

The **Woman Engineer**

WOMEN'S
ENGINEERING
SOCIETY



www.wes.org.uk

SPRING 2024
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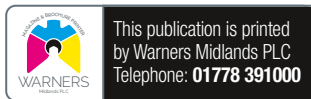
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@The Woman Engineer 2024

Welcome to the Spring issue of The Woman Engineer

As a historical WES partner sponsor member, I'm thrilled to be working with WES on the editing and publishing of the newly re-launched membership journal.

In response to a recent survey, kindly responded to by WES members, we have started to implement more of your valuable suggestions. This issue contains technical articles, more in-depth features on some of our members, a focus piece on wellbeing, plus more industry news with further detail on how WES supports members across the sector.

Going forward, I would like to invite you to contribute to the journal, especially with any technical feature ideas you may wish to share with the wider membership. Please feel free to contact me by email; julietl@warnersgroup.co.uk

Meanwhile, I do hope you enjoy this issue. I look forward to your feedback as well as meeting you at industry events before too long. As a team, we would also like to give our heartfelt thanks to Lynn Postle who steadfastly edited the journal and supported WES for many years.

All the very best

Juliet Loiseau MinstR
Publisher/Editor



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Welcome to the Spring 2024 issue

As the newly appointed president of the Women's Engineering Society (WES), it is with great pleasure that I welcome you to our revamped journal, now enhanced by the contributions of its new editorial team and the support of our newly established editorial board. These changes reflect our unwavering commitment to innovation, inclusivity, and the broadening of our reach and impact.

Following our Annual General Meeting, we celebrated the remarkable achievements of our previous president, Dame Dawn Childs, who has been honoured as a Dame Commander of the Order of the British Empire (DBE). This celebration was not only a testament to her outstanding contributions but also a reminder of the significant responsibilities I have assumed in my role. Having now served as president for five months, I am acutely aware of the legacy I am privileged to build upon.

WES events

In recent months, WES has hosted several noteworthy events, including our Student Conference and the Caroline Haslett Lecture, delivered by Dame Dawn. Her lecture provided a compelling glimpse into her extensive career and the impactful work she has been a

part of, offering both inspiration and enjoyment to all who attended. As the head judge for the Karen Burt Award, I am particularly close to this initiative. Reviewing the applications is always a highlight for me, as each entry not only represents an individual's journey to achieving Chartered Engineer status but also showcases the diversity and excellence within our community.

The National Apprenticeship Week has just concluded, and as someone who has personally navigated the apprenticeship route, I am immensely proud of our efforts to showcase apprenticeships and encourage more individuals to embark on this rewarding path.

Looking forward, WES is committed to continuing its strategic journey. Having completed the first phase of our plan, we now take a moment to reflect and prepare for the next steps in our mission to support and promote

women in engineering. We have had our first in-person board meeting since before the pandemic, and a significant proportion of this was on the strategy.

WES annual conference

I eagerly anticipate meeting many of you in person at our upcoming annual conference. The team has been dedicated to ensuring the event is as inclusive and accessible as possible, reflecting the values at the heart of WES. Together, we stand on the brink of an exciting future, and I am honoured to lead our society as we forge ahead, embracing challenges and opportunities alike.

K L Critchley

Dr Katherine Critchley
President of the Women's Engineering Society
www.wes.org.uk



WE50 nominations now open!

Nominations are now open for our Top 50 Women in Engineering Awards at bit.ly/42QZVny

From pioneering developments in transportation to innovations in healthcare and technology, women engineers in the United Kingdom have significantly enhanced people's lives, so this year we have chosen the theme Enhanced By Engineering.



Nominations are NOW OPEN for our Top 50 Women in Engineering Awards!

Our Top 50 Women in Engineering Awards celebrate the women engineers who use their engineering skills to improve lives. Nominations are open now for the 2024 awards (See bit.ly/42QZVny for entry requirements) Could you be a WE50 winner?

2024 criteria for nomination: Enhanced by Engineering

From pioneering developments in transportation to innovations in healthcare and technology, women engineers in the United Kingdom have significantly enhanced people's lives. Every day there are examples of where engineering has improved the lives of people, from Caroline Haslett's three-pin plug still in use today, to the airbags and seatbelts that contribute to vehicle safety, and the burgeoning development of fast and safe, at-home testing for infections in cancer patients. We can't wait to see what else women do in 2024.

Essential criteria – all nominees must be:

1. a woman, aged 18 or older;
2. working as an engineer, or working or studying in engineering industries and allied sectors, engineering education, or engineering research;
3. based in the UK (nominees do not have to be UK citizens);
4. not a previous WE50 winner;
5. able to demonstrate a personal contribution to an engineering

project or programme that has significantly enhanced people's lives; and

6. able to ensure the engineering and the enhancement is evident in the submission.

Desirable criteria:

1. work that supports sustainability and/or combats climate change will score well;
2. acting as an advocate for other women; enhancing people's lives with engineering;
3. acting as an advocate for other women in engineering; and
4. achieving beyond what would normally be expected for career stage – nominations are welcome at all career stages.

How to enter:

1. register on the Zealous platform by visiting bit.ly/42QZVny
2. use the the nominee's first name as the submission title;
3. upload a 400-word citation in document format (.doc, .docx, .odt) explaining how the nominee meets the criteria; and
4. complete the application form and submit the nomination.
5. 100 finalists are chosen from all the entries.
6. the top 50 winners will be invited with a guest to an afternoon tea, to be held on the 24 June 2024 to receive their trophy; and
7. the remaining 50 finalists will receive an electronic certificate.

Judging is made solely on the citation, all other information is collected for communication or purposes of demographic analysis.

Notes

1. nominators must register on the Zealous platform in order to make a nomination;
2. the nominator must provide contact information for themselves and their nominee;
3. nominators may nominate more than one candidate;
4. candidates are encouraged to nominate themselves;
5. do not use hyperlinks or embed media into the citation as these will be removed;
6. do not go over the 400-word limit as extraneous words are eliminated, often cutting off the citation mid-sentence; and
7. do not use formatting such as bullet points, bold or italic.

- ▶ Entries that are over 400 words will be cut off with the words [citation overrun] at exactly 400 words.
- ▶ Entries that provide only a CV or list of projects will not score well.
- ▶ Entries that focus solely on engineering or solely on supporting women will not do as well as those that demonstrate both.
- ▶ We regret that we cannot accept nominations for anyone based outside of the UK, even if they are UK citizens, with the exception of women serving in the armed forces.

Very best of luck to all nominees!

WES Annual Conference

17 & 18 April 2024

The WES Annual Conference will take place on the 17 and 18 April 2024. This two day event will be a fantastic opportunity for networking and learning.

Annual Conference

We hope you can join us at our new, more accessible, venue!



The Eastside Rooms
Woodcock Street, Birmingham, B7 4BL



April 17-18



wes



Raising the bar on individual competence

The Engineering and Building Services Skills Authority (EBSSA) is inviting multiple installer disciplines to begin codifying standards and competences for the sector. This initiative is part of wider industry and government efforts to 'raise the bar' on individual competence within the built environment in line with the new post-Grenfell competence regime established by the Building Safety Act.

On Monday 29 January 2024, EBSSA and the Construction Leadership Council (CLC), formally launched the Engineering Services 'Super Sector' – the entity charged with overseeing progress across all mechanical, electrical, plumbing, and associated trade disciplines.

The Engineering and Building Services Skills Authority was convened last year by Actuate UK members together with other leading sector bodies, such as BEAMA, CIPHE, TICA and the standards organisation MCS, to provide a credible authoritative voice for skills across all engineering and building services.

Key objectives of this skills coalition are to provide analysis based on transparent data on the sector skills demand and supply, and utilise this evidence to highlight needs, educate, influence policy makers and providers to close the skills shortage gaps with measurable interventions.

www.actuateuk.org.uk/resources/ebssa

Engineering construction careers 'lack appeal' to new entrants

The Engineering Construction Industry Training Board's (ECITB) career motivations study *Inspiring Directions* shows that the industry is struggling to appeal to the general population (young people and women in particular) to help plug workforce and skills shortages.

When broken down by age, the report highlighted that only 20% of those aged 16-19 outside the ECI would consider a career in the industry. This figure was only 15% for women, with 52% saying they would not join any of the industry's different sectors.

ECITB chief executive, Andrew Hockey, said: "Our Labour Forecasting Tool forecasts a 28% increase in demand for workers in the industry in the next five years amid a boom in project activity.

"Given the low ratio of new entrants to retirees in engineering construction, understanding the career motivations of this group is paramount to ensuring these workforce needs are met.

"This study suggests the image of the industry is not attractive to new entrants, especially younger people and women, and that more needs to be done to address recruitment and retention challenges.

"But solving the recruitment problem will require a collaborative, multi-agency approach that includes employers, governments, training providers and the ECITB working together to ensure careers in the industry are both more visible and more attractive."

Read the full report here: <https://www.ecitb.org.uk/career-motivations-in-engineering-construction/>



Electrospinning used for skin regeneration

A new method for electrospinning sponges that can act as 3D scaffolds for skin regeneration has been developed by researchers at the University of Surrey.

Electrospinning is a technique that electrifies droplets of liquid to form fibres from plastics, but which has previously only been used in the lab to make 2D films. The team say this is the first time electrospinning has been

used to create 3D structures that can be produced at scale.

A Taguchi experimental design approach was used to optimise the electrospinning parameters for forming PCL (polycaprolactone – a biodegradable polymer compatible with human tissue) and PCL/gelatine 3D sponges. The optimum mix of PCL and gelatine produced sponges with a highly porous structure that could support cell

viability, essential properties for tissue engineering scaffolds.

In engineering, the Taguchi method of quality control focuses on design and development to create efficient, reliable products. Its founder, Genichi Taguchi, a Japanese engineer considers design to be more important than the manufacturing process in quality control and seeks to eliminate variances in production before they can occur.





CEG's open letter to the UK Government

Our Climate Emergency Group represents a diverse group of professionals in multiple engineering and science sectors who address the emergencies related to climate change. We are asking the Government to accelerate work to ensure a future for all citizens.

In February this year, the WES Climate Emergency Group (CEG) sent an open letter to Government on the importance of embedding Climate Change into policies. We reproduce the letter here, and if you want to be involved with this group, email the CEG chair at CEGChair@wes.org.uk

Ask of the UK Government to embed Climate Change into policies

On the Regulation of whole life carbon: to mandate the alignment and certification of all public and private sector authorities to PAS 2080: Carbon Management in buildings and infrastructure 2023.

On the future proofing of infrastructure standards: to invest in full updates of all infrastructure standards based on weather predictions in line with a minimum 3°C warming to ensure future infrastructure projects are climate resilience.

On the energy efficiency in homes and non-residential buildings: to address the policy gap in owner-occupied homes and non-residential buildings and set a clear timeline of activities that align with the Net Zero targets.

On the success of future green jobs: to embed the recommendations from the Gender Pay Gap Report and the FTSE Women Leaders Review into the outputs from the Green Jobs Delivery Group.

Collectively, the ask is for the rapid turnaround of legislation and policy that supports the engineering industry to urgently deliver solutions built on credible climate science to ensure a safe, rapid and just transition for people and planet.

The letter was published in June to coincide with International Women in Engineering Day (WES's flagship global event to celebrate and raise awareness of the importance of gender diversity in

engineering) with co-signatories from key actors in engineering and sustainability.

Responses from industry and society

Since the launch in June, over 200 citizens have backed the letter through our open petition, with 100 signing up as supporters. Professor Vincent Pizzoni stated, "I don't think there is any doubt that we have a climate emergency and that we will need all hands on deck working collaboratively to succeed. The role of our engineers will be critical in developing the technology we need to win." Kara Liang added, "It's increasingly evident that now the biggest impact to be had is through ensuring that products are engineered to be sustainable, which protects not just those interacting with them but those around the world and those who follow."

Response from Government, whilst welcomed, has been underwhelming and non-specific. Whilst the Department for Energy Security and Net Zero signalled support for our sentiment, evidence for action and pace beyond the setting of targets and the signalling of more generalised and existing climate-adjacent plans was absent. More disappointing still was a self-satisfaction in the assessment that the UK is nudging just above the actions of other nations who are equally failing to legislate with urgency. A promise for leadership at COP28 has yet to bear the evidence of leadership we have called for.

The Department for Levelling Up, Housing and Communities was slightly more helpful in that as well as sign posting the setting of Net Zero targets in law, it also highlighted up-coming policy and consultation works as WES CEG watching briefs: operation

carbon emissions action in the Future Homes Standard (which sets out considerable improvement in energy efficiency standards for new homes), and consultations on embodied carbon emissions of construction consultations scheduled for the coming months ahead.


On behalf of the Secretary of State for Education, Baroness Barran helpfully outlined specific action the Government is taking to set the UK up for success in providing the capabilities and capacity of skills needed to deliver Net Zero but stopped short of responding specifically to our call on the Green Jobs Delivery Group.

Responses were also received from the Departments of the Environment, Food and Rural Affairs and Transport, with both being supportive generally, but neither offering reassurance of action specifically.

Supporters wishing to sign the petition can still do so by visiting bit.ly/3SMq1mQ and supporters wishing to write to their local MPs can do so using our template letter as a guide.

What you can expect next

We will be reviewing the responses and assessing our CEG action plan in the new year to ensure we continue to make our voice heard and create positive impact and we will share our plans on the WES website and via our social media channels.

If you have any questions or feedback about the open letter or our plan for action, please contact the Climate Emergency Group Chair at CEGChair@wes.org.uk 



WE WILL NEED ALL HANDS ON DECK WORKING COLLABORATIVELY TO SUCCEED.



To view The WES Climate Emergency Group Open Letter – June 2023 visit; www.wes.org.uk/activities/projects-programmes/climate-emergency-group

Heating and cooling coils transformed my life



Lisa-Jayne Cook FInstR FWES says she “fell into refrigeration”. It turned out to be a happy accident though as she explains here.

Like many others in the field, I ‘fell into’ refrigeration. It wasn’t an industry I’d ever even considered until I’d found myself out of education and in search of work. My first taste of the refrigeration industry and engineering was way back in 2000 when Heating and Cooling Coils, a local business offered me a drafting position within their coldroom division. I’m proud to say, I’ve not looked back since. I had no relevant experience or qualifications, but my mother, an engineer herself, had encouraged me to apply.

Building the foundations

I settled into the role and swiftly found myself moving from drafting coldstore designs into their applications department for air side heat exchangers. This role introduced me to the basics of thermodynamics and fluid mechanics, building on the knowledge I had gained while working in the coldroom division. This role ignited a passion in me I never knew I had and laid the foundations for my career in the industry.

In 2002 I was approached by Kelvion Searle. They offered me a position in their export sales team, supporting a new sales manager in a technical capacity. It was with Kelvion that I

completed my apprenticeship, attending Eastleigh College on day release, and working twilight shifts in the factory learning to braze and assemble our products. I completed my BTEC Level 3 in 2004, achieving a double distinction, for which I received the Governor’s Award at Eastleigh College and a shortlisting in the RAC IOR Student of the Year Awards in the same year.

Taking a lead on design

Over the 18 years I spent with Heating and Cooling Coils and Kelvion, I worked in a variety of roles, including applications manager and key accounts manager. In my latter years at Kelvion, while we were developing our CO₂ products and associated selection software, I took the lead on the design and specification of gas coolers for some of the UK’s leading supermarkets. This was a technically challenging role, but by far the most enjoyable.

In 2018 I joined the southern sales team at Aqua Cooling. Here I was responsible for the design, sale, and delivery of chilled water systems. This was a complete change of direction, moving from air side heat exchanger design to complete system design. Aqua Cooling generously invested their time in sharing their knowledge and helped me to develop my skills. I even found my way back to the drawing office here, producing piping and instrumentation diagrams for quotations and projects.

STEM role models

Aqua Cooling were particularly passionate about supporting their local community and encouraging

their employees to become STEM role models. Their passion led me to the Women’s Engineering Society and the Early Careers Board’s Lottie Tour; my first taste of promoting STEM careers beyond our local community. During my time with Aqua Cooling I was named in the Women’s Engineering Societies Top 50 Women in Engineering (2019) – Current & Former Apprentices; which, to date, has been one of the biggest achievements of my career.

In 2019 I had the opportunity to join J&E Hall’s service team as a sales and applications engineer. Working with J&E Hall was a fantastic opportunity to grow my application knowledge even further. With their expertise being predominantly in industrial refrigeration, it was again different to anything I had done before. I have been very fortunate in my career to be surrounded by knowledgeable people who are willing to invest in future talent, and J&E Hall were no exception.

Lottie on tour



(L-R) Jacinta Caden and Lisa-Jayne Cook receiving their WESO trophies

Dedication to tackling climate change

Since then, I have again moved into another completely different role, working as key account manager at GEA Heating and Refrigeration Technologies in their service division. This role is very much one of building relationships with our clients and ensuring they continue to receive the exceptional service they've come to expect from us. What I love most about my current role is that GEA are as dedicated to tackling climate change and increasing diversity in engineering as I am.

I have had many opportunities to be involved in exciting projects, which resulted in building the scope of my engineering knowledge. Refrigeration and cooling touch so many areas of modern life, there are endless opportunities to gain insights into processes and technologies outside of our field. I have worked on projects such as standardisation of refrigeration plant for commercial refrigeration applications, vinyl presses, brewing, plastic extrusion, and blow moulding, to laser cutting.

Enormity of a project

One standout project was the design and project management of chilled water plant for the tunnel boring machines at the Thames Tunnel Tideway project. It was exciting to work on as there were many challenges, not only to meet environmental requirements due to the proximity to residential properties and the small footprint we had to work within, but also for the quantity of chilled water required by the machines for operation and to the depths at which it needed to be delivered. Having been given the opportunity to visit a machine at Battersea; I still to this day remember how the enormity of the machines put the project into perspective.

Mentoring


Looking back, one of the best moves I ever made was to connect with industry leaders. This subsequently led to me finding myself a mentor within one of those leader organisations. It was this connection that has really catalysed my personal and professional growth, has led to new opportunities,



Lisa-Jayne Cook on site

connections, and networks, and has opened many doors for me.

Volunteering with industry bodies has also played an important role in my progression; gifting me access to extended networking and CPD. In the space of eight years, I have grown from committee member with the Institute of Refrigeration's (IOR) Women in RACHP (WiRACHP) to IOR board member and most recently president-elect, chair of the WiRACHP Committee, board member of the Air Conditioning and Refrigeration Industry Board (ACRIB), founding board member of International Women in Cooling (INWIC), STEM ambassador and STEMAZING woman, volunteer with World Refrigeration Day, NED for the Gosport and Fareham Multi Academy Trust Evaluation and Scrutiny Board and UN Women UK delegate.

All of this has propelled me to the position in find myself in today; STEM role model and advocate for equality, diversity, and inclusion; both of which are roles that I had never imagined for myself, but I'm so very glad to have grown into. I've been fortunate to have a very fulfilling career in engineering, I aspire to help others see the variety of roles on offer and how rewarding working in engineering really is. 

Other key dates

- 2004** – IOR and RAC Magazine Student of the Year – Shortlisted
- 2016** – Joins the IOR
- 2016** – Joins Women in RACHP Steering Committee
- 2019** – WES Top 50 Women in Engineering – Former and Current Apprentices
- 2020** – RAC Cooling Awards D&I Winner
- 2022** – GEA Global Awards – Gold Winner in People and Culture
- 2022** – We Are the City Rising Star – Science and Engineering
- 2022** – HRS Society Award
- 2022** – BESA Woman of the Year in Building Services
- 2022** – NFB Top 100 Most Influential Women in Construction
- 2023** – ACR News Diversity in Industry Award
- 2023** – National ACR and Heat Pump Women in RACHP Award
- 2023** – RAC Cooling Awards Gold Award
- 2023** – NFB Top 100 Most Influential Women in Construction and Highly Commended in Southern Hero Category
- 2023** – Great British Business Women Awards – Shortlisted Engineering and Manufacturing (winners revealed soon!)



SURVIVE AND THRIVE

BY MIKAELA SANCHEZ



Mikaela Sanchez is an embedded software engineer, and has had a relatively late diagnosis of combined-type ADHD. In this article, she shows why she feels that she has found the best career path for her, because of the problem-solving, creativity, and variety of work that is inherent in engineering.

Lazy. Forgetful. Selfish.

Those were words that others used to describe me, and how I used to describe myself for almost my entire life. I knew deep down that it wasn't true, but I didn't know how else to explain why I couldn't 'just do' certain tasks, or why I had so much potential but I couldn't 'just apply' myself.

What I didn't know, up until a few years ago, was that I had ADHD – a

neurodevelopmental condition that affects one's behaviour, causing difficulty in all aspects of life. I was diagnosed with combined-type ADHD, which means I have symptoms relating to impulsivity, hyperactivity, and inattention. This causes difficulty in working memory, attention, concentration, sitting still, and more. However, growing up, no one suspected anything was amiss because I was achieving good grades and not causing disruptions at school. This is not an uncommon experience. Girls are diagnosed less often because they are more likely to have

symptoms of inattentiveness only, and are less likely to show the disruptive behaviour more prevalent in boys.

To me, everything that went wrong in my life looked like and felt like a moral failing, especially when my grades started to drop during my GCSEs and A-Levels. Why could I concentrate and put massive amounts of effort into playing video games, teaching myself to code, and creating art, when I couldn't do the same for subjects I chose to study? Did I lie when I claimed I cared about my future and making a difference? Of course not, but I couldn't see that at the time.

“
THE DIAGNOSIS
HELPED ME
UNDERSTAND
MYSELF
BETTER.
”

Ups and downs

Fortunately, I was able to secure a place at the University of Kent studying computer systems engineering with a foundation year as the entry requirements for the course were low enough for me to enter. I did a lot better once I started studying at university; I was studying topics that I found fascinating and, more importantly, I met my partner. We studied together throughout the entirety of our degrees and encouraged each other to get to the finish line (I later learned that this is a technique that people with ADHD use called 'body doubling'). Unlike my time at school, I was achieving high grades in most of my modules. I still had trouble keeping up with assignments and pulled all-nighters for almost all of them, but for the first time in my life, I felt like I was starting to reach my potential.

Perseverance

Things started to fall apart after I began my placement year. Initially, I felt that everything at work was going quite well, but a few months in, my interest and motivation suddenly dropped. I was already struggling with trying to recover from depression during the peak of the COVID-19 pandemic, but now I had to contend with feeling like a massive failure again too. At around the same time, I saw a humorous post online about the author's ADHD symptoms and difficulties. I thought that it sounded a lot like me and explained a lot of the issues I had been having my entire life – for the first time I didn't feel so alone.

My partner encouraged me to seek a diagnosis, so I asked my GP for a referral and was put on the waiting list. However, months passed and I realised that I couldn't keep going if I didn't get help. I was at the point where I believed I wouldn't pass my placement, let alone complete my degree, if I didn't get a diagnosis and treatment. However, my partner and I weren't in a financial position to be able to afford a private diagnosis, and I couldn't ask my family to help either.

Hope and empowerment

Out of nowhere, I remembered that I had received an email from The IET (Institute of Engineering and Technology) a few months prior, mentioning 'Foothold' and


how they could help with funding for diagnoses. I decided to just go for it and applied to get help, asking if they could help fund an ADHD diagnosis for me. To my surprise, I received a grant to pay for diagnosis and titration appointments! I felt hopeful that I could continue to study and achieve my goal of becoming an engineer.

It helped me understand myself better. I didn't feel so broken, and I could start being kind to myself. The diagnosis also helped me access help from my university in the form of Disabled Students' Allowance and adjustments to help with completing assignments and exams, and also empowered me to ask for reasonable adjustments at my current workplace and apply for Access To Work, which is a government grant to help pay for practical support with work. Some examples of support include ADHD coaching, admin assistance, and noise-cancelling headphones, but are not limited to these.

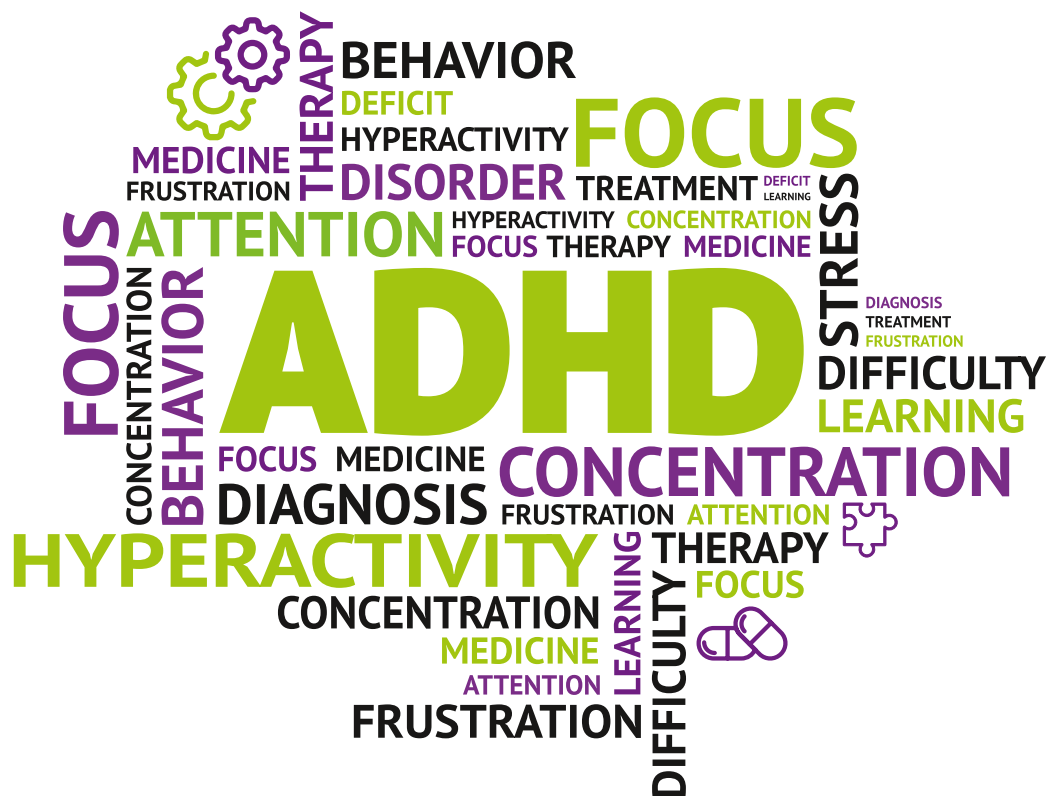
Result!

Even with medication and support, I still struggle, but it's not so bad anymore. I think the most impactful thing that has happened to me recently is starting my new role as an embedded

software engineer at Adaptix, helping develop new and innovative X-ray systems. My tasks are interesting and varied, my colleagues are lovely, and my manager, Linde, is very supportive and understanding. Flexibility and novelty are crucial for someone with ADHD, and I feel very fortunate to be in the position I am now.

Since obtaining my diagnosis, I have been spreading the word about Foothold with other engineers seeking a diagnosis for neurodivergent conditions, and working with them to create more materials for supporting people like me. I am also part of The IET Neurodiversity Member Network, which aims to help improve awareness in neurodiversity and support neurodivergent engineers and technologists. If you're interested in supporting either, I encourage you to reach out. 

If you can relate to Mikaela's experience and think you might have ADHD, the first step is to learn as much as you can about the condition. <https://www.myfoohold.org/differently-wired-hub-home/> and <https://www.nhs.uk/conditions/attention-deficit-hyperactivity-disorder-adhd/>





Digital twins and causal AI reasoning enables intelligent maintenance

Aircraft delays are a significant challenge facing our modern world. A delayed or cancelled flight costs passengers time, and airlines money and reputations, and they have a bigger impact on the environment than flights running to time.

WHAT IS A DIGITAL TWIN?

A digital twin is a virtual representation of an object or system that spans its lifecycle, is updated from real-time data, and uses simulation, machine learning and reasoning to help decision-making.

An aircraft occupying a parking space beyond its scheduled time prevents another from landing, cascading to traffic congestion in the airspace, burning excess fuel, emitting otherwise avoidable exhaust gases, and adding to excess emissions footprints.

Addressing this problem, Dr Cordelia Mattuvarakuzhali Ezhilarasu developed a framework for aerospace vehicle reasoning (FAVER) employing a combination of digital twins and causal AI reasoning to identify the root causes and possible consequences of aircraft system faults. This demonstrated potential to reduce unscheduled/surprise faults and associated emissions footprints.

Condition-based maintenance (CBM) enables customised maintenance planning of components and systems of a vehicle by monitoring their health condition. Integrated vehicle health management (IVHM) is an evolving capability that empowers CBM of complex systems like aircraft, by collecting data from sources like sensors, maintenance records, and design documents to condition monitoring, diagnosing faults and degradations, and evaluating remaining

useful life of the concerned systems. IVHM was initially introduced by NASA and further developed and adapted by several industries including aviation. IVHM aims to enable the vehicle to function as intended, increasing its reliability and availability, saving time and cost associated with unexpected downtime, and eventual consequence of prolonged maintenance activities.

One of the underexplored contributors of surprise faults in IVHM is cascading faults. An aircraft is a complex machine comprising multiple systems that are complex themselves. Aircraft systems (e.g. engines) are usually supplied by specialised manufacturers (e.g. Rolls Royce, GE) and assembled by the airframe manufacturers (e.g. Airbus, Boeing). These suppliers have their own health monitoring methods and maintenance practices customised for their systems and components. Aircraft systems interact with each other despite being developed in siloes. Due to these interactions, faults occurring in one system could cascade to others and affect them at an unexpected time. Troubleshooting such cascading faults using health monitoring technologies

developed for individual systems might be time-consuming and complicated. Hence, while most of the research in IVHM focused on developing health monitoring capabilities for individual aircraft components or systems, FAVER is developed to consider the causal relationship between aircraft systems, and to predict their cascading effect on other systems due to their interactions with each other. The framework, FAVER, consists of two essential parts: i) digital twin of twins; and ii) AI reasoning.

Digital Twin (DT) is a virtual representation of any physical asset¹, and it is used by FAVER to emulate the interaction between aircraft systems and to produce 'what-if' simulations to explore the unexpected scenarios in advance. The reasoning component in FAVER reasons through the health information from aircraft systems, exploiting the causal knowledge graphs, to identify the root causes and cascading effects of faults. FAVER is one of the first frameworks to leverage the versatility of DT together with the power of causal AI reasoning to isolate cascading faults at the aircraft level.

1. Development and Implementation of a Framework for Aerospace Vehicle Reasoning (FAVER) CM Ezhilarasu, IK Jennions - IEEE Access, 2021

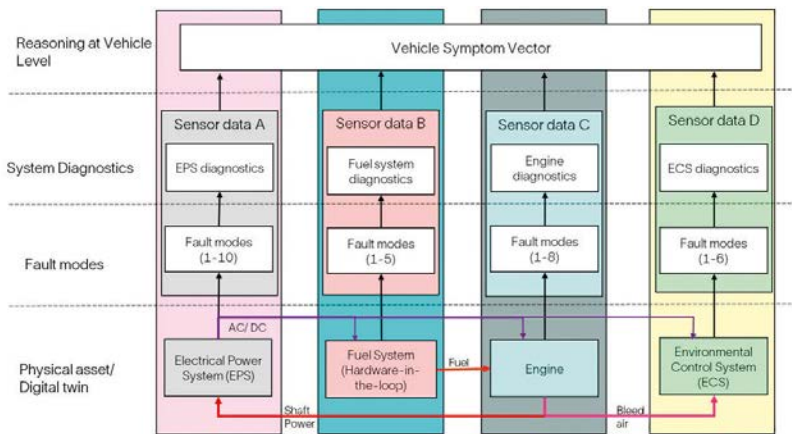


Figure 1 shows the working schematic of FAVER. For demonstrations, four safety-critical aircraft systems that interact with each other were chosen:

- the engine;
- the fuel system (FS);
- the electrical power system (EPS); and
- the environmental control system (ECS).

The FS provides fuel to the engine, the engine supplies bleed air to the ECS and shaft power to the EPS, and the EPS provides electricity to all other systems in the framework. Separate DTs are developed for each system to simulate their individual level operations based on input from user, which include healthy and cascading fault scenarios. DTs provide their health states as output in the form of symptom vectors. These symptom vectors allowed further reasoning. The DTs generate data required for developing individual diagnostics for concerned systems (vertical siloes of Figure 1). DTs are modelled to be modular, encapsulated from each other. The interaction between aircraft systems are simulated using a digital twin-of-twins approach, where all system DTs work together to simulate the aircraft, by passing scaled parameters to each other. This enabled systems on different scales to work together and prevented a complex, time-consuming, verification and validation (V&V) process, which would otherwise be required when a DT is updated or added to the framework.

The symptom vector generated by digital twin-of-twins is then passed on to FAVER’s AI reasoning layer, which is built with i) system level diagnostics, ii) fault attributes table, and iii) causal


relationships expressed in knowledge graphs. System level diagnostics use symptom vectors to diagnose the health of individual systems. A fault attributes table indicates the possibility of a fault occurring due to interaction within and across systems. A causal graph is built with knowledge of the wider aircraft system provided by experts. The knowledge layers from the fault attributes table and causal graph are then leveraged by a combination of reasoning algorithms, to reason through the results provided by system diagnostics, and identify root causes of system level faults and predict their potential cascading effects.

Results

The capability of causal AI reasoning in FAVER was demonstrated with real-world aircraft accident scenarios, where FAVER proved able to identify

the root cause and cascading effect of faults within the interaction network. By employing causal AI reasoning, the results produced by FAVER could be used directly by vehicle maintenance teams, as they are clearly explainable and show the routes for troubleshooting, as against the traditional machine learning algorithms which have black box approaches and cannot explain how a fault occurred or why the action is needed.

Future

FAVER can be easily expanded and adapted to new generations of aircraft in the future and ensure their on-time flying. The potential proven by FAVER, in employing digital twins and causal AI reasoning for investigating complex scenarios for maintenance, is transferable not just to other aircrafts, but to other types of complex machines. Cordelia is now researching how to use digital twins and causal AI to predict the effects of cascading faults among multiple pieces of drilling equipment, which will have substantial effects on reducing operational failures and related emissions footprint in the energy sector. 

“FAVER has been developed to consider the causal relationship between aircraft systems, and to predict their cascading effect on other systems due to their interactions with each other.”



About the author

Dr Cordelia Mattuvarukuzhali Ezhilarasu is senior AI research scientist at SLB Cambridge Research. Cordelia completed her PhD and worked as a post doc at Cranfield University where her research was sponsored by Boeing. Her research focuses on developing artificial intelligence (AI) techniques used for health monitoring and the maintenance of complex machines like aircraft and drilling systems. Cordelia is a Chartered Engineer and an elected member of IMechE.

Cordelia has previous work experience in solid oxide fuel cells (SOFCs) and semi-conductor industries in India. She has bachelor’s degree in aeronautical engineering and a master’s in industrial engineering, both from Anna University, India. Cordelia is a STEM ambassador, and visits schools to encourage children (especially girls) to take up STEM as their careers. Cordelia also believes strongly in bringing research to the public using simple explanations; she has been a speaker in a Soapbox Science event and has presented her research at the House of Commons as one of the finalists in the STEM for Britain event.



We all need allies!



Tej Bahia, Business Director at Arcadis

Preferably, one like **Tej Bahia**, Business Director at Arcadis, who won the WES Men As Allies Award 2023. We quizzed him to find out why he feels so strongly about encouraging women in whatever engineering field they choose.

Figures show that women make up just 16.5% of all engineers in the UK and that the gender gap in starting salaries among UK engineering and technology graduates widens as the level of study increases. So women need to be pretty determined to embark on engineering as a career and really plan towards it at school. How does Arcadis help enthuse girls and women?

Arcadis set up a STEM Ambassador Network that meets regularly to share knowledge and showcase best practice examples, creating resources to support diverse STEM engagement with the next generation of talent. We have STEM representatives in each team to

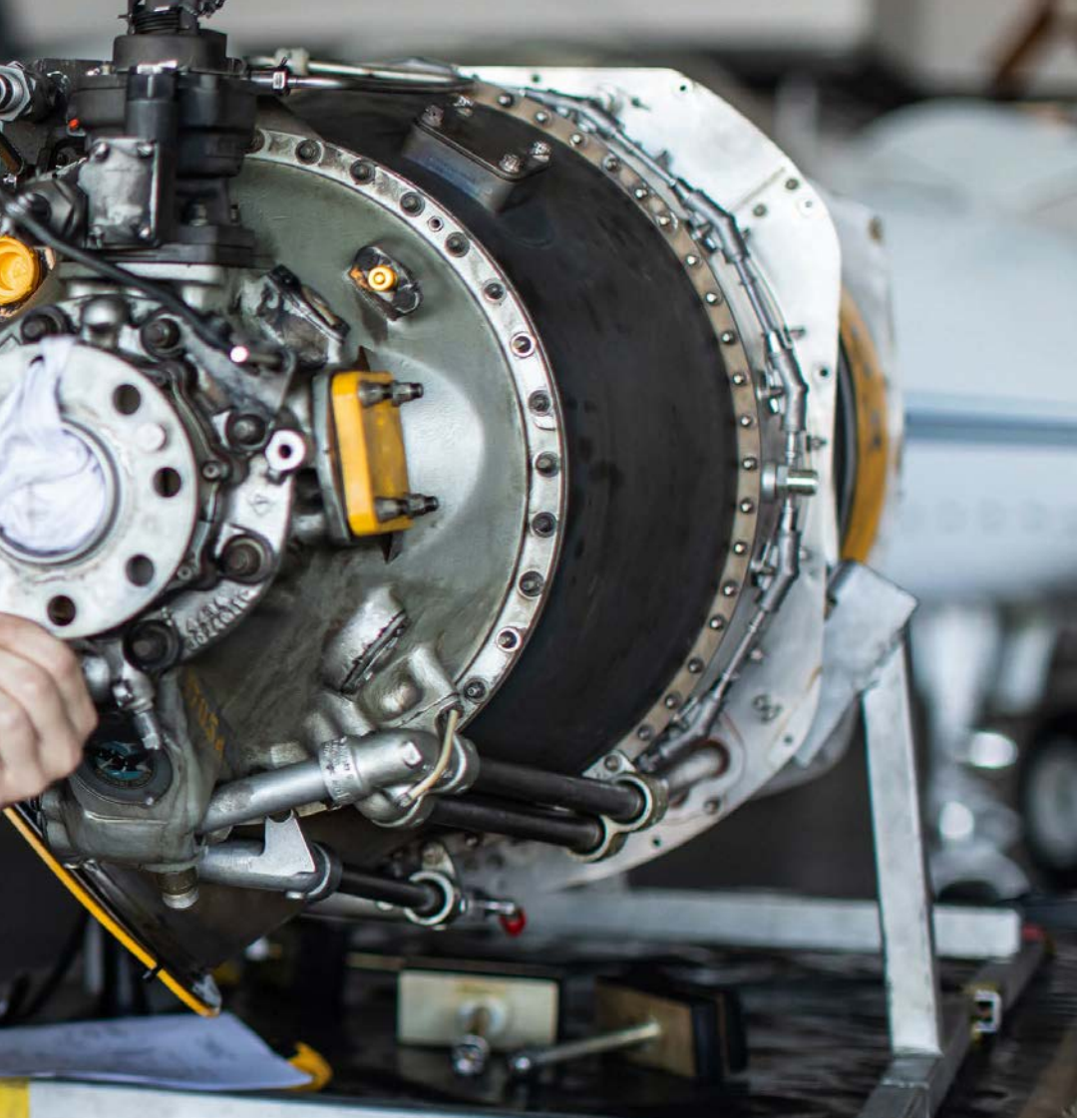
manage the coordination and delivery of STEM activities across regions. At the end of 2023 we supported STEM Learning UK at an event, sharing insights of AI machine learning with 102 students from 10 schools around the region, as part of the Royal Institution Christmas Lectures, which were aired on BBC over the festive period. These events, along with other initiatives we run including the use of virtual reality experiences to bring engineering and design to life, help to create an inclusive culture making engineering accessible to all. We also host taster sessions showcasing a 'day in Arcadis' at all-girls schools. This has been incredibly successful and many school leavers have joined our apprenticeship programme, where women are equally given the same opportunities as men. Within my own business unit, I encourage our

early years team members including female colleagues to take part in such initiatives, where they can provide firsthand experience and knowledge to school children about their experiences working at Arcadis.

What has Arcadis identified as the main barriers for women considering careers in engineering and what does it do to mitigate these? (Bearing in mind that the term 'engineering' is a blanket term that covers a multitude of disciplines).

Joining a male dominated environment can be intimidating for many women as this could give them the thoughts of it impacting their progression, however, Arcadis promotes based on merit and not gender. It continuously invests in women and makes them a driver in their own journey, whilst supporting and pushing them to be the best. An example of our investment is the

Above: At Arcadis, we encourage and support women's participation in all fields, and promoting diversity, inclusivity, equity, and belonging is crucial to creating a balanced and progressive workforce



I have always encouraged my own daughter to follow her dreams to become whatever she would like; we have discussed different sectors such as pharmacy, medicine, and engineering as a future career. I encouraged her to take work experience in each of these fields and more, and I was delighted when she finally chose engineering as her direction, a traditionally male dominated sector. Her decision was made by listening to the enthusiasm and passion of the women working in the industry she had witnessed whilst on work experience.

There is a lot more that the education system can do to move away from traditional practices and improve gender parity. I remember visiting my son's open day before he started secondary school, and the head teacher was very passionate about the subjects they teach and the results they achieved, which seemed very traditionally focused and not considering the wider lens of today's world. I asked the question about how the school created an inclusive culture and promoted diversity, to which the response was very bleak. I think the education system could learn a lot from industry and follow some of the great practices that we have adopted to improve areas like gender equality and STEM engagement.

Are women naturally attracted to certain engineering disciplines over others do you think?

Maybe in the past, but these days I don't think that women are naturally more attracted towards specific disciplines, I have seen a good mix of graduates and apprentices for example entering various engineering and consultancy disciplines. Historically, societal factors, stereotypes, and gender biases have influenced the choices women make regarding their career paths. However, these barriers are being broken down. At Arcadis, we encourage and support women's participation in all fields, and promoting diversity, inclusivity, equity, and belonging is crucial to creating a balanced and progressive workforce. It is important to create an environment that encourages women, to pursue their passions and talents in every engineering or consultancy discipline. ►

'PARRR' initiative, an award-winning programme which was launched in 2022 as part of our commitment to improving gender representation and reducing the gender pay gap, and the programme takes a new forward-thinking approach to addressing gender disparity. It is structured around six key workstreams, each with executive sponsors who are fully accountable for the delivery of cultural and behavioural change, along with hitting our target to increase the number of women in our business at all levels. It focuses on gender equity through a lens of Parity, Awareness, Recruitment, Retention, and Returners.

Alongside this, Arcadis intersectional Global Women of Colour Programme demonstrates our recognition that the women of colour within the business environment, experience significant levels of bias and challenge. Its aim is to improve the employee experiences of women of colour in our business and enhance equitable access to opportunities. And, through the programme we've heard first-hand about how these experiences continue to affect Arcadians from within our community.

These programmes were recognised at the Inspiring Women in Construction and Engineering Awards last year.

What would be the best way to get girls to accept that they can help improve the way things work (from the smallest thing, like getting the kettle to stop boiling for so long to massive infrastructure projects)? Does the education system need to change to develop more analytical brains, maybe it has to go further back than that even, to educate parents/carers to buy Lego (for example) rather than dolls?

Parents and carers should be challenging gender stereotypes from the beginning, not just with girls but boys as well. Carers could arrange activities, and experiences that promote problem-solving, creativity, and critical thinking. Inclusive role modelling is something we value at Arcadis, and teaching girls about diverse female role models who have made significant contributions in traditionally male-dominated roles may have a lasting, positive effect, which can help challenge stereotypes and inspire girls to believe in their own potential.

The nomination

Priyanka Duggal, who nominated Tej for the WES Men As Allies Award 2023, said: “Tej is a fantastic leader and an inspiring role model, but his contribution to leading change by improving the gender balance and pay gap is what has made an impact in the industry. His business unit is one third women, an increase from 15% to 30% in two years, with the ambition of ensuring half his staff will be women by 2025. Tej’s drive to empower women has been proven through his mentoring, enabling them to become fearless, powerful, and successful. Not only does he support and mentor female colleagues already in the company, but he also intentionally tries to recruit women from different sectors where there are transferable skills. Tej gives these women a foundation for their career to flourish in an industry they may not otherwise have considered.”

This is a wonderful endorsement of your work Tej, but what pushes you to champion women – what do you see in them that perhaps other industry leaders don’t?

Coming through the industry over the past two decades, I have witnessed and know the challenges women may face and the potential knock this can have on their confidence and career aspirations. I want to break down these barriers, and therefore, I ensure they feel supported, encouraged, and secure in their role and career plans. I believe that women can equally bring a wealth of knowledge, drive, and ambition, but also different perspectives, experiences, and skills. As an advocate for gender equality and parity, I believe women should have the same opportunities and receive the same recognition. Successful women in our industry will be seen as role models for the next generation, creating even more interest and parity in our industry.

It is plain that regardless of gender, Arcadis simply wants the best, so what perhaps unexpected bonuses or benefits have you seen as your women engineers progress and flourish?

Diversity, equity, inclusion, and belonging, is at the heart of everything we do at Arcadis, and forms the foundation of our Global Social Impact Strategy.


We recognise that to bring the best to our projects, clients, and customers, we need a strong mix of experiences, opinions, cultures, and different approaches and ways of thinking. At Arcadis, we have seen women flourish in many ways, whether it be taking senior leadership roles within the business, to making a significant difference and impact on the global stage through securing high profile industry roles.

When Arcadis launched its strategy, we included inclusivity targets alongside our financial ones. One of these targets – our 40% women in the workforce, 30% women in leadership – has accelerated our drive towards gender parity. We now have a diverse global executive leadership board with 60% women, demonstrating our senior leadership is leading by example. We’ve reduced our gender pay gap to its lowest since reporting began in 2017 and for the first year we’re including diversity, equity, inclusion and belonging in our annual people strategies, passing global targets to local leadership, and associating progress with leadership reward.

In my own business unit, I have seen women joining from different industries which are more female-led, and I have seen them become successful. As a result, we have improved the gender balance significantly in recent years, and I have witnessed my female colleagues develop into leadership positions, creating opportunity for themselves but also being inspirational for the next generation, this makes me proud.

Winning this award is recognition of your work to inspire women – but where did your inspiration come from in the first place?

I have always been very ambitious and I have always wanted to make an impact for a better industry – it’s simply in my DNA. My inspiration came from seeing how women were being treated unfairly in the industry, I knew then that I wanted to make my stamp and ensure no woman is ever left feeling like they are not good enough just because of their gender. Being a father of a young woman who is now entering the industry, and wanting to see her become successful, is what motivated and drove me to inspire women across the globe, and ensure they exceed their potential in their careers. In addition to this, during my time in my current role as business director, I was initially surprised by the gender balance in my teams overseas where it is the opposite to the UK, and 75% of the team are women, and this was also a trigger that inspired me to drive the change here.

With men holding the majority of roles within engineering and applied sciences, it is crucial that they are involved in making the cultural changes needed to attract and retain women in engineering and applied sciences. The Men as Allies Award seeks to celebrate a male engineer, or professional male working within the engineering, technical and applied sciences sectors, who has gone above the call of duty to support his female colleagues and address the gender imbalance within these fields. 

www.arcadis.com



A workplace culture that celebrates and embraces diversity

Historically, the world of engineering has been a typically male environment. In 2010 only 10.5% of engineers were women in the UK, but by 2021 this had risen to 16.5%, which equates to an extra 374,000 women pursuing a career in engineering, and this trend is set to grow.

AWE is planning its part in enabling this growth, so we're committed to fostering a workplace culture that celebrates and embraces diversity, ensuring equity for all employees, and actively promoting an inclusive environment where everyone can thrive.

We are externally recognised as an exceptional employer, having been ranked in the Top 25 Best Big Companies yet again this year.

Our leading flexible and smarter working policies – including a nine-day fortnight for all, and the option to tailor your working arrangements to suit your individual needs helps us to create a working environment that is open to all.

And there is something for everyone, whatever stage you are at in your career in engineering – our opportunities are vast and varied.

Company overview

We understand that people have different needs when it comes to working arrangements and that this can change over the course of your career. We encourage our employees to think creatively about their preferred working arrangements, we call this Smarter Working. This empowers all of our team to make the right decisions about where, when and how they work as far as their work allows; optimising the use of workplaces and technology. It improves productivity through a focus on outputs and enables a better work/life balance for all. From compressed hours, to part-time, and term-time only contracts – and all the rest in between – we're keen to ensure you have a healthy balance between work and home.

AWE is an exciting and unique place, providing interesting work that is critically important to help keep our country safe and secure.

Our mission is to support the defence and security of the UK. We do this through developing, manufacturing and maintaining the warheads for the UK's nuclear deterrent, as well as supporting the UK's counter-terrorism efforts. We are a strong and supportive team, united in our mission to keep the UK and everyone in it safe.

In addition, we are managing one of the largest infrastructure programmes in the UK to deliver a cutting-edge, sustainable science and manufacturing environment and maintaining an estate that spans more than 1,000 acres and some unique buildings.

We're immensely proud of what we do and our role in keeping the nation safe.

If you choose to come and join us, you'll be working with some of the greatest minds in the business and in some of the most advanced research, design and production facilities in the world.

Your job, your way

Our people are at the forefront of everything we do, and that's why we take wellbeing and equal opportunities incredibly seriously. Our aim is to create an inclusive environment for everyone – we want to make sure everybody working at AWE is able to bring their whole selves to work, whether that's on site, or working remotely.

And there are plenty of opportunities to move around in your career too!

There is so much we can offer you

- Competitive salary and regular pay reviews
- Generous Group Personal Pension
- Support to gain a relevant professional qualification
- Funding for the annual membership of a relevant professional body
- Family leave (up to 39 weeks full pay)

Other benefits include:

- A nine-day working fortnight, which means our offices close every other Friday.
- A generous total of 270 hours' leave a year which includes an allowance for Bank Holidays
- Flexible and smarter working options, to suit your needs
- AWE Life Insurance
- Our award-winning benefit scheme including Cycle to Work and an Employee Discount scheme.

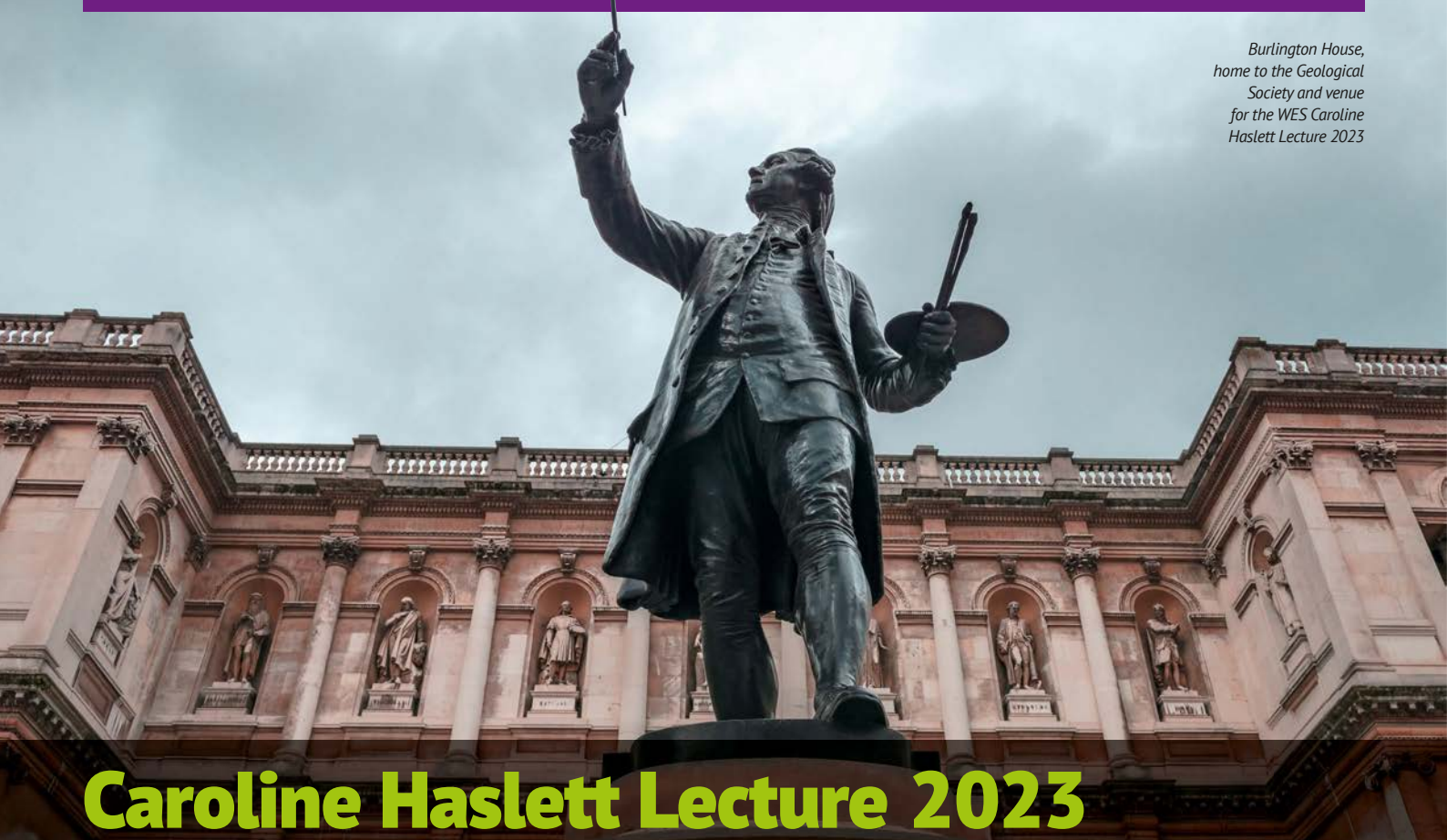
To view and apply to our current vacancies visit:
https://awepeople.wd3.myworkdayjobs.com/External_Careers?source=womeneng



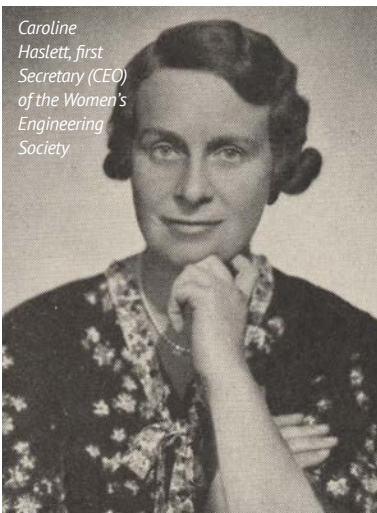
Celebrating women in engineering

We have a wide range of events, awards, campaigns, projects, programmes, and activities that support and encourage women engineers at all stages of their careers. Here are just two recent events to whet your appetite.

Burlington House, home to the Geological Society and venue for the WES Caroline Haslett Lecture 2023



Caroline Haslett Lecture 2023



Caroline Haslett, first Secretary (CEO) of the Women's Engineering Society

Caroline Haslett (1895–1957) was appointed the first Secretary of the Women's Engineering Society in 1919 with fellow engineer and suffragist, Rachel Parsons. Caroline Haslett's work in promoting women's participation in engineering and her dedication to advancing the role of women in technology left a lasting legacy, which we celebrate every year in December at the Caroline Haslett Lecture and Awards event.

Last year we hosted the event on 13 December at the Geological Society in London, and we were delighted to welcome our immediate past president, Dame Dawn Childs, as our guest lecturer.

Dame Dawn is the chief executive of Pure Data Centres Group. She's an accomplished engineer and operator who was honoured with a Fellowship from the Royal Academy of Engineering in 2020, and she was appointed DBE in the 2023 New Year honours list for her services to engineering.

Prior to joining Pure, her career spanned several engineering sectors and industries including UK change director for National Grid, group engineering director for Merlin Entertainments, head of engineering at Gatwick Airport and more than 20 years as an engineering officer in the Royal Air Force.



Dame Dawn was the longest serving president of the Women's Engineering Society from 2018 to 2023, so it was an honour for us hear her lecture on the theme of safety and security.

WES awards

This WES annual event also celebrates the winners of the Karen Burt Memorial Award for the best female newly chartered engineer, the Men as Allies Award and the Amy Johnson Inspiration Award.

Dr Karen Burt was a respected physicist and a member of the Women's Engineering Society. She campaigned tirelessly for women to have careers in science and engineering. Her experience and extensive research helped women working in engineering to manage their career breaks and return to work. The 2023 winner of the Karen Burt Memorial Award, as announced by head judge, and current WES president, Dr Kathryn Critchley, was Dr Angeliki (Kelly) Loukatou. Kelly works as an energy insight lead at National Grid UK, leading on the storage and flexibility insights of the Future Energy Scenarios. She is also the event lead of women in non-traditional roles, aiming at attracting, promoting, and sustaining women in engineering.

Other winners on the night were Fiona Tatton who won the Amy Johnson Inspiration Award and Tej Bahia, winner of the WES Men As Allies Award, and we were joined by more than 70 members and supporters to help us celebrate the winners and enjoy an evening of networking. (Turn to page 14 to read our interview with Tej Bahia).



WES Student Conference 2023

It was another great turnout and a packed programme of speakers and workshops for the annual WES Student Conference, when more than 120 attendees from across the country came together in Leeds on 1 December 2023.

“The day completely exceeded my expectations. I learned a lot, but I also got to feel that kind of emotion that you only feel in an all-female team.”

The event was opened by WES CEO, Elizabeth Donnelly, before we were joined by the Royal Engineers who ran their superb 'Build a Bridge' team-building exercise that gets everyone thinking and working together.

Throughout the day delegates were able to attend a range of workshops covering skills such as presentations, writing a CV and inspiring the next generation. There was also an incredibly popular talk given by Vince Pizzoni titled *How to get a graduate job in six months*. Vince's talk was full of advice on applying for jobs, dealing with interviews and the importance of doing your research about the company you are applying to.

Valuable networking opportunities

A session on building confidence was delivered by Elizabeth Donnelly and there were some informative takeaways including the fact that often body language is more important than the words spoken when it comes to the impression you may make on a person.

To round off the day we were joined by Megan and Anais from Team Repair who gave an inspirational session for all budding entrepreneurs.

One of the best elements about the student conference is the networking that goes on amongst the students and the speakers who answered questions and provided encouragement to individuals throughout the event.

It really was an incredibly enjoyable and exciting day, and it was great to see so many women in one room. As one student said: *“The day completely exceeded my expectations. I learned a lot, but I also got to feel that kind of emotion that you only feel in an all-female team.”*

One of the workshops at the WES Student Conference last December



Elizabeth Donnelly, MSc FRSA MRAeS MINCOSE
Chief Executive Officer at Women's
Engineering Society



Now that you have reached the final pages, I hope you are as delighted as I am with the relaunch of our journal. The Woman Engineer has been published continually every quarter since December 1919 and its first edition contained this note to our readers:

“In issuing the first number of our magazine at the present moment, we have two main objects in view. Firstly, we hope that it will encourage and stimulate all women who are interested in engineering, and secondly, that it will be a means towards removing the prejudices and artificial restrictions which now prevent women from taking up engineering as a trade or profession.”

Almost 105 years later, I find that this message still resonates. The journal now contains more engineering content to encourage and stimulate readers, and articles showing the tremendous achievements of women engineers, and how they have overcome obstacles to continue their careers.

Inspiration

Our new feature, **A Woman Engineer**, plays on the journal's title and introduces readers to an inspirational woman engineer. On page 8 of this issue, Lisa-Jayne Cook FInstR FWES, explains how she (like many women engineers) “fell” into refrigeration engineering. It inspired a passion for thermodynamics and fluid mechanics. Cook's career has since expanded from air side heat exchanger design to complete system

design for chilled water systems. Unsurprisingly, Cook is an award winner, including being named one of WES' 2019 Top 50 Women in Engineering: Current and Former Apprentices, (alongside WES President, Dr Katherine Critchley). Cook also designed and project managed a chilled water plant for the tunnel boring machines at the Thames Tideway project which is building an enormous sewer under the River Thames. In 2019, WES' centenary year, I was privileged to attend the naming of one of the boring machines (Rachel) in honour of WES' first president, Rachel Parsons. It is wonderful to see how WES connects members to our origins.

Neurodiversity

On page 10 Mikaela Sanchez writes about her experience of being an engineer with ADHD. One in seven

people worldwide are thought to be neurodiverse and up to 30% of engineers are estimated to be dyslexic. Girls with ADHD are less likely to be diagnosed than boys, because they are more likely to show symptoms of inattentiveness rather than disruptive behaviour. Sanchez accidentally discovered “body-doubling”, a great technique to remain focused by working or studying with someone else who is aware of your task and will encourage you to keep going while you do the same for them. She also secured finances for a private ADHD diagnosis from the Institution of Engineering and Technology's (IET) Foothold programme. Foothold can help support engineers and their families with care and disability grants, carer support and access to their wellbeing hub, even if they are not IET members.



Development

Dr Cordelia Mattuvarukuzhali Ezhilarasu describes her development of a Framework for Aerospace Vehicle Reasoning (FAVER) on page 12. FAVER has two essential parts: a Digital Twin and AI reasoning used in combination to reduce unexpected aircraft faults and resultant emissions. A Digital Twin is created for each of four core systems in aircraft: the engine, fuel system, electrical power system and environmental control system and these can be manipulated to emulate potential problems. FAVER then uses an AI reasoning layer built with causal relationships to analyse and reason with the Digital Twins, to discover the root cause of aircraft systems problems. Results have shown that FAVER is more transparent than black box approaches, allowing maintainers to see the routes for troubleshooting. FAVER's potential can clearly be applied to other sectors such as energy as well as aerospace.

Allies

Since our very first days, WES has been fortunate to work with male allies. Sir Charles Parsons, father of Rachel and husband of Lady Katharine Parsons, was an ardent supporter of WES, including advertising in The Woman Engineer to help cover its costs. Today, we celebrate such support with our Men As Allies Award, given in 2023 to Tej Bahia, Business Director at Arcadis. Bahia's interview on page 14 is a fascinating insight into how


men can support women engineers. He recognises the determination that women must have to embark on an engineering career and has actively recruited women into his team, setting targets to increase female representation to 50% by 2025. He's also a mentor and advocate for gender parity. Bahia's main driver was his surprise at seeing women comprise 75% of his overseas teams yet significantly less in the UK. Having seen how successful women engineers are, he was determined to drive change in the UK, and his continued success makes him a worthy winner of the award.

Talent

I think WES' founders would be surprised but delighted to discover that The Woman Engineer is still being published 105 years after its first publication. They might be disappointed that women still make up only 16.5% of engineers, but they also appreciated that it was never going to be easy for women to be accepted in the industry. Engineering is still a male-dominated field, and as Bahia says in his interview, schools retain a very traditional focus in their view of the working world.

This is why I meet so many talented woman engineers. It is much easier to study another subject, or to agree that girls who are good at science should become doctors or science teachers. It's easier to graduate with an engineering degree and work in the

human resources department rather than the engineering division. This means every single woman engineer who has the determination to face the sometimes-daily battles to show her expertise, must be talented. As President Kennedy said on embarking on the great engineering feat that sent humans to the moon, *"We choose to do...things not because they are easy, but because they are hard."*

We still have a long way to go before we achieve parity in engineering, but remember, that 16.5% represents nearly a million women. And while there are women engineers, the Women's Engineering Society will be there to support them. 

Elizabeth Donnelly
Chief Executive Officer of the Women's Engineering Society

www.wes.org.uk

"Every single woman engineer who has the determination to face the sometimes-daily battles to show her expertise, must be talented."

Partners and wes



WES is delighted to welcome our new partners who have joined us on our journey to increase diversity and inclusion in the engineering sector.

Company Plus: Nestlé Group
Company: Harwin, Prodrive, Premier Foods, Rolls-Royce Motor Cars, Hydro
Education: University of Nottingham
SME: Amodo Design
Start Up: Bradwell Blacksmiths

Group, National Grid, Metis Consultants, SuSHY, Heathrow Airport, Imperial College, and The Open University.

Thank you to our event sponsors:
The Apprentice Showcase 2024: BAE Systems, JLR, and Capula.

We are also grateful for our renewing partners, who include:

- Airbus – returning for a two-year partnership, 2024-2026; and
- Leonardo – returning as a company plus partner for 2024.

Our partners will collaborate with us at:

- WES Annual Conference, 17-18 April 2024
- International Women in Engineering Day, 23 June 2024

Mott MacDonald, Frazer Nash, FCDO Services, Burns & McDonnell, Zurich Engineering, Equinix, Sellafield, Smiths

For partnership and sponsorship enquiries, please contact: partners@wes.org.uk

Partner up

By partnering with WES, the largest organisation of professional female engineers in the UK, you can:

- provide your female technical staff with tailored support;
- encourage girls to see engineering as a career option and
- develop your company's diversity and inclusion programme.

You'll enjoy direct access to our extensive member network, which includes opportunities to share knowledge and experience with other partners.

You can also attract future employees at our networking events and promote your jobs on our website and to our social community of over 40,000 followers.

As a result, you'll have the chance to raise your company profile as an investor in women.

<https://www.wes.org.uk/partnership/why-partner/>

The Woman WOMEN'S ENGINEERING SOCIETY Engineer

If you would like to promote your products and services to our enviable readership of women engineers, please get in touch with Victoria Brown to discuss a variety of bespoke packages to suit all budgets on **01778 395029** or by email at victoria.brown@warnersgroup.co.uk



Become a part of our culture.



Hydro places our people at the core of our operations, valuing their expertise, creativity, and dedication. We're driven by industries that carry real significance, making meaningful impacts on the world.

Want to be part of industries that matter? Learn more and apply at hydro.com/careers or send us an email at marketing.extrusion.uk@hydro.com



Advenco introduces Chilled Water System Tanks

Hot water specialist Advenco has introduced the Chilled Water System (CWS). This range of premium carbon steel tanks serves a diverse range of commercial cooling applications – including heat pumps, chillers or fan coil units – which require chilled water storage.

Each vessel features multiple large bore flanges providing high-capacity connections as standard at high and low levels catering for a wide range of system applications with moderate to high flow rates. 10 high-capacity, low-height models from 300 to 5,000 litres enables chiller systems to considerably improve performance by ensuring better temperature control, increasing chiller longevity, reducing condenser cycling and improving system start-up times.

Each CWS tank is supplied with dual-layer insulation, the inner lining providing an anti-condensation underlay, and then a further 100mm of outer insulation. The Advenco CWS range is suitable for use with standard working pressures of up to 6 bar. For projects requiring higher pressure, such as multi-storey buildings with basement plant rooms, 10 bar versions are available on request in all sizes.

Multiple sensor pockets at all levels provide straightforward integration of controls or BMS sensors. An inspection/clean-out flange allows for ease of service or maintenance.

www.advenco.co



New high rise flue kits from Keston provide uncomplicated compliance

Keston's new stainless-steel High-Rise Flue Kit provides a simple and compliant solution for high-rise buildings.

Suitable for all buildings in England and Wales higher than 18 metres, the kit is fully compliant with the latest building regulations and is suitable for installations in Scotland above 11 metres.

Made from 316 stainless steel, it offers a corrosion-resistant alternative to other non-combustible or fire-resistant materials. It is compatible with the Keston Combi 2 and System 2 boiler ranges. Containing an air outlet and flue terminal, each kit also contains fittings and thread sealant.



www.keston.co.uk

HiKOKI Power Tools launches the CV18DA Multitool

Elevate your work with HiKOKI's CV18DA Multitool, a great addition to any toolkit thanks to its precision and performance. The CV18DA Multitool, which features a new and improved tool-less blade change feature, marries brushless motor technology with a design that's both nimble and robust.

The HiKOKI CV18DA Multitool is a master of adaptability, accepting both Starlock and OIS blades all with a quick and easy tool-free blade exchange system. This swift swap capability also allows you to transition between accessories with ease. This Multitool's lightweight build and ergonomic grip mean you can navigate the tightest corners or stubborn jobs without sacrificing comfort or control. It is the perfect tool for busy tradespeople, ensuring that no time is wasted.

This next generation Multitool features HiKOKI's UVP anti-vibration technology for superior control, ensuring smooth operation while keeping vibrations to a minimum. Its compact control and ergonomic design make it ideal for hard-to-reach areas, ensuring that even the most intricate tasks in confined spaces can be tackled with precision and ease.

The Multitool's low vibration body also makes it really comfortable to use, especially during extended run times as it reduces fatigue and enhances both control and accuracy. Adding to its user-friendly design is an integrated LED light, which improves visibility in poorly lit areas, a common scenario for many tradespeople.

Operating at an oscillation angle of 3.6 degrees and offering a no-load speed range of 6,000 to 20,000/min, the HiKOKI CV18DA Multitool is adept at everything from cutting and scraping to sanding. With an overall length of 327 mm and a weight of just 1.2 kg (excluding the battery), this is a user-friendly, lightweight companion on construction sites.

All this is backed up with three year and five-year, heavy-duty warranties, subject to product registration and terms and conditions, giving you extra peace of mind.

www.hikoki-powertools.co.uk





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