and advanced engines. However, considerable uncertainties remain around safe and effective end use, with these unknowns spanning fundamental understanding, practical application, and acceptance.

This multidisciplinary programme seeks to overcome the critical related technical, economic, and social unknowns through flexible, interdisciplinary research on disruptive NH3 engine concepts capable of high thermal efficiency and ultra-low NOx. The goal is to accelerate understanding, technologies and ultimately, policies which are appropriately scaled and ‘right first time’.

Professor Thanos Tsolakis, Dr Dawei Wu, and Dr Martin Herreros are part of a consortium including the Universities of Nottingham, Cardiff, Oxford and Brighton, and several industrial partners to receive funding via an EPSRC Programme Grant ‘Decarbonised Clean Marine: Green Ammonia Thermal Propulsion (MariNH3)’.

REVIEWING DESALINATION TECHNOLOGIES TO SUPPORT GREENHOUSE FOOD PRODUCTION

Researchers from the Birmingham Energy Institute have reviewed desalination technologies to support greenhouse food production. Our global population is expected to grow from 7.7 billion to 8.5 billion by 2030 and 9.7 billion by 2050, consequently increasing the demand for food production. One way to increase food production is to cultivate crops in controlled-environment greenhouses, which boost productivity and extend the productive crop season.

Large-scale greenhouses require cooling technologies to maintain temperatures of the crops. Traditionally, greenhouses were cooled via evaporative cooling, but this process consumes large quantities of freshwater and does not perform adequately in hot and humid conditions.
Liquid desiccant air conditioning (LDAC) is an emerging technology, powered by solar energy that can mitigate the high-water requirement and maintain optimal growing conditions in self-sustained greenhouses. However, LDAC technology depends on constant availability of a low vapour pressure liquid desiccant (LD), which is creating a bottleneck for this technology.

GLOBAL COMMUNITY

The School has continued to extend its global reach by continuing to work in Europe, Asia, Africa, and further afield. Not only are our teams making connections with co-creators and industry abroad, but we are influencing research and extending our reach to students across education. The projects below show how we have expanded our research and education this year to ensure we remain innovative and dynamic.

BCRRE has now moved to the final stages of the project HVT038 – Novel Traction Systems for Sustainable Futures in LICs in Sub-Saharan Africa. Funded by the Foreign, Commonwealth, and Development Office (FCDO), this applied research initiative is developing cost effective solutions to decarbonise railways in the African continent. Making them accessible and viable for those regions is a significant step-change in enabling financially constrained economies to reduce their GHG emissions without constraining their economic development. Our preliminary results were presented at the Transport Evolution Africa Conference both in 2021 and 2022.

In 2021, Professor Anson Jack, Dr Marcelo Blumenfeld and Professor Clive Roberts helped the Ethiopian Railways Corporation in mapping the capability gaps to develop their railway training academy. The work later delivered a roadmap for bridging those gaps in facility planning and programme content for the Ethiopian railway operator.

Dr Marcelo Blumenfeld led the delivery of an online Continued Professional Development (CPD) programme for the Tanzanian Land Transport Regulatory Authority (LATRA). The programme upskilled more than 70 civil servants of the agency in two modules of Urban Transport Management and Safety, and Rail Infrastructure, Commissioning, Certification and Registration. With over 95% of the participants rating the programme as excellent, we can safely claim it as a success despite the travel limitations at the time.

The past year has also seen BCRRE broaden its institutional engagement beyond the railway sector, exemplified by the growing relationship between the centre and the United Nations. This included a number of expert projects for the UN Economic and Social Commission for Asia and the Pacific (ESCAP) on cybersecurity led by Dr John Easton and Dr Richard Thomas, and on rail decarbonisation led by Professor Stuart Hillmansen, Dr Marcelo Blumenfeld, and Alex Burrows. Following those, the group hosted a representative of the organisation, Mr Sandeep Jain, during the World Congress for Rail Research (WCRR2022), where the next steps of the collaboration were discussed.

Further demonstrating the presence of the centre in South America, Professor Clive Roberts, Dr Marcelo Blumenfeld, and Achila Mazini hosted the president of the Latin American Association of Railways (ALAF), Mr Jose Villafane, to the UKRRIN building in July 2022. This visit builds on one of the two strategic Memorandum of Understanding (MOU) that BCRRE holds in the region (the other being with the Brazilian Ministry of Infrastructure), and will be key to establish a number of research and capacity building activities in the continent.

The University of Birmingham is a world-leading institution with a strong track record in many subjects, including automotive research. Uniquely, the Birmingham CASE Automotive Research and Education Centre (the CASE Centre) covers all four areas of automotive research: a) autonomy and sensing; b) business and strategy; c) impact on the Environment; and d) sustainability and circular Economy.

The CASE Centre holds webinars regularly to disseminate the latest automotive research results and promote internal and external research collaborations. Since its inauguration in March 2022, the centre has held four webinars including three academic seminars and one industry forum. The webinars have attracted more than 93,000 attendees joining online and in person. The first webinar and networking workshop was an inauguration event on 21 March 2022. Chaired by Professor Hongming Xu, this event marked the formal kick-off of this new establishment which continues to grow in engagement and innovation.

PEOPLE

The School has grown over the years to deliver high-class education and research via our academics and operational support through our professional services teams. Below are three of our academics that are continually producing high-class research and teaching as well as three of our Professional Services staff that are working across the School to deliver.

RAYA AL-DADAH

Raya Al-Dadah is a Reader in Sustainable Energy Technologies in the School of Engineering at the University of Birmingham. She was awarded BSc in Mechanical Engineering in 1985 and PhD in Electrohydrodynamic Enhancement of Boiling Heat Transfer in 1994. She took a lectureship position at the University in 1996, was promoted to Senior Lecturer in 2014 and to a Reader in 2019.

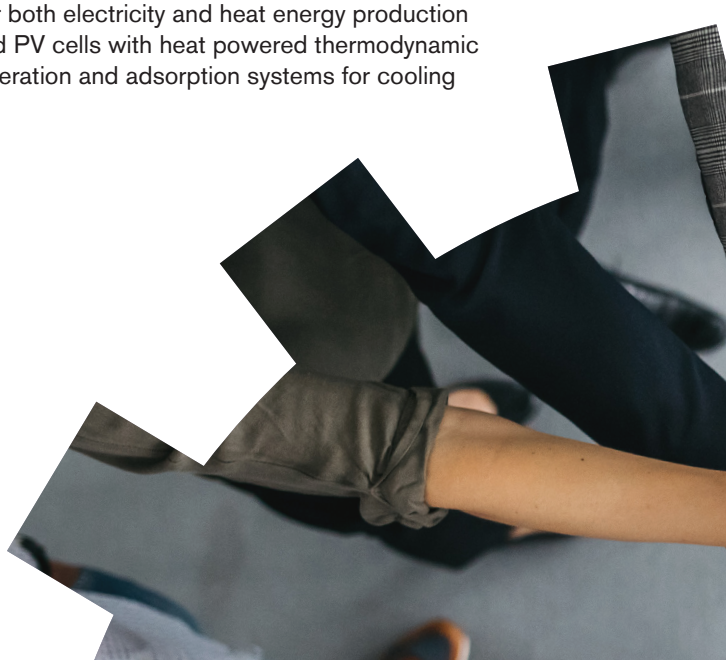
She has more than 25 years research experience in sustainable and clean energy systems for various applications including heating, cooling, electricity generation and water desalination / treatment. She is a fellow of the Institute of Refrigeration, a fellow of the Institute of Mechanical Engineers and a member of the Higher Education Academy (UK). She has researched and supervised research projects and published over 150 papers in reputable journals and international conferences with a H index of over 30.

She is a member of several research groups in the UK including 'Sustainable Innovations in Refrigeration, Air Conditioning and Heating" (SIRACH) and "Sustainable Thermal Energy Management' (SusTEM).

DR AL-DADAH'S RESEARCH WORK INCLUDES:

- Heat-powered adsorption heat pumps for energy storage, cooling, heating, power generation and water desalination using advanced adsorbent materials, namely Metal Organic Framework (MOF). With more than £3M funding from DECC (HS28), British Council, Innovate UK and EPSRC, and Qatar National Research Foundation, she developed several MOF materials and small-scale prototypes of adsorption heat pumps for energy storage, heating, cooling and water desalination. With funding from the Department of Energy and Climate Change (DECC, now called BEIS), Dr Al-Dadah developed an adsorption energy storage system to store the off-peak, cheap night-time electricity to be recovered for heating of domestic houses during the day.

- Harnessing solar energy: Developing efficient methods of harnessing solar energy based on concentrated Photovoltaic cells (silicon cells as well as multi-junction cells) for both electricity and heat energy production (PVT and CPVT). The research involved integrating concentrated PV cells with heat powered thermodynamic systems like Organic Rankine Cycle for additional electricity generation and adsorption systems for cooling and water desalination.



CHRISTOPHER GILLIAM

Christopher Gilliam is an Assistant Professor in Applied Signal Processing in the School of Engineering at the University of Birmingham. He received M.Eng degree (Hons.) in electrical and electronic engineering from Imperial College London, UK in 2008, and PhD degree in electrical and electronic engineering in 2013. He was a Postdoctoral Fellow with the Image and Video Processing Group, Department of Electronic Engineering, The Chinese University of Hong Kong, from 2013 to 2017, and a Research Fellow with the RF & Antenna Research Group, School of Engineering, RMIT University, Australia, from 2017 to 2022. He joined the University of Birmingham in April 2022. He has extensive experience in sensor signal processing and contributed to projects sponsored by Australia's Defence Science Technology Group (DSTG) on sensor scheduling in multi-static sonar systems, autonomous search algorithms for mobile sensors, decision classification under uncertainty and the design and implementation of UAV mounted SAR imaging sensors. His research interests include sampling theory and its application in image processing and radar systems, sparse sampling involving signals with finite rate of innovation, motion estimation and registration for image sequences, in particular biological and medical imaging, and sensor management.

BAHMAN GHIASSI

Bahman is an Associate Professor of Structural Engineering and a chartered engineer (MIStructE, CEng) in the School of Engineering at the University of Birmingham. He obtained his PhD in 2013, held two postdoctoral fellowships from 2014 to 2018 (including a Marie Curie Fellowship at the Technical University of Delft), was appointed as Assistant Professor of Structural Engineering at the University of Nottingham in 2018 and then joined the University of Birmingham in 2022.

His research centres around sustainable construction materials with the focus on innovative alternative cements, cement-based composites, masonry, and waste-based materials. In 2019, he was awarded the RILEM Gustavo Colonetti medal for his 'outstanding scientific contribution to the field of construction materials and structures'.

RILEM (International Union of Laboratories and Experts in Construction Materials, Systems and Structures) is the most prestigious organisation in construction materials and structures. Dr Ghiassi is the author of more than 150 peer-reviewed scientific articles in reputable journals and international conferences. He has given several invited talks and keynote lectures and is an active member of international scientific committees, including Chapter lead and Experimental Round Robin Testing Workgroup leader in RILEM Technical Committee 290-IMC (Durability of inorganic matrix composites used for strengthening of masonry structures) and Chapter leader in RILEM Technical Committee 292-MCC (Mechanical Characterization and Structural Design of Textile Reinforced Concrete). He is also a full member of the EPSRC review college and serves as the expert reviewer in a number of international scientific funding bodies including the European Commission and COST.

ALI WRIGHT

Prior to working at the University, Ali had a career in the Civil Service spanning 15 years, eventually managing teams of up to 20 staff and intermediate managers. She started in HM Revenue and Customs, moving onto a promotion to what was the General Teaching Council England (GTCE), which later transferred to the Department for Education (DfE) in various roles, from Professional Standards Support Manager and following a merger of the GTCE, as Initial Investigations Team Manager at the DfE.

Ali started her University of Birmingham career in 2013 in the College of Life and Environmental Sciences as an Education Support Team Manager for three years, moving into the Operations area as an Operations Manager for a further five years. In 2021, Ali was fortunate to secure a secondment in the College of Engineering and Physical Sciences in the School of Computer Sciences as a Head of Operations. This was cut short after six months as the opportunity to secure a permanent role arose here in the School of Engineering as Head of Operations starting in May 2022.

Ali's role now involves leading the delivery of a high quality, professional administrative function by supporting the Head of School, management teams and working with College staff, to shape and influence the strategic direction of the School. Ali enjoys immensely enjoys the variety, complexity, and challenge of operations from a strategic perspective, and the opportunity to lead, develop and support staff to reach their potential. It is a privilege to support the School of Engineering and the wonderful staff.

JEN CLERICI

Jen is the Education Support Manager for the School of Engineering and is responsible for managing education administrative processes, ensuring compliance and excellence in delivery. These are processes that span the student life cycle from first day to graduation, including topics such as curriculum management, assessment, timetabling, registrations and progression. Jen work closely with the Senior Academic Teaching team to strategically navigate the upcoming business needs in line with School, College and University compliance, resource allocation amongst the Education Support team and ultimately providing high-quality student experience.

She manages a team of 12 as part of the School of Engineering Education Support Team and they work collaboratively with academic teaching staff, students, Wellbeing and Student Experience, plus the College admin team, the six other schools within the College, and central University departments to implement education practice and initiatives and provide high-quality support for colleagues and students. Her role also includes managing the School of Metallurgy & Materials Education Support team and associated education administrative functions and, in addition to this, she engages with further University responsibilities acting as Chair of Hearings, supporting Human Resources with disciplinary, grievance or capability cases.

Jen's initial engagement with Higher Education administration began as an undergraduate in a student mentoring scheme capacity and since then she continued her curiosity and care for higher education administration. Jen's background includes management and quality assurance roles, and she feels it is rewarding to be a part of the progressive School of Engineering where there is much to achieve collaboratively.

KIERAN HANSARD

Kieran started at the National Buried Infrastructure Facility (NBIF) in March 2020 as a Senior Technician, and then took a temporary role as Facility Manager, before securing the role as Construction Manager in 2022. Most of his work experience before joining the University of Birmingham has been within the construction industry, working on sites as a qualified plumber as well as various other positions. After some years, Kieran decided to go back to studies and underwent an undergraduate degree in Civil Engineering. As a mature student, Kieran juggled the balance of studies and work to support his growing family.

Once completing his degree, Kieran worked as a structural engineer for numerous years, designing large scale buildings up to 14 stories high. While this role was fulfilling, having spent many years working practically on site, when he saw the opportunity arise to use both his practical and academia skills at NBIF, he knew he had to apply.

Kieran's current role at NBIF sees him ensuring that all health and safety measures are up to date and adhered to. He also works to ensure NBIF is compliant with all relevant policies and procedures. As Construction Manager, Kieran works closely with the academic team, planning and organising projects that require technical support.

As part of Kieran's role, he manages NBIF's technical staff. This includes but not limited to, making sure the University of Birmingham has the expertise to support projects, run the sites safely and make sure everyone understands their roles and responsibilities ensuring safe practice and efficiency.

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Learn more about the School of Engineering at
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