

THE ENGINEER

June 2024



Game changers

Women in engineering who have shaped today and are building tomorrow

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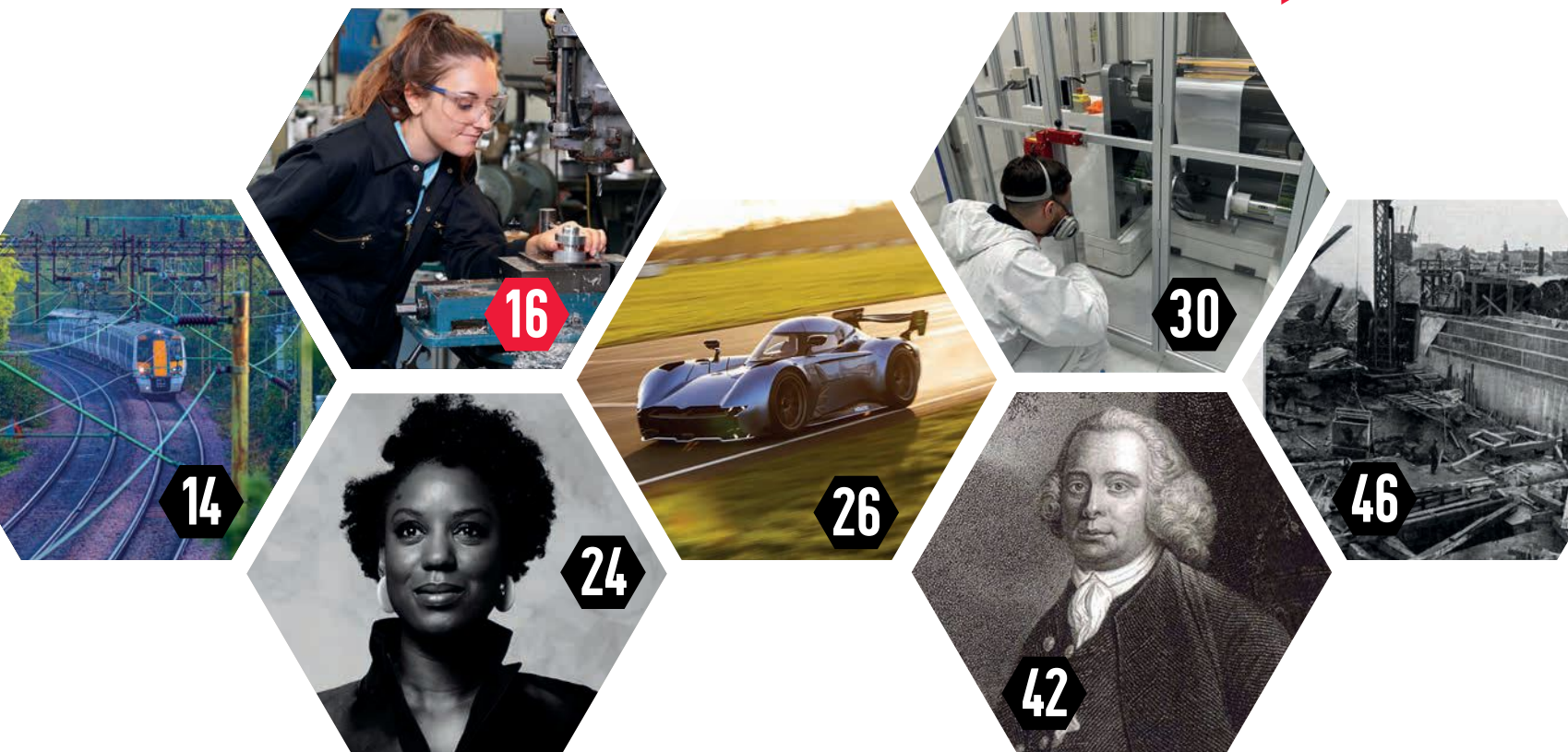


Tinius Olsen introduces VectorExtensometer, a self-contained extensometer capable of replacing multiple contacting and non-contacting sensors with a single, industry specific, next generation instrument.

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- Improving test success rate by eliminating contact-point slippage
- Eliminating consumable parts

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Mark Allen Group, St Jude's Church,
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Editor & Publisher Jon Excell
jon.excell@markallengroup.com

Features Editor Andrew Wade
andrew.wade@markallengroup.com

News Editor Jason Ford
jason.ford@markallengroup.com

Editorial Graduate Ellie McCann
ellie.mccann@markallengroup.com

Commercial Director Justyn Gidley
+44 (0)20 7738 5454
justyn.gidley@markallengroup.com

Sales Manager
Kim Reddick
kim.reddick@markallengroup.com
+44 (0)17967 169106

Business Development Manager
Jessica Sutton
jessica.sutton@markallengroup.com
+44 (0)17879 413610

Art Director
Calvin McKenzie

Production
Jamie Hodgskin

Publishing Director
Marc Young
marc.young@markallengroup.com

Subscriptions & Customer Services
circulation@markallengroup.com

The Engineer is available for International
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For more information please email
jon.excell@markallengroup.com

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SCAN ME



JON EXCELL

Mind the gap

Along with the need to inspire more young people to consider a career in engineering, attracting more women into the profession remains one of industry's most enduring and intractable skills challenges. The equation is a simple one: in the face of a widening skills gap, half of the population are still woefully underrepresented in the UK's engineering workforce. Addressing this is vital if we are to deliver the pipeline of engineering talent that will be critical to the sector's future growth.

That's not to say there hasn't been progress. Indeed, the numbers are making steady - albeit slow - movement in the right direction. Today, women account for 16.5 per cent of UK engineers (up from around 10 per cent just over a decade ago) and there are now perhaps more inspiring female engineering role models than ever before, from renowned business leaders to impressive young innovators at the forefront of some of the most exciting areas of technology.

In parallel with this, there also seems to be a more nuanced understanding of the challenge, and a growing awareness of some of the practical measures that employers can take to address the gender gap, from unconscious bias training for hiring managers to the adoption of flexible working arrangements more compatible with a family life.

But despite the progress, there's still much to do, whether it's removing some of the bottlenecks preventing women from re-entering the workplace after maternity leave or understanding and addressing some of the societal issues that see girls - who massively outperform boys in STEM subjects at GCSE level - move away from physical sciences as they go into A-levels.

There are many practical measures that can help, but alongside this it's vital that we continue to hammer away at the stereotypes, to celebrate the achievements of women engineers and remind women, girls (as well as teachers and parents) of the incredible opportunities available in engineering, which is why events like this month's International Women in Engineering (23rd June) are so important.

In this issue we're delighted to be playing our own small part in this important exercise by shouting about some of the incredible female engineers (past and present) who have transformed our world: from the trailblazing engineering innovators of the past who have helped shape the present, to the inspiring female innovators of the present day who are helping shape the future. We hope you enjoy reading their stories.

Finally, we're excited to announce that The Engineer's 2024 Collaborate To Innovate (C2I) awards - is now open for entries. As always we're looking for the most inspiring examples of how engineering collaboration is address society's most pressing problems. For more information visit <http://awards.theengineer.co.uk>

Jon Excell

EDITOR • JON.EXCELL@MARKALLEGROUP.COM

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MISSION STATEMENT

The aim of The Engineer is to champion and promote engineering innovation and technology development across all of the UK's key engineering sectors.

5

THINGS WE'VE LEARNT THIS ISSUE

- 1 HGVs account for 20 per cent of UK transport CO2 emissions
- 2 The global military electrification industry is expected to be worth \$17.6 bn by 2030
- 3 Labour plans to reach 55GW of offshore wind capacity by 2030
- 4 Apprenticeship achievement rates in England are falling below the government's target of 67 per cent
- 5 16.5 per cent of UK engineers are female

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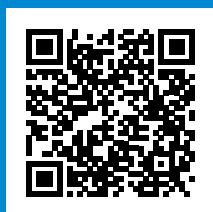
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AUTOMOTIVE

- Wayve raises \$1bn for the development of AI-powered self-driving cars

DEFENCE & SECURITY

- Government invests in facial recognition to clamp down on retail crime

ENERGY & ENVIRONMENT

- Aston works with Asian partners to tackle rice crop emissions

MANUFACTURING

- UK manufacturers demonstrate adaptability despite major disruptions

MEDICAL & HEALTHCARE

- AI-generated medical responses need monitoring, study finds

RAIL & MARINE

- Green shipping could add 4m jobs by 2050, report claims

SKILLS & CAREERS

- Growth optimism fuelled by investment in tech - report

Shadow Hand withstands the rigours AI research

Three-fingered dexterous hand takes blows to prove its mettle

JASON FORD REPORTS

A UK company known for making highly anthropomorphic robot hands has developed Shadow Hand, a dextrous three-fingered robotic hand made to withstand the rigours of real-world machine learning research.

Around five years in the making, the new Shadow Hand was built by Shadow Robot Company for Google DeepMind.

"They found that all robot hardware used for machine learning was not really up to the job," said Rich Walker, director of London-headquartered Shadow Robot.

Walker added that robots developed for AI research can literally fall apart when used beyond their design parameters, fail to acquire useful data because of the way they are designed for control and operation, cannot operate for long periods of time without needing a restart or reset, or are not built with the assumption that interaction and collision is normal for it, which leads to damage.

"And lastly, almost all the robots that they've looked at, even the ones that were pretty robust and pretty reliable, didn't have the kind of dexterity and manipulation capabilities that DeepMind really cared about," said Walker.



Known for Dexterous Hand, Shadow Robot's five-digit flagship product, the company's new solution 'is a lot chunkier' with each easily swappable finger weighing 1.2kg and the total unit weighing 4.1kg.

The hand measures 350mm in length, and 165mm x 160mm in width and height. According to Walker, it behaves much more like an optimised manipulator rather than a human-like hand. It can also withstand being struck by a hammer.

"We think this is a kind of a new level of robustness and performance in mobile hardware," said Walker.

Kinematics in each finger - containing 155 individual sensor channels, plus video from the distal tactile sensor - are similar to a human finger, with an ad-abduction joint at the base, and three flex/extend joints along its length.

The four joints of each finger

are driven by five motors housed in the base of the finger in an N+1 configuration.

"The reason for this is that if you simply drive each joint directly when you change direction, there's a point where you have no force on the tendon and therefore you have backlash, a point where the joint doesn't move," said Walker. "If you have an N+1 configuration you can maintain tension all the tendons all the time.

Each motor unit executes a 10kHz force control loop, giving active compliance to every joint.

Now available to purchase, Shadow Hand goes from fully open to closed in 500 milliseconds and can give a 10N fingertip pinch. Each finger contains dozens of 3-DOF taxels on the middle and proximal phalanges and hundreds on the fingertip, with 'a significant dynamic range' of 0.01N to 80N.

Read more at www.theengineer.co.uk

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SCAN ME



Aftrak off-grid energy project wins Milken Motsepe Prize

Green energy innovation is providing electricity and farming tool

JASON FORD REPORTS

A Loughborough University-led initiative aiming to bring affordable green energy and food security to communities across Africa has won the Milken Motsepe Prize in Green Energy.

Named Aftrak, the project was among four other finalists vying for the \$1m prize that was announced at an awards ceremony in Los Angeles on May 6, 2024.

Aftrak is a self-sustaining system made up of a solar microgrid, a micro electric tractor – both invented and built at the University – and Deep Bed Farming (DBF), a practise that disrupts compacted soil, inhibits soil erosion, and captures rainwater close to where crops are grown. Once established, DBF more than doubles crop yield and gives smallholders additional income that can be used to purchase electricity from the microgrid.

“We have tried to optimise



the design so that we can do in country build and repair without complex tooling as far as possible,” said Prof Dani Strickland, from Loughborough’s School of Mechanical, Electrical and Manufacturing Engineering. “An example of this is the use of metal structural components that can be stamped, or laser cut and folded.

The Aftrak Micro Electric Tractor Unit is a battery and solar powered machine whose main purpose is to prepare compacted soil for DBF -using a 5kW motor that drives a circa 500rpm chain trencher that can dig down to 400mm - but can also provide electricity for off-grid homes.

The tractor’s 200W solar array

tops up the machine’s 5kWh temperature stable lead acid batteries that can run for two hours or several days depending on the application. MPPT and CC are installed for charging.

The system’s 15kW solar array comprises 10 easily assembled, ground mounted panels and generates 75kWh of electricity per day for uses including lighting, cooking, phone charging and milling grain. The solar array also houses a charging station for the tractor.

“We still have a way to go with cost optimisation as we were ordering parts to tight time scales,” said Prof Strickland. “However, we have a good idea where we can save costs. An example would be integration of all our power electronic systems onto a single detachable and replaceable board.”

Aftrak is being deployed in Malawi, where nearly 90 per cent of the population lack access to electricity.

NEWS IN BRIEF

LICENSE GRANTED

The Office for Nuclear Regulation (ONR) has granted a nuclear site licence to Sizewell C for it to install and operate a nuclear power station in Suffolk. The decision follows an assessment of the licence application made by Sizewell C Ltd, with ONR concluding that the application met all the requirements set out in regulatory guidance. The granting of a site licence does not allow the start of nuclear-related construction on the site.

SECOND LIFE

Disused batteries from Nissan LEAFs are to be given a second life in Britain following a Strategic Pilot Agreement between Nissan and Ecobat Solutions UK. The agreement will investigate ways of commercialising the process: locating, safely transporting, dismantling, repairing and repurposing EV batteries for second life usage. Nissan could also then offer those second life products to market with an official manufacturer warranty.



REPORT HIGHLIGHTS HOW SMES CAN UNLOCK THE VALUE OF APPRENTICESHIPS

JON EXCELL REPORTS

A new report published by skills charity Enginuity and The Engineer magazine highlights some of the practical measures that engineering and manufacturing SMEs should take to ensure that their apprenticeship schemes are a success.

Based on a detailed survey of key SME employers and qualitative interviews with a number of SME business leaders, the *Unlocking the value of apprenticeships for engineering and manufacturing SMEs* report was commissioned by Enginuity to understand why apprenticeship achievement rates in England are falling

below the government’s target of 67 per cent, and uncover some suggestions on how this situation can be improved.

The report also explores why some firms maintain achievement rates that are consistently higher than average. Indeed, although all the SMEs taking part in the research reported some issues with the apprenticeship system, 61 per cent of those responding to the survey reported completion rates greater than 65 per cent.

By comparing survey responses from SMEs which have achieved good achievement rates with those that have achieved lower achievement

rates, the report identifies a number of priority areas for business including the importance of mentoring, benchmarking apprenticeship schemes and working closely in partnership with training providers and colleges.

The report, which can read in full at www.theengineer.co.uk, offers 10 recommendations, highlighting a series of practical measures that can be taken by employers, training providers and policymakers.

Enginuity is encouraging organisations across industry to download the report and act on its recommendations.

DIGITAL TWIN

UK businesses will be able to take advantage of digital twin technology following a £37.6m investment by Belfast Region City Deal and Innovate UK into the UK Digital Twin Centre. Opening later this year in Belfast, the new centre of excellence is expected to transform how industries develop products, services and systems. Led by Digital Catapult, the Centre has been launched with co-investment from Thales UK, Spirit AeroSystems and Artemis Technologies.

[Read more at www.theengineer.co.uk](http://www.theengineer.co.uk)

Smart 'man overboard' detection deployed on North Sea rig

ANDREW WADE REPORTS

An AI-powered system that can automatically detect and track persons overboard at sea has been deployed on an oil rig for the first time.

Developed by Edinburgh-based Zelim, Zoe is a person in water (PIW) detection system to aid search and rescue operations at sea.

It uses a suite of cameras and sensors to monitor the area around a vessel, raising alerts if someone falls overboard. Once someone is in the sea, Zoe's software can then track them with around 97 per cent accuracy to a distance of over 330m. The system has been trained on a dataset of over 4.9 million maritime rescue images across a range of ocean conditions.

Zoe was deployed on the jack-up rig Valaris Stavanger in February 2024. Zelim installed a tailored solution that includes seven infrared and optical cameras placed around the vessel, allowing the entire rig to be monitored. Following an initial trial period, Valaris will evaluate the suitability of the system for use on other assets



in their fleet.

Glen Spearman, offshore installation manager onboard Valaris Stavanger said that if someone ends up in the water, the alarm is raised and one person acts as a spotter to maintain visual contact.

Andy Tipping, head of commercial at Zelim, explained that 80 per cent of deaths from drowning occur in the first 30 minutes.

"However, if the person is wearing a survival suit they can eliminate the effects of cold water shock, massively increasing their chances of staying alive for longer," he said. "The biggest risk is not

being found - a person in the water can very quickly become lost, even with people with eyes on them.

With Zoe, a PIW situation triggers an automatic alert to the radio operator, who can see a 10-second clip of when the alert was triggered whilst simultaneously viewing live footage.

The system continues to track the PIW, increasing their chances of successful rescue. Zoe also logs the position of the vessel and the person overboard at the point of detection for mayday call geo-location, as well as providing the radio operator with a mayday script and actions checklist.

AIRLANDER 10S PROPOSED FOR RURAL SCOTLAND

Hybrid Air Vehicles is working with HITRANS to build a business case for the commercial deployment of Airlander 10 airships.

HITRANS (Highland and Islands Transport Partnership) is the statutory transport body for Scotland's Highland and Islands, which makes up over 50 per cent of Scotland's land mass. With a relatively small population spread across such a wide area, moving passengers and freight in the region is challenging.

Having conducted a UKRI-funded feasibility study on using airships in northern Scotland, HAV and HITRANS will now advance the business case for the commercial deployment of Airlander 10 vehicles in the region. HAV has also committed to reserve early production slots for six Airlander 10 aircraft for HITRANS.

Airlander 10 can carry about 100 passengers or ten tonnes of freight payload, or a combination of both. HAV claims the airship produces up to 90 per cent fewer emissions when compared like-for-like with similar aircraft. **AW**

Read more at www.theengineer.co.uk

COLLABORATION TO ADVANCE MOBILE CHARGING FOR DEFENCE

JASON FORD REPORTS

Technology designed to charge passenger electric vehicles is being developed for defence applications following the signing of a Memorandum of Understanding (MOU) between Solus Power and Qinetiq.

London-headquartered Solus Power develops off-grid mobile DC-to-DC rapid charging and energy storage technologies.

The company has developed a mobile charging solution centred around its 'Kratos' technology, which is a modular, stackable and easily

transported power unit.

Described as 'Jerry Cans of electricity', each ruggedised Kratos unit measures 550 x 450 x 110mm and weighs approximately 25kg. The material used for Kratos' housing is currently classified, as are the number of cells per unit.

"To make it rugged, steel support pillars are placed through gaps in the battery pack to provide the structural support as well as supporting ribs around the outside provide structural strength to the housing to withstand

being driven over by a Land Rover," said Stas Leonidou, CEO of Solus Power.

The Lithium-ion power units can deliver ultrafast charging to electric vehicles, drones, or equipment. Users can also scale the number of packs to increase capacity.

"Units are connected in parallel," said Leonidou. "Each unit has a high voltage three pin flying lead cable which attaches to each unit."



A report published by the British Army found that the global military vehicle electrification industry is expected to be valued at \$17.6bn by 2030.



Electrifying road freight gets JOLT from new project

JASON FORD REPORTS

A new programme dubbed Project JOLT aims to help freight operators switch to electric heavy goods vehicles (eHGVs).

JOLT (Joint Operator Logistics Trial) is led by The Centre for Sustainable Road Freight (SRF) and involves partners including John Lewis Partnership, and Volvo Trucks UK.

Freight contributed £13.6bn to the economy in 2022 and 98 per cent of food and agricultural products are largely carried by HGVs that account for 20 per cent of CO2 emissions from domestic transport.

JOLT founder David Cebon, a Professor of Mechanical

Engineering at Cambridge University and director of SRF explained that Project Jolt will provide partners with shared access to a fleet of electric vehicles and mobile chargers which will be used for three months per team to carry out a pre-agreed sequence of trials.

“The logistics industry doesn’t know how it’s going to do electric logistics, there are so many major unknowns,” he said.

“Going fully electric introduces significant challenges around cost, charging infrastructure and productivity,” added Justin Laney, general manager for Central Transport at John Lewis Partnership.



The partners will pool data and learning from their experiences with eHGVs in retail, delivery, and manufacturing operations to help develop transition plans for their own businesses and for the wider logistics industry.

Specialists will analyse and model data including vehicle and charger performance, operational efficiency, and costs across as many industry uses as possible.

John Lewis Partnership will use an eHGV from Volvo Trucks UK in their logistics operation.

“We operate around 4,500 commercial vehicles of all sizes

- from small vans to 44-tonne articulated trucks,” said Laney. “For smaller vehicles such as vans and light trucks, EVs are the answer - and we already have a range of these in our fleet.”

Laney continued: “It’s more complex when it comes to heavy duty, long-range vehicles, though, and this is felt across the industry. That’s why we’re delighted to be kickstarting Project Jolt’s important initiative. The data we gather from trialling electric HGVs will be invaluable in informing the progression to fully zero tailpipe emission solutions.»

ABOUT:ENERGY TASKED WITH MCMURTRY BATTERY CHALLENGE

ANDREW WADE REPORTS

McMurtry Automotive is working with About:Energy to test and model the high-performance battery pack that will power its forthcoming Spéirling PURE hypercar.

In 2022, the Spéirling fan car set a record time of 39.08 seconds on the Goodwood hill climb and has subsequently clocked a 0-60mph time of 1.4 seconds. The forthcoming Spéirling PURE – the production version that will be available to the public for just under £1m – is set to be even faster.

Powering the PURE will be the Molicel P50B, a 5.0Ah 21700 form factor lithium-ion cell, claimed to have one of the highest power densities in the world at 260Wh/kg. When the P50B is released later this year, About:Energy will rapidly test and model its unique performance

metrics, allowing McMurtry engineers to incorporate the data into the design and simulations of the PURE’s battery packs.

Gavin White, co-founder and CEO About:Energy, said his company is working in parallel with McMurtry on the quickest and most in-depth battery knowledge transfer to date, with the

aim of eliminating the need for costly and time-consuming in-house battery testing by arming companies and their engineering teams with direct access to advanced battery intelligence.

White told The Engineer that About:Energy has been working with the Molicel P45B - predecessor to the upcoming P50B - for the past year. According to White, that experience should allow About:Energy to deliver a battery model to McMurtry on the P50B within about a month, enabling the team to maximise battery performance on the PURE.



UKAEA IN CZECH COLLABORATION

The UK Atomic Energy Authority (UKAEA) is working with a Czech research partner on a test rig to help develop cryogenic components for its prototype fusion powerplant, STEP.

The Spherical Tokamak for Energy Production (STEP) will rely on High Temperature Superconducting (HTS) tapes to magnetically confine fusion plasma at a temperature of around 150 million degrees Celsius. The HTS tapes will operate at -253°C.

To test the magnetic components, UKAEA has signed a deal with Centrum výzkumu Řež (CVŘ). Together, they will develop the Hi-CrIS (High neutron fluence Cryogenic Irradiation of Superconductors) test rig that will collect data on the properties of the HTS tapes when subjected to fusion-like conditions.



Read more at www.theengineer.co.uk



Labour pledge to tackle four key barriers in UK energy transition

ELLIE MCCANN REPORTS



Grid delays, planning delays, the 'growing' skills gap and supply chain problems will be rectified by the Labour party if it wins the next general election.

Speaking at Innovation Zero in London (May 1, 2024), Ed Miliband, shadow secretary of state for Climate Change and Net Zero, named these specific issues as the 'four horsemen of the apocalypse'.

Specifically, Miliband said that achieving Labour's policy of a net zero grid by 2030 would be impossible without addressing these issues and implementing collaboration across government departments and industry.

Miliband also accused the government of sending 'mixed signals' on its commitment to

an energy transition, stating "uncertainty is the enemy of investment."

He said Labour could offer 'supportive' decarbonisation policies and frameworks that could help improve the direction and investment in the green economy.

"The government has no plan, and because there is no plan, there is no forcing mechanism to drive the government to make decisions for the long-term interests of our country. That's one of the things we want to change," said Miliband.

Labour said it could provide this clarity and investment through the creation of Great British Energy, a publicly owned energy company.

"Great British Energy will partner with the private sector to unlock technologies like

floating offshore wind. We will see further investment in ports for infrastructure and drive the biggest investment in home decarbonisation this country has ever seen," said Miliband. "If Labour is in power, this will be a whole government effort involving every department."

According to Labour policy, Great British Energy will also utilise the specialised workforce required to deliver on Labour's ambitions.

With this, Labour said it is committed to doubling Britain's onshore wind capacity to 35GW, tripling solar power to 50GW, and quadrupling offshore wind with an ambition of 55GW by 2030.

"We offer consistency in a mission," concluded Miliband.

L3HARRIS AWARDED £21M BOMB DISPOSAL ROBOT CONTRACT

L3Harris has been awarded £21m by the Ministry of Defence to deliver up to 50 medium-sized T4 explosive ordnance disposal (EOD) robots.

The contract includes in-country support, maintenance, training and follows L3Harris' delivery of Project STARTER, a program that replaced the legacy fleet of large EOD robots with 122 T7 systems.

Able to navigate narrow urban spaces, the T4 can also operate in aisles of planes, trains and buses and can climb stairs.

Advanced controls, high-definition cameras and fast datalinks will enable the operator to perform tasks like unzipping bags and opening glove boxes from distance.

At just over 100kg, the T4s are smaller than the 300kg T7 UGV and will be used as the rapid response system for emergency situations as it can be transported in a 4x4 vehicle.

Both models use 'advanced haptic feedback', allowing operators to feel their way through the process of disarming devices. **JF**

Read more at www.theengineer.co.uk

URENCO RECEIVES £196M TO BUILD ADVANCED NUCLEAR FUELS FACILITY

JASON FORD REPORTS

Urenco has received £196m in government funding to support the development of an advanced nuclear fuels facility at the company's Capenhurst enrichment site in Cheshire.

The new facility, the first in Europe outside of Russia to develop the next-generation nuclear fuel, will help the Department of Energy Security and Net Zero (DESNZ) to realise its High Assay Low Enriched Uranium (HALEU) Programme announced in January this year.

HALEU is uranium enriched up to 20 per cent and will be needed to fuel most advanced modular reactors (AMR) that will help the UK to quadruple its nuclear capacity by 2050. Urenco's facility will have the capacity to produce up to 10 tonnes of HALEU per year by 2031.

According to DESNZ, AMRs are more efficient and use novel fuels, coolants, and technologies to generate low-carbon electricity. Their high heat output means they can also be used to decarbonise industry and produce hydrogen.

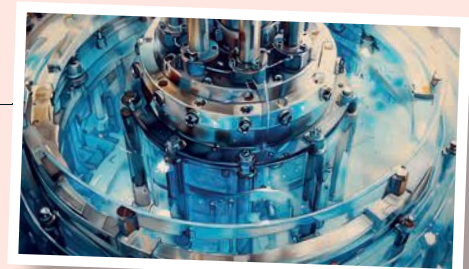
Commenting on the announcement, Tom Greatrex, chief executive of the Nuclear Industry Association said:

"This investment will enable the UK to fuel advanced reactors around the world, building on our existing capabilities to strengthen energy security for our allies.

"Urenco at Capenhurst is at the very forefront of the UK's capability, with this new facility bringing opportunities for the supply chain, new jobs and

investment in the North West of England.

In a related development, a consultation launched on May 8, 2024 proposes designating all fusion plants nationally significant infrastructure projects that will be assessed by the Planning Inspectorate and decided on by the secretary of state for energy.



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DAME DAWN CHILDS

Bridging the gap

Dame Dawn Childs, chief executive of Pure Data Centres Group, on the persistence of the gender gap and what can be done to address it

There is no doubt that engineering touches all our lives on a daily basis. Through engineering solutions we will continue to shape our world and find pathways through critical challenges such as the climate emergency. Surely then a career in engineering would be a coveted prize for any young person and anyone would be actively encouraged to take up the engineering profession? Especially as there is an ever-increasing gap in the engineering workforce with a shortfall of hundreds of thousands of qualified people.

As a profession, we are missing a trick on many fronts. We need to do more to enhance the reputation of engineering and highlight its many benefits. This is crucial because technical employers often fail to create sufficiently inclusive workplaces, which hinders our ability to foster and retain the diverse talent that does find its way into engineering.

I'm passionate about improving diversity and inclusion in the round - but for women in engineering in particular. Over the three decades of my career, the number of women in engineering in the UK has merely increased from 7 per cent to 16.5 per cent. At that rate of progress, we would not attain a balanced engineering workforce for another century, at least! More importantly, we would fail to bridge the skills gap and miss out on harnessing the brain power to help find the engineering solutions and innovations of tomorrow that we desperately need.

Despite the overt focus on diversity and the significant amount of STEM outreach conducted by professional engineering institutions, charities, and engineering companies through school programs and competitions, progress in diversity has been slow. Why is this the case? And, more importantly, how can we increase the pace and plug the skills gap?

Having spent five years as President of the Women's Engineering Society and served as Chair of several industry Diversity and Inclusion Committees, I (and many others) have spent a long time researching and trying to answer these questions. Whilst there is no singular solution, there is a suite of initiatives that companies can adopt that will definitely help to increase the pace.

A good starting point is to increase information and advice about engineering careers. Helping women and girls to understand better the purpose and social impact of engineering would enthuse and engage them into thinking that engineering could be a choice for them.

A significant part of this is having visible role models such as current female engineering leaders and, importantly, early career engineers for young people to engage with.

I think it would be unusual for anybody to feel like they are a role model naturally, but in fact, every person is a role model for somebody. They need to be open to connecting and discussing what they do and how they got there. I have found that the more I talk about engineering and careers, the more people want to know, and the more I can broaden the conversation. This will also help a very influential group of people, the parents, to see engineering as a good career choice for their little girl. Over the last decade, INWED has created a fantastically rich pool of role models and has helped to shine a light on many different career pathways and roles within engineering that women are already thriving in.

We then need to make opportunities more accessible. This can be achieved through a couple of small changes. We must ensure that job adverts and role descriptions do not use masculine language or demand

educational backgrounds, experience or requirements which are too specific. A more open approach can only yield a wider pool of potential applicants.

Then we need to do a better job of making our workplaces inclusive so that once we have found that great talent; we can keep it. This will take time and definitely requires more than a 20-minute annual online training course on D&I!

It is about driving intent from the top and doubling down on behaviours and actions that exclude or alienate. This helps to ensure that there is a level playing field of support for all employees and that opportunities are equally open to all.

The only way to check if this is being achieved in any company is to ask the employees and keep checking back and testing. This cannot include positive discrimination for any cohort of employees as that is toxic and prevents progress rather than helping.

Even though progress has been slower than hoped, I remain optimistic that we can increase the pace. There is a keener understanding of the challenges now, and the ever-burgeoning skills gap gives us a sharper focus on casting our net wider to find the talent. Inclusion is key - and ultimately, it helps every employee in any company, not just female engineers. #ENGINEER

Dame Dawn Childs is chief executive of Pure Data Centres Group and a former President of the Women's Engineering Society

Imagine working on something you can't test, but cannot fail...

It could have spent years on a submarine before being launched into the extreme cold of outer space... it would then need to withstand extreme heat and shaking as it comes hurtling back down through the atmosphere. And it would still need to work.

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GAME WOMEN IN PAST AND

The Engineer puts the spotlight on 20 female engineers who have shaped the past and are building the future

When The Engineer put out the call for nominations for this special feature to mark International Women in Engineering day (23rd June, 2024), we were inundated with scores of outstanding candidates. Although the gender gap in engineering remains stubbornly persistent, it's testament

to the impact women have had in the sector that we had such a hard time narrowing our list down to just 20. It's worth pointing out that the list is neither scientific nor exhaustive. Rather, it is merely a snapshot that tries to illustrate both the breadth and depth of the female engineering talent that has shaped, and continues to shape, the UK and the world beyond.

Hertha Ayrton (1854 - 1923)

- The engineer who tamed the electric arc



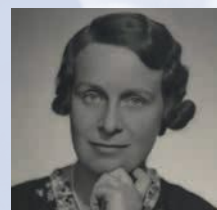
Polymath Hertha Ayrton was an electrical engineer, mathematician, physicist and inventor, suffragette and, aged 44, the first female member of Institution of Electrical Engineers (IEE, now Institution of Engineering and Technology, IET).

Ayrton's work on overcoming the flickers and hissing that came from electric arc lighting was acknowledged by the Royal Society in 1906 with the Hughes Medal "for her experimental investigations on the electric arc, and also on sand ripples."

From 1884 until her passing in 1923, Ayrton had registered 26 patents: five on mathematical dividers, 13 on arc lamps and electrodes, and the remainder on the propulsion of air.

Dame Caroline Haslett (1895 - 1957)

- Electronics innovator



Dame Caroline Haslett was an electrical engineering pioneer and a champion of women's rights throughout her esteemed career. After progressing from a clerk to engineer at the Cochran Boiler Company, Haslett became the first secretary of

the Women's Engineering Society (WES) in 1919. As editor, she used WES' magazine *The Woman Engineer* to ask women what electrical appliances would free them from the drudgery of housework. It was her suggestion, as the only woman on the Institution of Electrical Engineering committee in WW2, to create the three-pin plug for the protection of children that we still use today.

CHANGERS ENGINEERING PRESENT

Hilda Lyon (1896 – 1946)

- Airship pioneer



From humble beginnings as a shopkeeper's daughter, Hilda Lyon was to become one of the most influential women engineers of the 20th century. As an aeronautical engineer, her list of achievements includes helping to design the R101 airship, inventing the

'Lyon Shape' and being the first female recipient of the Royal Aeronautical Society's R38 Memorial Prize. A blue memorial plaque located at her father's shop on Market Weighton High Street, Yorkshire reads: 'Her work is still used for stability software and submarine design.' In 1934, *Flying* magazine described Lyon as "the classic authority on the subject of stresses in transverse frames."

Beryl May Dent (1900-1977)

- Early contributor to computer-aided engineering



Born in Wiltshire to a family of schoolteachers, Beryl May Dent's foundational education helped her go on to shape the course of modern engineering. She obtained a First in applied mathematics from Bristol University, later specialising

in theoretical physics and publishing several papers with direct applications to atomic force microscopy. Over the next three decades, Dent worked at Manchester's Metropolitan-Vickers Electrical Company, starting out as a technical librarian. She continued to publish papers on maths as well as the emerging area of computational science, showing how computers could assist electrical design engineering.

Amy Johnson (1903 - 1941)

- Aviator and engineer



An icon of the 20th century, aviator Amy Johnson was the first female pilot to fly solo from the UK to Australia, as well as the first to gain a ground engineer's 'C' licence. Johnson's achievements gave her a platform to pursue career

opportunities as a fashion model, journalist and entrepreneur. The outbreak of the Second World War saw her return to aviation in the Air Transport Auxiliary. It was in this capacity, while on a routine 'ferry flight', that she met her tragic end in circumstances that remain disputed to this day, further adding to the Johnson legend.

Beatrice Shilling (1909 – 1990)

- Battle of Britain innovator



It was only a brass washer in the shape of a thimble, but Beatrice Shilling's engineering fix to a major design flaw in World War Two Hurricane and Spitfire fighter plane engines contributed to the eventual outcome of the Battle of Britain. Designed to allow just enough fuel to maintain power while preventing flooding, Shilling's 'RAE Restrictor' stopped Britain's Merlin engine carburettors flooding in temporary negative-g manoeuvres such as a nosedive or inverted flight.



Dr Dame Sue Ion GBE FREng FRS
– Materials scientist and nuclear fuels expert



A longtime advocate for nuclear power and its role in our future energy systems, Dr Dame Sue Ion studied materials science and metallurgy at Imperial College London before joining British Nuclear Fuels in 1979. She would go on to become executive director of technology there, later holding a seat on Tony Blair’s Council for Science and Technology. Along with Sir David King, Ion is credited with persuading the Labour government of the time to shift its policy on nuclear and renewable power, shaping the energy landscape of Britain today. Ion was elected a Fellow of the Royal Academy of Engineering (FREng) in 1996 and was a vice-president from 2002 to 2008.

Professor Dame Anne Dowling OM DBE FREng FRS
– Cambridge University



A world authority on combustion and acoustics, Professor Dame Ann Dowling was the first woman to hold the role of Professor of Mechanical Engineering at the University of Cambridge in 1993, and the first female President of the Royal Academy of Engineering from 2014 to 2019. Professor Dowling’s work has always been committed to providing society with power and mobility without environmental damage or excessive noise, with a recent focus on reducing jet noise during take-off. Her research career has largely been at Cambridge University – where she now serves as a Deputy Vice-Chancellor and Emeritus Professor - but she has also held visiting posts at MIT and the California Institute of Technology.

Professor Dame Helen Atkinson DBE FREng
– Cranfield University



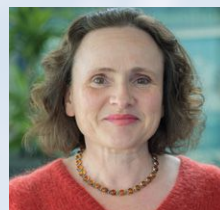
Internationally renowned materials engineering researcher, powerful advocate for women in STEM and passionate educator, Dame Helen Atkinson’s name is usually amongst the first to be added to any list of influential UK engineers. A hugely respected figure across industry, Dame Helen is currently Pro-Vice-Chancellor of the School of Aerospace, Transport Systems and Manufacturing at Cranfield University, where she’s helping to lead a number of key projects that are shaping the future of the aerospace sector, including the £67m Digital Aviation Research and Technology Centre (AIRC) and the Cranfield Hydrogen Integration Incubator (CH2i), a £69m effort aimed at scaling up hydrogen aviation.

Caroline Hargrove
– Chief Technical Officer, Ceres Power



Though originally from Quebec, Canada, it’s in the UK that Caroline Hargrove has really made her mark. She joined automotive legend McLaren in 1997, working for over a decade on the Woking outfit’s F1 simulator before going on to help found McLaren Applied and acting as CTO there for several years. More recently, Hargrove has pivoted to renewable energy, taking on the CTO role at Ceres Power. The company recently received the RAEng’s MacRobert Award for its pioneering SteelCell, a reversible fuel cell technology that was hailed by the Royal Academy as “a huge game changer for hydrogen generation.”

Professor Penny Endersby CBE FREng
– Chief Executive, Met Office



The first female chief executive of the Met Office, Professor Penny Endersby has made significant contributions to the delivery of life-saving science and services in defence and security and weather and climate, both in the UK and internationally. Prior to joining the Met Office, she had a distinguished career at the Defence Science and Technology Laboratory (Dstl), beginning as a graduate researcher in armour and ending as Director of Cyber and Information, and acting Chief Technical Officer. Endersby was awarded the 2021 Society Medal by the British Computer Society in recognition of her use of IT to benefit society, specifically through investment in the Met Office’s supercomputer and data systems in support of weather and climate prediction.

Dame Judith Hackitt DBE FREng
– Chemical engineer and civil servant



Of the many engineers who stepped forward following the Grenfell Tower fire disaster, Dame Judith Hackitt’s contribution has been one of the most impactful. Her Independent Review, published in May 2018, was robust and challenging and the implementation of her recommendations has the potential to transform an industry that had allowed a ‘culture of indifference’ to evolve and be perpetuated towards the safety of buildings. An engineer by profession, Dame Judith holds a degree in chemical engineering from Imperial College, London and is currently Chair of the skills charity Enginuity. Elected a Fellow of the Royal Academy of Engineering in 2010, Dame Judith will be awarded one of the Academy’s highest individual awards, the President’s Medal, in July 2024.

Professor Catherine Noakes OBE FREng

- Airbone infection expert



As one of just two engineers sitting on the UK government's Scientific Advisory Group for Emergencies (SAGE) Prof Catherine Noakes played a key role in shaping the UK's response to the COVID-19 pandemic.

A chartered mechanical engineer with a background in fluid dynamics, Noakes is one of the world's leading authorities on ventilation, indoor air quality and infection control in the built environment. By focusing on the science underpinning environmental transmission of COVID-19, Noakes advanced the understanding of the spread of the virus and helped shape mitigation strategies to keep people safe. Noakes is currently Professor of environmental engineering for Buildings and Pro-Dean for Research and Innovation at the University of Leeds.

Yewande Akinola MBE HonFREng

- STEM champion



Yewande Akinola MBE, is an award-winning Chartered Engineer and innovator with a focus on developing sustainable products who could have become an architect had her mother not persuaded her to focus on engineering. Akinola went on to

study Engineering, Design and Appropriate Technology at the University of Warwick before being awarded a Masters degree at Cranfield University. After graduating, Akinola worked for multiple engineering firms such as Thames Water, ARUP Group and Laing O'Rourke, focussing on sustainability and developing solutions for emerging economies. Akinola currently works with a variety of schools, showcasing engineering as a career choice for pupils.

Professor Anusha Shah

- ICE President



Amidst the plethora of oil-paintings of white-haired men lining the walls of the Institution of Civil Engineering's historic Westminster HQ, one portrait stands out: that of Professor Anusha Shah, the institute's 159th president, and the first woman to hold that office.

A specialist in water and environmental engineering, Prof Shah has over 22 years of experience designing, managing and leading projects and programmes both in the UK and overseas. The multi award-winning engineer has been celebrated as a leading voice on climate change and is currently also senior director, resilient cities, at engineering consultancy Arcadis.

A MESSAGE FROM ENGINUITY

As the charity dedicated to closing skills gaps in our engineering and manufacturing sector, Enginuity understands the role inclusivity and diversity plays in addressing labour shortages and supporting the innovation needed for UK businesses to be at the forefront of designing, making and maintaining the solutions to society's greatest challenges.

It is said that "if you can see it, you can be it" so initiatives like The Engineer's Top 20 Women in Engineering are vital in inspiring women to enter careers in the sector. But we need to ensure these women are not seen as exceptions by increasing visibility of the increasing number of women working in the sector every day. This International Women in Engineering Day, Enginuity is asking people to share the stories of as many women in engineering as possible.

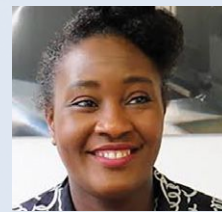
Year-round we support other important initiatives – from providing interactive STEM resources to inspire young women with the careers available in engineering to funding a project that is helping people on a career break, the majority of whom are women, to return to the aerospace and automotive industries.

Follow us on social media to find out how you can help to set the agenda and change the sector.

Ann Watson – CEO, Enginuity

Dr Nike Folayan MBE HonFREng

- Diversity champion



As current Technical Director and Technical Discipline Leader for Communications and Control at WSP and Chair and Co-Founder of the Association for Black and Minority Ethnic Engineers UK (AFBE-UK),

Dr Nike Folayan has changed the face of UK engineering by promoting wider diversity and empowering young women from all backgrounds to join the profession. AFBE-UK champions higher achievements in education and engineering, particularly for people from Black and minority ethnic backgrounds, and currently has over 20,000 beneficiaries and 2500 members. Dr Folayan is a Fellow of the IET, a Trustee at EngineeringUK and StemettesFutures and her accolades include an MBE for services to diversity in engineering.

Yasmin Ali

- Renewable energy innovator



Growing up in Iraq, Yasmin Ali regularly experienced power cuts, and so has dedicated her career to developing and improving the energy resources that are so crucial to our lives. After study in Nottingham and Malaysia, she gained a Masters

in Chemical Engineering, and began her career working in coal and gas, fired power generation and oil. Ali subsequently shifted her focus to renewable energy, working for the UK government in energy innovation and now as a Hydrogen Project Development Manager at RWE. In her newly published book *Power Up*, Ali explores our global reliance on energy and advocates for the green future that we must create.



Ella Podmore MBE

– McLaren STEM ambassador



While studying Materials Engineering at the University of Manchester, Ella Podmore was selected for several internships including at Shell and McLaren Automotive. She is now a Senior Materials Engineer at the latter, a position she was promoted to in 2022,

just four years after she started at the company. As a McLaren STEM ambassador, Podmore is passionate about encouraging all young people to consider a career in engineering. As testament to her own outstanding ability and commitment to better the industry, Podmore was honoured in the Queen's Jubilee Birthday Honours List and was named IET's Young Women Engineer of the Year 2020.

Roisin Speight

- Principal Engineer, Space Park Leicester.



Roisin Speight leads a technical engineering team and oversees a portfolio of space projects at University of Leicester's Space Park Leicester. Prior to joining University of Leicester, Roisin worked for RAL Space (STFC) as a Systems Engineer

and for Airbus Defence and Space and has played key role in a number of different projects currently in space; from telecommunications satellites to ESA's Solar Orbiter mission. This month (June) she looks forward to the launch of the first project she worked on at University of Leicester; SVOM, a Franco Chinese mission dedicated to the study of the most distant explosions of stars.

Thanks to all of the following companies who have expressed their support for The Engineer's Women In Engineering Campaign



Your Partner for Innovation



Fiona Harden

– Engineering Manager, UKAEA



Yet another on our list with a background in physics, Harden has used that fundamental scientific understanding to carve out an exciting career at some outstanding organisations, including a four-year stint at CERN. Returning to the UK, she initially took up a role with the Science and Technology Facilities Council before moving on to the UK Atomic Energy Agency. Harden's time at UKAEA has seen her take lead engineering roles on STEP (Spherical Tokamak for Energy Production), the UK's forthcoming prototype fusion reactor. Due to commence operations around 2040, STEP could be a pivotal device in humanity's quest for clean, abundant energy.

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Engineering Equality in UK Manufacturing

Ahead of International Women in Engineering Day 2024, The Engineer interviewed employees at Yamazaki Mazak to discuss their experiences in the manufacturing industry.



Engineering and Production are core functions of our business. However, a successful manufacturing company relies on much more to operate effectively," shares Anita Kenny, Head of European Marketing & CRM. "At Mazak, women play integral roles across the entire business, bringing essential skills, experience, values, and attitudes that ultimately drive our success. It's crucial for female role models to be visible throughout the organisation, showcasing the variety of careers available in an engineering company."

Beth Addis, Machining Supervisor – Large Castings, highlights the importance of early exposure to manufacturing as a viable career. She applied for an apprenticeship at Mazak after attending a STEM outreach session in 2015 organised by the company at her school.

"Before that visit, I hadn't considered manufacturing as a potential career. Now, I've completed a Level 3 machining apprenticeship and an HNC in manufacturing engineering. I'm currently studying for an MSc in Engineering Business Leadership, all fully supported by Mazak," says Beth, who has won numerous regional and national awards during her apprenticeship.

"I was one of the first women to complete a machining apprenticeship at Mazak. Those challenging experiences helped me bring a diverse leadership style to my current role, where I oversee a team of 20 engineers. As a woman, I offer unique perspectives, fostering a collaborative and inclusive ethos. We share the same goals and must work

➔ Beth Addis, Machining Supervisor – Large Castings at Yamazaki Mazak's European Manufacturing Plant in Worcester.

together to achieve them."

Hayley Richardson, Senior Manager - Indirect Production, emphasizes the importance of trust and collaboration. Joining Mazak's purchasing department in the 1990s, she was the only woman on her team but was encouraged to pursue her CIPS qualification during her first year.

"I've had the opportunity to lead significant projects, including developing a new pool system for a 'just in time' supply solution and implementing our first ERP system. Now, as one of four senior managers in the procurement team and the only woman, we operate as equals, sharing common values," Hayley explains. "My biggest lesson in over 20 years in manufacturing is that it's absolutely OK to be a woman in this environment. In engineering, what matters most are ability, confidence, and staying true to oneself."

Retaining a strong sense of self rings true for Jas Cordelle, who works as a Technical Support Engineer at Mazak during the day while pursuing her passion of drag bike racing in her spare time.

"I'd always been around engineering because my dad is a design engineer and I have been involved in drag bike racing from the age of 10, so I was probably predisposed towards engineering as a career," says Jas, who joined Mazak over 10 years ago as an apprentice and chose Mazak's Spindle Service Centre as her area of expertise.

She continues: "When I started there was only one other woman on the shopfloor, however I'd been in a very



👤 Anita Kenny, Head of European Marketing and CRM at Yamazaki Mazak.



👤 Jas Cordelle, Technical Support Engineer at Yamazaki Mazak's Spindle Service Centre.

👤 Hayley Richardson, Senior Manager - Indirect Production at Yamazaki Mazak.

male dominated sport with my drag racing so I was used to working alongside predominantly men. Now there are half a dozen women just on the shopfloor and more coming through the apprenticeship scheme.”

Jas now supports Mazak customers throughout Europe with any spindle-related challenges. “My role has evolved from building spindles to helping customers resolve any problems they encounter. I can offer remote spindle servicing support to provide a same-day solution where possible. If needed, I will also fly directly to a customer site to fix the problem in person.”

Future-proofing female engineering

The number of women entering engineering and manufacturing roles continues to rise. Last year, Mazak hosted its first recruitment open house exclusively for women entering the manufacturing industry.

“It was encouraging to see so many young women attend the event. While some were nervous when they first arrived, seeing so many other women sharing their own experiences from across both Mazak and the UK manufacturing industry made a real difference and helped challenge any preconceived perceptions,” Anita concludes.

“We aim for our workplace to reflect society, and a visibly diverse, inclusive workforce is essential in fostering a sense of purpose and belonging.”

For more information about careers at Yamazaki Mazak, please visit: <https://www.mazakeu.co.uk/careers>.





ENGINEERING EMPOWERMENT

Engineering is the backbone of our society in many ways, from ensuring the safety of our infrastructure to developing the technology that underpins our everyday lives.

Whilst engineers of all kinds should be championed – and indeed this is a key remit of The Engineer – perhaps the most unsung of this workforce are those in the minority of it, namely women engineers.

Last year, women made up just 16.5 per cent of the engineering workforce, according to an Engineering UK research report. Though this does not take away from the work nor brilliance of these female engineers, the disparity in the sector undoubtedly creates an extra barrier for them: striving to prove themselves in an industry in which they are so heavily outnumbered.

The Women's Engineering Society (WES) has been a champion for the sector's female cohort since its creation in 1919, aiming to promote the avenue of engineering to women and provide them with a space to share their ideas and passions for science and technology.

The WES created International Women in Engineering Day (INWED) in 2014 – first as National Women in Engineering day, which then evolved into an international celebration after it gained UNESCO patronage in 2016 – to recognise the work female engineers do in breaking down the gendered barriers in the field.

For this year's INWED (June 23, 2024), the WES set the theme as 'enhanced by engineering' to specifically focus on the amazing work that women engineers around the world are doing to support lives and livelihoods every day.

One engineer who embodies this theme is Yewande Akinola, an award-winning engineer who has worked all over the world on projects largely focused on sustainability and innovative design. Akinola was born and raised in Ibadan, Nigeria, and recalls that she had an interest in the built environment from an early age.

"I started off wanting to

Ahead of INWED24, engineer and innovator Yewande Akinola talks about the need for more female empowerment and diversity in the industry. Ellie McCann reports.

become an architect," she told *The Engineer*. "I was super interested in buildings, how they looked on the outside. I would spend hours as a child building models of homes that I thought would be better living spaces for my mother, myself and my sister.

"Just before I started to apply for universities, my mother suggested engineering

instead. She recognised that I was interested in the inner working of buildings more than their exteriors, and probably thought that with engineering, I would be able to express and experience creativity in lots of different ways."

It was this encouragement that led Akinola to Warwick University, where she studied Engineering Design and Appropriate Technology, before gaining her Masters in Innovation and Design for Sustainability at Cranfield University while in industry.

"I was really attracted to an engineering degree that had a bias towards emerging economies and all about manufacturing using local resources. It taught me how to put people at the heart of whatever solution I was coming up with," she said.

"I didn't know at the time that it was setting me up for a career in sustainability in lots of different countries! My year in industry with Thames Water was pivotal in cementing my appreciation for practical engineering and the role it has in influencing our day to day."

Akinola said that, during this year, she was guided and supported by senior engineers who showed her the workings of our water systems, with plant site visits to hands-on design. This support continued in her post-graduate role as a Design Engineer developing water supplies and water management systems at Arup, and as a Principal Engineer and Innovation Lead at Laing O'Rourke.

Despite this support throughout her career, though, Akinola emphasised that she has still faced many incidents of gender bias – unconscious or not.

"On paper, someone's gender should not be barrier, it shouldn't stop anyone from being the best version of themselves, in any profession. But the barrier comes in when there is a perception challenge," she said.

"There can be hesitancy and resistance when you don't match a particular person's idea of what an engineer looks like. There have been times when I've arrived to



site, and people think I'm there to take notes! People are often surprised at what I'm able to do because they don't expect it to come from a black women engineer, for example.

"In my view, we can turn all of these challenges into strengths – if people don't see me coming because they don't expect it from me, then I'll use that to my advantage."

Akinola also said that her own experiences of fighting against this bias have shaped her commitment to strengthening the core of the industry, through encouraging *all* young people to consider engineering as a career, and by promoting diversity.

Championing the idea that institutional change can be achieved through education, from the ground-up, Akinola has worked on multiple campaigns that show young people that engineers do not look just one way.

She has worked alongside the Royal Academy of Engineering for their 'Designed to Inspire' campaign and was featured in the Institution of Engineering and Technology (IET) campaign 'Portrait of an Engineer', which aimed to dispel traditional perceptions of the job and instead highlight the diverse career opportunities available across industry.

Now, as a consulting engineer, vice president for the IET, television presenter and Innovate UK Ambassador for clean growth and infrastructure – to name a few – Akinola continues this commitment to bettering the engineering field.

And not without rightful recognition: in the 2020 New Year Honours list, she was awarded an MBE for her services to engineering innovation and diversity in STEM. Other accolades include the IET's Young Woman Engineer of the Year Award and a Top 50 Workplace leader in the UK.

In July of this year, Akinola is hosting her own three-day industry conference called The Ripple Effect (Women in Engineering and Technology), which will provide a space for women engineers and allies in the sector to take part in innovation workshops, network with one another and hear from industry experts and thought leaders on topics such as how to evolve the industry for progress.

"As part of the programme I've curated, so many women have shared that they don't feel supported by their companies," said Akinola. "It's so heartbreaking. Women engineers should be treated the same as their male colleagues in terms of investment and training opportunities.

"A lot of organisations talk about what they would like to do for their female employees, but I would say to them: put your money where your mouth is. Employers need to invest in



🕒 Now as an innovator, consultant and presenter, Akinola is continually advocating for a sustainable and inclusive industry

women, but also tackle any gender bias by providing training programmes across the board."

And as for her advice for any young person that is considering the profession of engineering, Akinola said: "Get involved with the amazing programmes that are out there, find a role model and somebody you can ask questions to, find an organisation that you can go on a journey with.

"If you are keen to bring a tangible impact to our world, then engineering is the profession for you – no matter who you are or what you look like." #ENGINEER



🕒 Akinola was named in the 2020 New Year Honours list



TRACK RECORD

Two years ago, the all-electric McMurry Spéirling fan car shattered the Goodwood Festival of Speed's hill climb record, clocking a time of 39.08 seconds. The hair-raising run shaved more than two seconds off the previous time, set by a Formula 1 McLaren in 1999. In the wake of its Goodwood success, McMurry is now on the cusp of launching the Spéirling Pure, a track-ready version available to the public for a cool £1 million.

Needless to say, battery performance is fundamental to McMurry's endeavours. As well as powering the

The record-breaking McMurry Spéirling EV is about to get a battery upgrade. Andrew Wade spoke to About:Energy's Gavin White about testing and modelling its high performance cells.

Pure's 1000 bhp (745kW) peak output, its battery pack also serves the 'Downforce-on-Demand' fan system, enabling the vehicle's incredible cornering speed. On top of this, the pack needs to be able to rapidly recharge so that a day out at the track doesn't involve waiting around for hours in between each face-melting run.

So far, the various iterations of the Spéirling have been powered by the P45B, a high-performance lithium-ion cell manufactured by Taiwan's Molicel. Production models of the Pure, however, are set to be equipped with Molicel's follow up, the P50B, a 5.0Ah 21700 form factor cell, claimed to have one of the highest power densities in the world at 260Wh/kg.

When the P50B is released later in the year, the job of rapidly testing and modelling its unique performance metrics for McMurry will fall to UK firm About:Energy. Founded in January 2022, the Camden-based startup combines expertise in battery testing

and software to build digital models that can reduce reliance on physical research and engineering, speeding up design and development.

About:Energy's work on the P50B will allow McMurtry engineers to incorporate that data into the design and simulations of the Pure's battery packs, ultimately getting the car into customers' hands quicker, and in an optimised state.

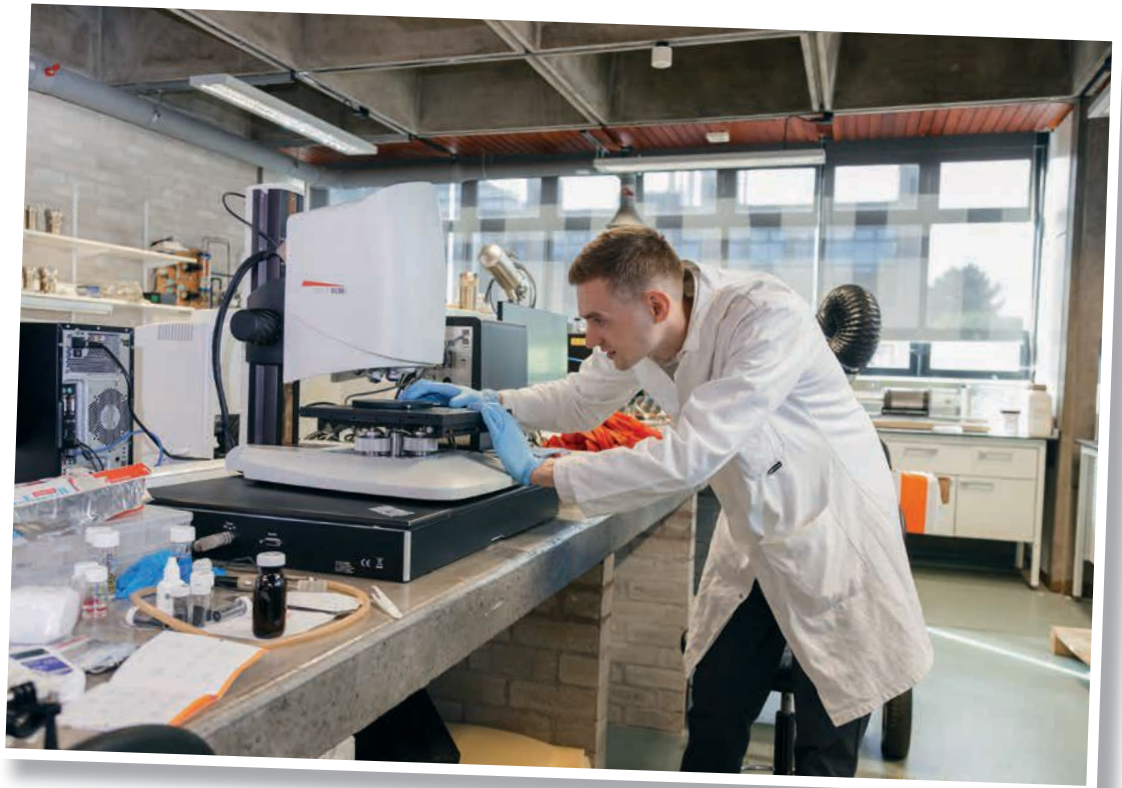
"We started About:Energy to fill a fundamental research gap," said Gavin White, the company's co-founder and CEO. "A huge amount of research is going into developing battery models. But a very limited amount of research is going into developing the inputs for these models. About:Energy measures these inputs and provides them at a very high quality.

"Batteries are complex, which makes the testing and modelling we need to do equally complex. Batteries not only provide electrical current but also generate heat - properties driven by the chemical reactions inside. Over time, these reactions lead to battery degradation, impacting all other performance aspects. In our labs, we isolate these different attributes through precise measurement."

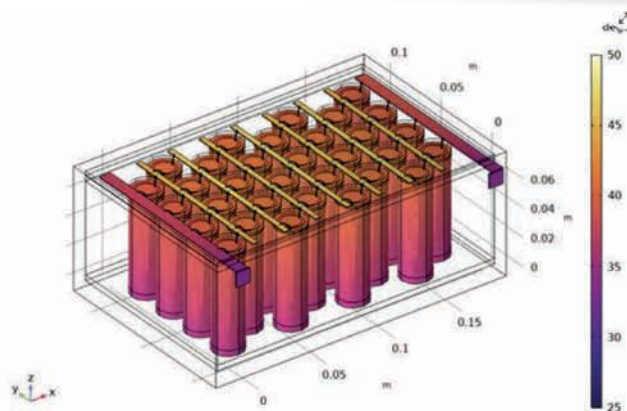
White told *The Engineer* that About:Energy has been working with the Molicel P45B for the past year, testing large volumes of cells individually that correlates to 'decades of battery test data'. This allowed About:Energy to build an enormous dataset for McMurtry, which in turn enabled the supercar manufacturer to simulate how the cells perform in tandem with the Spéirling. According to White, the experience they have with the P45B should allow the company to deliver a battery model on the P50B within about a month of receiving the new cells, allowing the McMurtry team to rapidly maximise battery performance on the Pure.

"McMurtry are one of Molicel's flagship customers," said White. "As soon as cells are available for testing, we'll be fast acting to support the testing and analysis.

"The release of the P50B is planned for later this summer. On the P45B, its



➡ Gavin White at About:Energy's Camden test labs



➡ About:Energy's modelling will enable McMurtry to maximise the Spéirling's performance

predecessor, we have already completed extensive tests and are providing this to McMurtry to enable them to be able to push prototype performance with this cell further ahead of the P50B release and this technical partnership.

"Measuring the thermal performance of a battery takes weeks, while evaluating battery degradation can take years. As a company, we have developed unique methods and processes to obtain this data accurately, rapidly, and at scale. For the P50B, we will focus on reducing the average time to gather data and deliver value to our customers due to its relevance in industries that need to quickly advance technologically."

In April of this year, McMurtry posted footage of test driver Max Chilton tearing around Silverstone in a Pure prototype, clocking F1 pace while tapping just 80 per cent of the car's power and fan-boosted downforce. Inevitably, rumours of an assault on the Nürburgring Nordschleife are being whispered, with petrolheads eager to see if the Spéirling Pure can challenge the fastest times at the infamous circuit.

The 'Ring - as it is affectionately known in motorsport circles - is an almost 21km-long track in Germany, often used by supercar manufacturers to showcase the performance chops of their latest creations. Some commentators have questioned whether the Pure's battery can get it round the Nordschleife at full tilt, especially given the power demands of the fans, which deliver downforce by rotating at up to 23,000 rpm. If those doubts do have any substance, the P50B could help address them, as according to White, the new cells offer significant improvements over Molicel's P45B.

"We have supported several Molicel customers in various industries using the P45B," White told *The Engineer*. "Public data on the P50B shows that this battery offers approximately 10 per cent more energy and 30 per cent power (continuous discharge)."

One presumes these calculations have already been factored in by McMurtry, which says the Pure will ship with a 100 kWh battery pack. Given that →



↑ The Spéirling has demonstrated F1 pace at Goodwood and Silverstone

the Volkswagen I.D.R – current holder of the EV record at the Nordschleife – was equipped with a 24.7 kWh pack, it seems the Pure should have more than enough juice to get round the ‘Ring, if McMurtry does decide to take on the challenge. And the models that About:Energy delivers may well help inform those decisions. According to White, the primary benefit that his company delivers to McMurtry and others is ‘time to insight’.

“This is the interval between receiving physical batteries from a supplier and understanding their performance at the vehicle level,” he said. “This facilitates the rapid design of battery packs or control systems for integration into vehicles. Battery design involves advancing technology and balancing trade-offs among various metrics such as cost, time, energy, and lifetime. For any given electric application, the battery is central to its performance.”

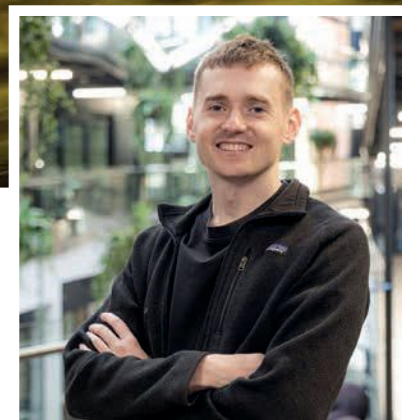
/// BATTERIES ARE COMPLEX, WHICH MAKES THE TESTING AND MODELLING WE NEED TO DO EQUALLY COMPLEX ///

Once About:Energy receives new cells, it carries out physical testing at its lab in Camden, London. Cloud software is then used to process the test data, before About:Energy’s modelling team transforms it into models that replicate various battery performance behaviours.

“We package these models into fully functional digital models on platforms like Matlab Simulink, enabling McMurtry to integrate them seamlessly into their battery systems or vehicle concepts,” said White.

“These models are ‘white-box’, meaning our customers can see how the model works and the data that goes into it. This transparency is crucial for our most technically sophisticated customers like McMurtry, as it allows them to build more intellectual property and deepen their understanding in the battery domain.”

McMurtry will then use the models to optimise the performance of the Spéirling Pure and help it to answer several



key questions: how to increase charging speed without impacting battery lifetime; how to enhance acceleration without compromising safety; how to increase battery regeneration to reduce vehicle wear; and how to improve in-use battery state-of-charge estimation.

“About:Energy does not provide McMurtry with the answers to these questions but provides the toolkit to find them,” White explained.

“The process will enable a team of world-leading engineers to spend less time testing batteries and more time developing world-class concepts and breaking records.”

THEENGINEER

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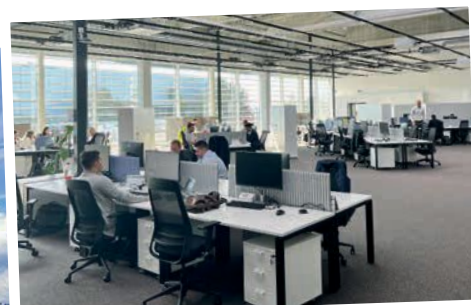
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Bright sparks: The case for UK battery production

InoBat's chief commercial officer Iain Wight and senior commercial manager Kathryn Cranfield talk to *The Engineer* about the challenges and opportunities facing battery manufacturers in the UK. Chris Pickering reports.



The government may have softened its stance on the proposed ban of new petrol and diesel passenger cars, but the global automotive industry is still heading rapidly towards electrification. It's a trend that's playing out across other industries too, from residential energy storage to aerospace. And it's one that's opening up major gaps in the supply chain – particularly in the UK.

The challenge with battery cells is that they're very difficult to produce at a reasonable cost in anything other than huge volumes. Outsourcing is fraught with risk due to the finely controlled manufacturing processes, where the slightest change in temperature or humidity can result in a batch of bad cells. Meanwhile, setting up your own production line requires huge investment and guaranteed volumes.

"When I started working in electronics, a few clever engineers could go a long way. You'd see companies that started in sheds becoming major players, but that's simply not possible

InoBat's Volta 1 R&D facility near Bratislava, Slovakia

with battery production. The upfront cost is a totally different order of magnitude," explained Iain Wight, chief commercial officer at InoBat.

Wight is a veteran of the UK's low-volume automotive industry. He started off as an electronics engineer at BAE Systems, but rapidly transferred to Pi Research, followed by long stints in commercial roles at Ricardo and WAE. His work there with high performance electric powertrains highlighted some of the challenges facing specialist manufacturers.

"It's incredibly difficult to supply high performance batteries at a commercial rate that's acceptable to the market. The cell chemistries required for applications like high performance

automotive and aerospace generally aren't very well served by the industrial giants in China, Japan and Korea," he commented.

InoBat was set up to plug this gap in the market, but it faces a mammoth challenge. The first issue is that small scale battery production is very much a relative term. By Wight's estimation, a manufacturer needs to be producing one or two gigawatt-hours of battery production per year to reach the point where its prices become commercially viable – even for premium high-performance applications.

Scaling up

InoBat is based in Slovakia where it already has a 10,000 m² R&D centre and a pilot line. The company plans to scale up by adding another line of 2 to 4 GWh capacity, as well as developing a joint project with a Chinese battery manufacturer for the first gigafactory in Slovakia, which will bring a capacity of 20 GWh in first phase, with the potential to expand further.

The company had previously considered setting up a factory in the UK, but it's not an easy task, Wight explained: "One of the major challenges is the power going into the factory. If you've got plans to scale up to a large factory, say 32 gigawatt hours, you need somewhere

Iain Wright, Chief Commercial Officer and Kathryn Cranfield, senior Commercial officer





in the region of 180 megawatts coming into it, and that needs to be primarily from renewables to make sense. That's one of the reasons why there's been a lot of uptake of battery production in Scandinavia, where electricity is perhaps 5 cents per kilowatt hour, whereas in the UK and the rest of Europe it's more like 20 or 25 cents."

Other challenges include land costs, logistics for the raw materials and the lack of upfront government subsidies compared to EU states. Nonetheless, Wight and his colleagues are still very keen to establish a facility in the UK.

"We've seen three sites in the UK that we think would be suitable for a gigafactory, including one that had the advantage of being a free port. We think the way forward will be a smaller size of factory – perhaps in the region of 3 or 4 GWh – probably with a number of different lines, producing different formats but to a similar chemistry," he commented.

This comparatively compact size would be large enough to take advantage of the economies of scale attached to cell manufacturing, but small enough to keep the power demands relatively low.

Part of the challenge is finding the right customers. Tata is aiming for 40 GWh from its planned factory at the former Royal Ordnance site near Bridgwater in Somerset, but the Indian giant owns Jaguar Land Rover, giving it guaranteed access to a high-value volume manufacturer. Nissan also has its own battery facilities, with further expansion on the way. Both manufacture hundreds of thousands of vehicles in the UK each year, but the remaining British manufacturers are far smaller. Bentley produced 13,560 cars last year, Aston Martin 6,620 and Lotus 6,970. It's likely that any factory supplying to these markets would need several different customers to be viable.

"We've been trying to find a level of commonality that would allow us to pool a number of customers together around similar cell architectures. It's certainly something that we believe is possible," commented Wight. "From a funding point of view, we're confident that there's enough [external investors] out there to fund the building of a factory once that commitment is

// WE LOOK AT BATTERY PRODUCTION FROM WHAT WE TERM A CRADLE TO CRADLE PERSPECTIVE //

present. As long as you have a long-term offtake agreement the level of risk associated with building a battery factory is actually quite low."

Raw materials

It's not uncommon for battery manufacturers to work in close partnership with materials suppliers or even own their own mining operation. One of InoBat's partners is a major mining company, which is currently seeking to open a large lithium mine in mainland Europe. Elsewhere, Imerys British Lithium (IBL) has set up a pilot plant for lithium extraction near Roche in Cornwall, with plans for a full-scale operation capable of extracting up to 20,000 tonnes of lithium carbonate per year.

In general, though, it's unlikely that we'll see a sudden shift in sources for the raw materials, explained InoBat's senior commercial manager, Kathryn Cranfield.

"Mining is a long-term project, so I don't think we'll see a big change during this decade in the raw materials extraction. That's likely to remain in China, Australia and South America, but it's the refining and processing that might be brought closer to Europe," she said.

Part of the reason for this shift is that manufacturers are preparing for the introduction of the EU's Rules of Origin regulations in 2027. These will place a 10

per cent tariff on the value of the vehicle if manufacturers don't source at least 45 per cent of the battery raw materials from the EU or the UK (moving up to 55 per cent in 2032).

The same year will see the introduction of Battery Passports. Under these regulations, every electric vehicle battery on the EU market with a capacity of over 2 kWh will require a detailed digital record of its specifications, including information on its raw materials, production and recycling.

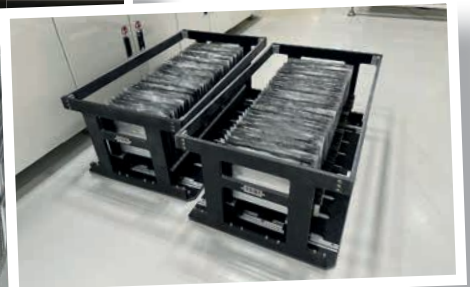
"We look at battery production from what we term a cradle-to-cradle perspective. So we want to be involved, right from the ground up, and all the way round to the recycling to ensure that we're producing in a holistic way and that we know what's happening at each stage. That's going to become even more important once the Battery Passport regulations come into effect," said Cranfield.

These regulations could well strengthen the case for UK battery manufacturing, which Wight believes will play a key role in future automotive production.

"There are a lot of challenges around setting up in the UK, but we're desperately keen to find solutions to those, because otherwise British manufacturers will be dependent on getting perhaps the most critical

element of their future vehicles from abroad, which puts them in a precarious position. Currently, the UK produces over 1.5 million engines per year, and 60 per cent of those are exported. That's a position we need to get to with batteries, and we've got the key skills in the country to do it," he concluded. #ENGINEER

Cathode production (below and bottom left) and finished cells (bottom right)





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KEEPING UK MANUFACTURING AT THE CUTTING EDGE

Leading figures from academia, government, industry and the UK's innovation network assembled in Sheffield to design a blueprint for how we can better translate research excellence into commercial success.



The Company of Cutlers in Hallamshire turns 400 years old in 2024.

Once tasked with regulating the trade of cutlery in Sheffield, the trade guild has evolved into the voice of the city's manufacturing, discussing the latest challenges, developments and opportunities for the sector.

From the Bessemer process to batteries, the Davy lamp to data lakes, over four centuries the company's home, the magnificent Cutlers' Hall, has seen and heard it all.

Where better then, in April this year, for almost 200 leaders from manufacturing research and innovation to gather and discuss

what the future of manufacturing should look like.

Their goal: conceptualise new approaches for better integrating and connecting research and innovation activities so industry can support the UK's net-zero targets, while delivering sustainable and balanced growth for the economy.

No small task and no grander venue in which to attempt it.

"Being surrounded by such industrial heritage is a reminder that we are the custodians of manufacturing. What we do builds on the legacy of the likes of Henry Bessemer and Harry Brearley," said

Katherine Bennett CBE, CEO of the High Value Manufacturing (HVM) Catapult.

"We also remember that our conversations are the same ones trade guilds have been having for centuries. We may be more likely to talk about wind turbine blades than knife blades now, but in essence the question remains the same: what are the technologies, processes and skills we need to drive economic growth and stay competitive in a global marketplace?"

The conference formed part of the UK Manufacturing Forum, a collaboration between HVM Catapult and the Institute for Manufacturing (IfM) at the University of Cambridge, that gathers leading academics,



knowledge experts and senior figures from industry and government to explore emerging trends and cultivate opportunities for collaboration.

The *Future of UK Manufacturing* event was a partnership between the UK Manufacturing Forum and the Engineering and Physical Sciences Research Council (EPSRC), bringing together manufacturing researchers and innovators to design future research priorities, investment areas and opportunities for UK manufacturing. It comprised two days of presentations, panel discussions, networking and workshops.

"We are a science superpower – the facts back that up – but we must get better at accelerating our research to solving real-world problems. We have the community together now, we know what the problem is and we can see what might need doing. We just need to join the dots," said Professor Tim Minshall, Head of the Institute for Manufacturing.

"The event brought the people doing the research and the people tasked with the deployment of that research under one roof. It was a chance to coalesce around a single message that communicates the power and the value of manufacturing."

Current successes and opportunities for UK manufacturing were reviewed by Professor Sarah Sharples, Chief Scientific Adviser for the Department for Transport, and Benjamin Nicol, Senior Policy Manager in Advanced Manufacturing at the Department for Business and Trade. Professor Conchúr Ó Brádaigh, Vice-President and Head of the Faculty for Engineering at the University of Sheffield, stressed the importance of fundamental and translational research being undertaken side by side.



Covering the *Materials and Manufacturing Vision 2050* and *Transport Vision 2050*, Mike Biddle, Executive Director for Net Zero at Innovate UK, talked about the power of collaboration: "Our strength in the UK is how we come together; we need to paint a picture of how glorious our future can be. The enemy is the clock, not each other."

Giving a view from industry, Warwick Spearling, Director at Technicut, a Sheffield-based manufacturer of cutting tools, said: "Our ambition is to be a leader in artificial intelligence (AI), advanced manufacturing and technology adoption; a cutting company wants to be cutting edge. There is a global race for development and we must embrace improvement and change."

With an overview of the *UK Innovation Report 2024*, Dr Carlos López-Gómez of Cambridge Industrial Innovation Policy at IfM Engage, assessed the contribution of manufacturing to the UK economy, comparing industrial performance with the world: "The UK has a world-leading manufacturing and materials research base, but more has to be done to fully translate the UK's leadership in scientific research and innovation into economic value capture through industrial activity."

The second half of the conference, led by

the EPSRC, focussed on how to better leverage manufacturing research to support improved UK resilience, productivity and sustainability.

Lisa Coles, Joint Head of Manufacturing and the Circular Economy at EPSRC, said: "We wanted everyone in the room to be really clear about the ways they can engage with EPSRC and we tried to bring that to life through 'manufacturing stories' – short presentations from some of our successful projects.

"From semiconductor start-ups to high performance sustainable composites, we got people thinking about the challenges we all face, but also the value of collaboration and

what interventions might look like."

Attendees were then tasked, in a series of workshops, to debate and shape where research and innovation could be most impactful and how it should be articulated to policy makers.

"Our vision is for a sustainable, resilient, thriving and productive UK wide manufacturing

sector and to enable this we need to work in partnership with stakeholders across and beyond UK Research and Innovation (UKRI)," said Lydia Gardner, Joint Head of Manufacturing and the Circular Economy at EPSRC.

"We asked people to tell us how they thought we could encourage collaborative working, how they would explain the manufacturing research and innovation case, and how could we encourage industry to coalesce around one vision."

The outputs from the workshops are now being discussed and a clear action plan will follow this summer.

"There is so much we have taken away from this event and we have committed to a focused action plan to maintain the momentum," said Professor Chris Dungey, Chief Technology Officer at HVM Catapult.

"Clear themes emerged from the event: firstly, fragmentation - the need for a single powerful message everyone can rally behind that tells our story well; secondly, people – without the pipeline of talent we won't be able to achieve anything; and thirdly, the need for a clear long-term vision for our industry."

Collaboration, workforce skills and an end to short termism. Themes as relevant now as they were in 1624. #ENGINEER



Plastic-based igus:bike goes into production

The first 100-bike production run of the plastic igus:bike is under way, with plans for annual output of 10,000 bikes within two years.

Claimed to be 'virtually maintenance-free', the igus:bike – recently renamed RCYL – is made up of 92 per cent plastic, including the frame, the bearings and the toothed belt. The latest version of the bike has actually seen the proportion of plastic in the bike increase, with parts such as the seat post and brake lever, now made plastic rather than metal. igus claims a high proportion of the plastic in the bike is from recycled sources.

"I am delighted that we have now come a great deal closer to this vision," said igus Group managing director Frank Blase, who has been pursuing the idea for the bike for several years.

"The igus:bike is finally hitting the road under a new brand name, RCYL. After approval for road use, rapid delivery of the first 1,200 pre-orders is planned."



↑ The igus plastic bike is made largely from recycled sources

New features on the latest version include a freewheel using longer life xiros ball bearings that allow the wheels to run both lubrication-free and more smoothly, as well as a bipod stand to park the bike safely. The bike is envisioned as an urban mobility vehicle

that could be used in fleets across cities, similar to the 'Boris' bikes seen in London and in many major cities around the world.

"The igus:bike, which weighs around 17 kilograms, is now 92 percent plastic – we believe a world first for a production bicycle," said Matthew Aldridge, managing director of igus UK. "From the frame to the bearings, it is all plastic and largely recycled. Even the drivetrain is polymer, which was considered almost impossible in the bike industry for a long time.

"To reduce waiting times when orders increase, we are building our own igus bicycle production line at our factory in Cologne. The goal is to produce 10,000 bicycles per year," says Matthew Aldridge, managing director of igus UK in Northampton.

The igus:bike is expected to cost around £1500 and is available to pre-order via the igus website.

World first facility to offer unprecedented insights into materials

Start-ups-based SME Ionoptika is working with Surrey and Manchester universities to establish a groundbreaking new Multimodal Ion Beam Imaging Facility.

Backed by a £3m grant from the Engineering and Physical Sciences Research Council, the facility will use beams of charged particles to examine materials at an unprecedented microscopic level. Housing a multimodal 3D elemental and molecular imaging system at a sub-micron scale, the facility will be the first in the world to use beams of charged particles at high and low energies to measure biological systems and materials.

"The fact that Surrey and, indeed,

the UK has the ambition to build this truly unique facility should not only excite researchers in academia and industry, but it signals that we are serious about breaking new ground in a range of scientific areas," said Professor Melanie Bailey, principal investigator of the project from Surrey University.

The high-energy beams will be delivered by a particle accelerator at the UK National Ion Beam Centre, a national research facility funded by EPSRC and led by Professor Roger Webb at Surrey. The system will produce X-rays, gamma rays, and particles, and the combination of this information will give a detailed map of the elemental and molecular makeup of materials.

↓ The facility will probe materials at the molecular level



"This is a really exciting development for the Surrey Ion Beam Centre," said centre director Professor Webb, co-investigator of the project.

"We have been a national research facility since 1979, and we support over £100m in funding from more than 30 universities. This is one of several upgrades to our centre, and we are looking forward to opening our doors to researchers across the UK to make the most of this investment."



HP releases new material for 3D polymer production



HP has unveiled a new polymer material for its industrial 3D printers, which it claims delivers a better finish with a lower cost per part.

Developed with Arkema, the new PA 12 S material is said to improve surface aesthetics while reducing costs for customers using HP's Jet Fusion 5200 Series 3D printing solutions. The material is also set to become available for the Jet Fusion 5600 Series later this year, broadening its application across HP's suite of polymer 3D printing solutions. It was launched at the annual AMUG (Additive Manufacturing User Group) Conference in Chicago.

"From design to parts production and post processing, HP is committed to delivering a broad range of innovative materials and programs for more

sustainable production," said Francois Minec, Global Head of 3D Polymers, HP Inc.

"We are thrilled to once again join our colleagues across the industry at AMUG as we collectively look to accelerate scale and adoption of additive manufacturing."

According to HP, the newly launched material is being used by customers including Accel Digital Solutions, Decathlon, Erpro Group, and Materialise for aesthetic parts with enhanced surface finishes and lower production costs.

"After receiving test samples of the new HR PA 12 S material, we found the print quality and surface finish were markedly better," said Brandon Teets, founder at Accel Digital Solutions, an additive manufacturing startup.

↑ The polymer material is leading to improved surface finish and lower costs

"HP's Multi Jet Fusion equipment delivers unmatched precision, speed, and quality for both prototyping and production of parts and finished goods. This technology enables us to provide substantial value through time and cost savings, benefiting industries such as automotive, healthcare, sports, and more."

Grégoire Mercusor, Additive Manufacturing Materials Strategy Leader at French retail company Decathlon, highlighted the material's impact on reducing part roughness, likening its effect to hours of tribofinishing on current materials.

"The high refresh rate of up to 85% and the attractive price point of PA 12 S are poised to unlock new project opportunities," he said.

Project to investigate hybrid approach to titanium manufacturing

Shropshire-based SDE Technology is leading a project to develop a new hybrid superplastic forming process that would enable it to expand into the aerospace market.

The new hybrid technique is estimated to shorten the forming cycle time by over 50 per cent and cut manufacturing costs by as much as 25 per cent compared with traditional superplastic forming. Manufacturing with this new approach uses new tooling that reduces process time.

The project forms part of the National Aerospace Technology Exploitation Programme (NATEP) and is supported by the Advanced Forming Research Centre (AFRC) within the National Manufacturing Institute Scotland (NMIS) Group. Boeing and Timet UK are supporting the project with technical and business activities.



↑ New forming process could cut manufacturing costs by a quarter

"So far, the research has demonstrated huge potential with important parallels between the new hybrid method and the traditional approach already evident," said Evgenia Yakushina, forming team lead at AFRC.

At the end of the 18-month research project the team aims to prove that complex-shaped titanium components can be manufactured to the same specification, tolerances and quality

compared to traditional superplastic forming.

Further funding has also been secured to evaluate the carbon footprint of the new process, which could be cut because of shortened heating and forming times, plus using lower temperatures of around 800°C.

Richard Homden, CEO of SDE Technology, said: "Hot forming was not previously our area of expertise, but with the technical support and knowledge base from the AFRC we can see it becoming a core element of our business plans moving forward. We're especially excited by the opportunity to become part of the supply chain for aircraft and provide Boeing with UK-manufactured components."

The project is being funded by the Aerospace Technology Institute (ATI) programme through NATEP.



PTC launches Onshape Vision for Apple Vision Pro

PTC has launched its Onshape Vision application for Apple Vision Pro, transforming the way designers can interact with their 3D computer-aided-design (CAD) models.

Leveraging the spatial computing capabilities of Apple Vision Pro, Onshape Vision allows product developers to manipulate their digital designs projected onto a physical space by using hand gestures, eye movements, or voice commands.

PTC said that Onshape Vision offers a new dimension to product development by bringing 3D digital designs into our physical reality in a way that feels natural. For example, designers can 'hold' their digital products, expand or



Apple's Vision Pro is a mixed reality headset

shrink them to any scale needed, or disassemble and inspect individual components or parts.

When using an Apple Vision Pro, colleagues from different locations can visualise, interact with, and move around the same product design.

Onshape's cloud-native architecture

uses a single source of data, so any comments typed in Onshape Vision can be seen in Onshape across all platforms, including Mac, iPad, and iPhone. Any changes to the CAD model are seen immediately in Onshape Vision.

Steve Ghee, PTC's Augmented and Virtual Reality CTO, said: "It's been amazing to see this concept move from the earliest stages to today's Onshape Vision app. I've spent most of my career working on ways to bring 3D, digital content into the real world, and this is one of those rare moments that makes us say, 'Wow, we've really done it.'"

"I'm so impressed by how real the digital content looks with Apple Vision Pro. Designers will be able to experience their products in a totally new way, and we can't wait to see how this informs the future of the design, review, and collaboration experience."

PTC said that professional users can try Onshape for free for six months by signing up for the Onshape Discovery Programme.

Dassault Systèmes introduces its virtual worlds campaign to Piccadilly Circus

Dassault Systèmes has launched a digital campaign inviting people in London to see and understand how virtual worlds are impacting real life in areas such as health, cities and manufacturing.

From April 28 - May 5, Piccadilly Circus was illuminated by a huge 780-square-metre screen which showcased innovations created with Dassault Systèmes' virtual twin technology, highlighting how imagination and innovation contribute to a thriving, more sustainable world.

Every 10 minutes, an exclusive 40-second immersive video using a 3D effect was projected on the screen, featuring 3D animations that transitioned from the world's first fully functional model of a human heart, to humans and robots working together

to make products from upcycled parts, to a pod for growing plants in any environment - including on the moon.

Dassault said this campaign, created with the out of home advertising company Ocean Outdoor, offered passersby a glimpse at the preventative patient care, sustainable production and cleaner transport that can only be achieved by leveraging the virtual world to model these possibilities.

The public were also able to download an augmented reality application on their smartphones, to see how Piccadilly Circus could look in a more sustainable future.

"A key driver for sustainable innovation is a greater awareness of the challenges society faces, and how to address them. Our groundbreaking experiential campaign in Piccadilly



The screen showed a series of 3D animations

Circus extends an invitation to millions of people to immerse themselves in a journey of discovery - one where imagination meets innovation and reveals a thriving world for patients, citizens and consumers," said a Dassault Systèmes spokesperson.

"We wanted to share how virtual worlds illuminate possibilities, inspire collaboration, and pave the path towards a brighter, more sustainable future."



You've probably heard of the term augmented reality (AR), and while we understand what it means from an entertainment perspective, what is its role in a manufacturing work environment?

Often assimilated as a strange term in science fiction movies, AR is now closer to everyday life and gradually evolving into the industrial world.

Augmented reality technology integrates virtual elements in 3D in real-time within a real environment. The principle is to combine the virtual and the real worlds digitally to provide perfect integration.

It is important, though, to understand the difference between all of the existing technologies: mixed reality, virtual and augmented reality.

When using AR, we don't just superimpose virtual information on an image but integrate synthetic information in the real environment.

Conversely, virtual reality (VR) immerses a user in a reality entirely generated and assisted by a computer. Immersion is typically enabled by hardware devices such as VR goggles, headsets, or walled rooms with video screens to fill the user's entire field of view. VR brings an immersion in a 100 per cent synthetic or digital environment.

The newest term, augmented virtual reality, or augmented virtuality, is nothing more or less than another way of characterising virtual data. Here, digital data is not displayed in a real environment but the opposite.

Instead, one or more pieces of information from the real world is imported and displayed in a digital environment. For example, when a user equipped with a VR helmet sees their own hands appear while immersed in a digital world and interacts with it.

Mixed reality (MR) is a fusion between real and virtual worlds, where digital and physical objects cohabit to create new

Augmented reality in the manufacturing industry

Wendy Mlynarek, Strategic Business Development Director at DELMIA, considers the many applications of augmented reality in the manufacturing industry, while also exploring some of the basics for the sector.

environments.

MR is differentiated by a very specific interaction of digital content with physical space. Nevertheless, it remains a dimension that covers all forms of AR, that is, all degrees of fusion between real and virtual worlds.

So how does augmented reality work? AR adds virtual information (texts, animations, images, 3D models) into the real environment.

To do this, it inlays this information into the user's environment in different ways: the insertion of these elements into a video stream viewed on a screen or tablet, displayed on lenses in the user's vision, or through the use of a projector to display information directly on the object.

However, this information must be embedded in the right place and it's necessary to know the location where it resides. For this purpose, we use one or more sensors to ensure the data location such as depth sensors or GPS.

AR solutions are therefore distinguished by means of restitution, the means of capture, and the way they use the latter to localise themselves.

The solution's first category aims to locate itself in relation to the global environment - for

example, using cell phone sensors (GPS, inertial navigation systems) allows one to locate oneself outdoors (PokemonGo, GoogleMaps or LiveView). It displays information that remains stable in relation to the world.

Within the future manufacturing industry, AR could reshape many aspects, such as the increased competence of operators and their way of interacting with a real working environment by importing digital data.

AR can guide operators step by step with information in forms such as digital and contextualised instruction sheets, images and videos, and 3D renderings.

This could replace the time-consuming, manual processes of the past and make task execution much faster and simpler. AR can bring multiple gains in the industrial environment, through remote visualisation, better information transmission, or field data feedback to the digital twin.

The data collected with AR can be used to promote the digital transformation of information, understand and optimise industrial processes, reduce the risk of errors, increase the skill of operators and contribute to better traceability.

In addition, AR applications

can be used via various hardware devices such as multimedia systems like smartphones or tablets, fixed or mobile workstations with industrial-type cameras, projection systems, or AR headsets and glasses.

These connected tools and augmented reality allow digital work instructions to be easily displayed and visualised regardless of the company's environment.

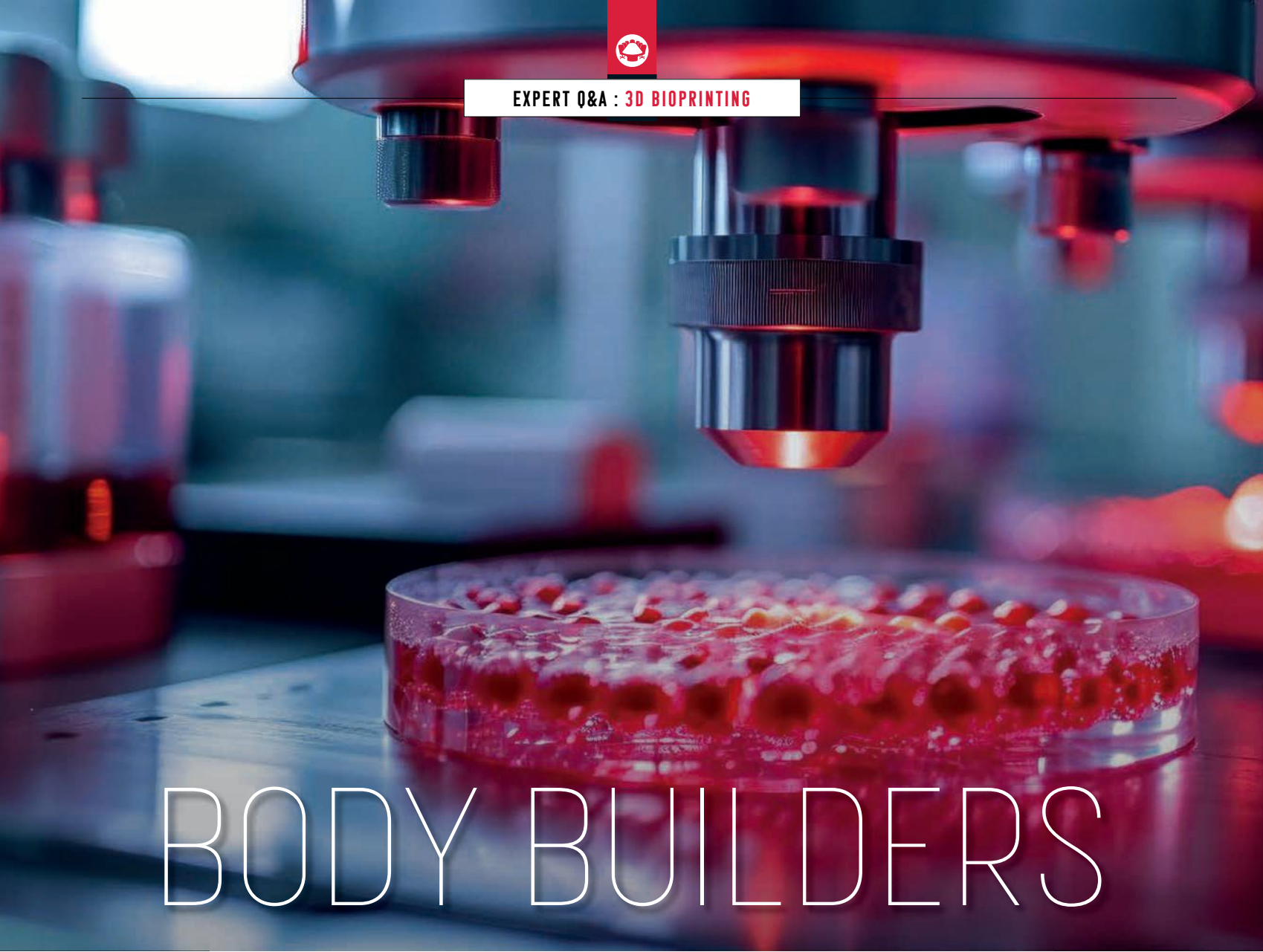
In order to choose the right use case, manufacturers should focus their efforts and research on operations that generate costly defects (non-conformances), long or unscheduled downtime, plant safety problems or high customer dissatisfaction.

Indeed, they should also ask themselves the right questions: which teams should be included in the project? Which operations are the source of the most significant number of errors? Which ones generate the highest costs? Which tasks generate a more or less prolonged stop of production? Which ones cause safety problems?

Once these questions are answered, manufacturers will be ready to determine the best use case for their plant and launch the project - all they have to do then is find the solution and above all, the right supplier!

Ultimately today, everything deploys and evolves very quickly, and the same goes for these AR technologies that will continually evolve and improve.

So what we can say for the future of these solutions is that the new versions will be based on these different axes: the evolution of the ergonomics and performance of certain types of equipment which today are not always adapted to industrial environments; the introduction of multi-modalities, such as voice recognition or gesture control; and the improvement of cloud-based tools and the arrival of 5G enable network communication performance compatible with cloud-based execution of AR algorithms, for instance.



BODY BUILDERS

JON EXCELL REPORTS

In general terms what is 3D bioprinting and how does it work?

FR: Bioprinting is defined as the application of 3D printing to biomedical applications. It involves the use of materials or 'bioinks' that include the cells found in our body. Using these bioinks, we can print 3D structures that recreate the tissues and organs found in our body. This process involves creating a design file that can be used by the printer to create the desired shape, developing a bioink that is suitable for the cells but also compatible with the bioprinting process, and isolated and expanding the cells of interest in the laboratory. Once printed, the bioink and the shape provide the necessary biochemical cues to the cells, during incubation, to support their growth and

The fast-moving field of 3D bioprinting has the potential to revolutionise healthcare. The Engineer spoke to two engineers at the forefront of this exciting new technology frontier

maturation into a functional tissue or organ.
CH: 3D bioprinting is any form of 3D printing that involves living cells, sometimes printing with cells but more often printing a biomaterial scaffold that will then have cells added.

Why is it an important area of research and what are its potential applications?

FR: Globally, the demand for donor organs is greater than the supply. With an increasing and ageing population combined with medical successes in organ and tissue transplantation, the increasing need for donor organs and tissues has

resulted in a shortage in the supply. In some countries, there are national organ donor programmes to increase the number of organs available for transplantation, but such schemes are still not sufficient to provide the numbers of organs needed. Without these tissues, many people waiting for organ transplantation will die. 3D bioprinting also holds great potential to provide biomedical scientists with lab-based models of human tissue to investigate and understand disease, and to support the discovery of new drugs and medicines.

CH: There are numerous areas of research being conducted all around the world. Typical applications include biological laboratory studies; pharmaceutical drug testing; and soft



AI generated image illustrating possible future application of bioprinting

Adobe Stock

and hard tissues for human regenerative medicine, including complete organs.

Outline your key areas of activity in this field?

FR: The Additive Biofabrication Laboratory is located within the Nottingham Biodiscovery Institute and is a multi-disciplinary collaboration between cell biologists and biomaterials scientists, with engineers and clinicians. The Additive Biofabrication Laboratory houses state-of-the-art 3D bioprinting equipment to allow for the printing of biologically relevant structures. An example of our work is the development of bioprinting strategies to recreate intestinal tissue, specifically the intestinal stem cell crypt, so that we can provide a future cell-based therapy or 'living plaster' that resembles and functions in the same way as the lining of the large intestine. We hope to use this to treat patients during the early stages of

inflammatory bowel disease where the intestinal lining is lost, causing pain and diarrhoea. By replacing this lost tissue with a 3D bioprinted 'living plaster', we hope to support the tissue to heal and reduce the numbers of patients where the disease progresses such that they need surgery.

CH: We are specifically doing work for pharmaceutical testing, for various soft and hard tissues, and for transplantable lungs.

How do you expect the technology to develop over the next 10 years?

FR: 3D bioprinting is a rapidly developing field. Recent advances have seen the development of new 3D printing systems able to create 3D tissue structures in a single print (volumetric additive manufacturing) and systems that provide unprecedented resolution and feature size (multi-photon lithography). Further advancements are likely to focus on the scalability and increasing the speed of these systems such that we can manufacture regenerative medicine products as required. The development of bioinks that include chemistries with the required reaction kinetics for these new technologies, and that can be synthesised at scale and quality (GMP) will be needed to enable us to print the diversity of organs and tissues required. Further research will unlock the cell supply chain for new regenerative medicines and will pave the way towards personalised therapies. These technologies need to progress together, under a guiding regulatory framework, to ensure the full potential of 3D bioprinting can be realised.

CH: Our hopes and expectations are that in 10 years bioprinting will have significantly reduced animal testing for drug development and that some drugs will have been approved based on using bioprinted tissues. Additionally, we hope that regenerative medicine will have opened new and exciting treatments to significantly improve human health.

Do you believe we can ever expect to see 3D printed tissue or organs for transplantation? And what are the key technical obstacles to that vision?

MEET THE EXPERTS:

➔ **Chuck Hull** - EVP, Chief Technology Officer for Regenerative Medicine, 3D Systems

➔ **Felicity Rose** - Professor of Biomaterials and Tissue Engineering, University of Nottingham



➔ **Chuck Hull** - EVP, Chief Technology Officer for Regenerative Medicine, 3D Systems



➔ **Felicity Rose** - Professor of Biomaterials and Tissue Engineering, University of Nottingham

FR: Yes, I do expect to see 3D printed tissues and organs available for transplantation, but I expect that it will take 50 years or more to see a fully transplantable organ manufactured using these technologies. The technical hurdles that need to be overcome include the development of new bioinks suitable for the various cell and tissue types in the body such that we can create not only the desired shapes and structures but also deliver the right biochemical cues to the cells to produce functional tissues and organs. We will need to develop the technologies available to allow for faster printing times (to support cell survival) without losing resolution of the print; these printing technologies will also need to be scaleable for manufacture. We will need to develop the bioprinting strategies to allow for the printing of larger and more complex tissues, such as a whole organ, that contains blood vessels and a nerve supply, so that the organ remains viable and is fully functional at the time of transplantation.

CH: We certainly believe this. Living cells are the key to regenerative medicine, and the purpose of 3D bioprinting is to build an environment where the cells can live and function as they should. The obstacles include having the right materials, printing with the required precision, and placing the right cells to create new tissue. Other obstacles include the significant pre-clinical and clinical work for human health applications. This includes demonstrating to the regulatory agency (the U.S. Food and Drug Administration) that the treatments are safe and effective and are produced using Good Manufacturing Practice (GMP). The timeframe for this is uncertain and it usually takes several years. **ENGINEER**



JAMES BRINDLEY: EIGHTEENTH CENTURY CANAL PIONEER

An icon of the industrial revolution era of canal construction, James Brindley's enduring contribution to engineering was his development of the puddling technique.

WRITTEN BY NICK SMITH

There can't be many engineers to have their death broadcast in the local newspaper in octosyllabic rhyming couplets, but on 1 December 1772 the *Chester Courant* published an epitaph poem recalling the achievements of one of the major contributors to the birth of the 'Canal Age'. While the anonymous verse lacks the lyrical grace of the great English poets of the day – Thomas Chatterton, Thomas Gray or Christopher Smart – it is fitting in that it gets the job done practically, properly and without fuss. 'James Brindley lies among these rocks', it begins before informing the reader that 'he made canals, bridges and locks'. Towards the end of perhaps one of the only poems ever written to include the word 'air-vessels', we're told that 'there ne'er was paid such attention, as he did to navigation'.

That there were versifiers out there attempting to immortalise an English engineer with a roughly hewn 'heroic sonnet' – and that there were newspaper editors prepared to print their attempts – attests to the esteem in which the pioneer canal builders were held. Brindley's name may be all but forgotten today, but in his heyday what the Canal & River Trust describes as the



JAMES BRINDLEY 1716-1772

man behind the 'first modern British canal' was something of a celebrity, renowned for building 365 miles (587km) of canals in his lifetime as well as watermills. Brindley's influential role in the rapid growth of narrow canal-building was such that almost a century later the most important of Victorian industrial historians Samuel Smiles called one of his many books on the subject *James Brindley and the Early Engineers*.

James Brindley was born in 1716 in the Derbyshire village of Tunstead. Most of what we know about Brindley's early life comes from Smiles, who informs us that his father 'neglected' his children by 'permitting them to grow up without education' while his mother 'did what she could to teach them what she knew, which was not much'. When James was 11, his father inherited a farm in Leek where his son was employed as a labourer and showed an interest in mechanical work. Smiles notes that 'one of the things in which he took most delight when a boy, was to visit a neighbouring grist-mill and examine the water-wheels, cog-wheels, drum-wheels, and

other attached machinery, until he could carry away the details in his head'. By the time he was 17, Brindley was apprenticed to the millwright ('as yet the only engineers') Abraham Bennett in Macclesfield. According to Smiles, Bennett 'thought him slower than most lads, and even stupid', but was useful for getting beer for the men, and who 'only worked his way to dexterity through a succession of blunders'.

Having completed his apprenticeship, Brindley set himself up as a wheelwright in Leek before expanding his business in 1750 by renting a millwright's workshop in Burslem from Josiah Wedgwood's family. Over the next decade he established a reputation for his skill with machinery, building engines for draining the Wet Earth Colliery at Clifton and for a silk mill in Congleton. These projects, and his 1758 involvement in surveying a proposed canal link between Liverpool and the Mersey, brought Brindley to the attention of the Duke of Bridgewater, who owned a coal mine in Worsley. The Duke was anxious to improve the efficiency of moving coal from his mine to his primary market in Manchester, only a few miles away. At the time roads were so unreliable that coal could not be transported by wagon, but was instead taken by packhorse at a rate of only 3cwt (152kg) per animal

journey. One of Bridgewater's workers, John Gilbert, pointed out that the same horse could pull more than a hundred times the load along a canal.

Cutting a ten-mile canal between Worsley Colliery and Manchester required parliamentary approval, leading Gilbert to engage Brindley to assist with demonstrating the engineering challenges such as the Barton Aqueduct to non-technical politicians. Famously, Brindley demonstrated the proposed construction by slicing a round of Cheshire cheese in half to represent two arches. Notorious for rarely committing his designs to paper, Brindley placed flat objects above and below the semi-circles to show the river and canal flow paths; much to the amusement of a scrutineer hired to review the project, who exclaimed to the Duke: 'I have often heard of castles in the air, but never before saw where one was to be erected'.

When asked by the parliamentary committee to explain the 'puddle' technique of waterproofing the aqueduct continually referred to in his evidence, Brindley ordered a mass of clay to be delivered to the committee room and formed it into a trough to show how it could be used as a sealant. 'Thus it is' said Brindley 'that I form a watertight-trunk to carry water over rivers and valleys wherever they cross the path of the canal.' From this point on 'puddling' became the standard option for lining canals and, from the mid-nineteenth century, earth-filled dams. According to industrial archaeologist Mike Nevell, England's first navigable aqueduct was 'one of the seven wonders of the canal age'. It was also a vital economic shot in the arm for the Midlands. As Smiles explains: 'the cutting of the canal from Worsley to Manchester gave that town the immediate benefit of a cheap and abundant supply of coal; and when Watt's steam-engine became the great power in manufactures, such supply became absolutely essential to its existence as a manufacturing town.'

In *Navigable Waterways* LRT Rolt states that the success of the Bridgewater Canal enhanced Brindley's reputation, leading to further commissions to construct more canals.



Images: Alamy

// YOU MUST LET ME CARRY OUT THE WORK IN MY OWN WAY //

JAMES BRINDLEY (1716-1772)

This phase of Brindley's career started with the Runcorn extension to the Bridgewater canal that would connect that to his next major work, the Trent and Mersey Canal, that was partly brought about by the Staffordshire potter Josiah Wedgwood's desire to minimise stock breakages incurred during road transport. At just over 90 miles, and with 70 locks and five tunnels, the canal cost a colossal £130,000, and yet succeeded in reducing Wedgwood's transportation overheads by a factor of 15. Understandably, Wedgwood's biographer comments that the Trent and Mersey was at the time 'the greatest civil engineering work built in Britain'.

At Wedgwood's invitation Brindley joined the Lunar Society, a circle of eminent figures of the Midlands Enlightenment who met monthly during the full moon, whose membership included engineers Matthew Boulton, James Watt and Samuel Galton. According to Jenny Uglow's history of the society *The Lunar Men*, Brindley was now exchanging ideas with the leading intellectuals of the day, and in recognition of his canal-building successes had become 'national hero, a model of how practical genius could triumph over low birth and near illiteracy'.

Brindley's ultimate ambition was to see the whole of England connected by canals, linking the four great rivers – Mersey, Trent, Severn and Thames – in his 'Grand Cross' scheme, of which he saw the Trent and Mersey waterway as the 'Grant Trunk Canal'. In 1762 he records in his diary that he'd set about 'raconitering' the project. Although he went on to work on ten canals in his career and had surveyed the entirety of the potential system, he did not live to see it

finished. While surveying a new branch of the Trent and Mersey canal, Brindley became drenched in a storm and retired to an inn to dry off. He soon became seriously ill, forcing his return home to Turnhurst, where he was attended by fellow Lunar man, the noted physician Erasmus Darwin (grandfather of evolutionary biologist Charles). Darwin diagnosed the engineer with diabetes, from which he never recovered, and died at the age of 56. 'To the last he was full of projects and full of work' observed Smiles, 'and then the wheels of life came to a sudden stop, when he could work no longer.' Or as his anonymous epitaph writer put it: 'And, when too late, his Doctor found, water sent him to the Ground'.

The ever-colourful Smiles leaves us with an anecdote from Brindley's deathbed. 'It is related of him that, when dying, some eager canal undertakers insisted on having an interview with him. They had encountered a serious difficulty in the course of constructing their canal, and they must have the advice of Mr. Brindley on the subject. They were introduced to the apartment where he lay scarce able to gasp, yet his mind was clear. They explained their difficulty – they could not make their canal hold water. "Then puddle it," said the engineer. They explained that they had already done so. "Then puddle it again – and again!"' **THEENGINEER**



Recently, *The Engineer* reported that HITRANS (Highland and Islands Transport Partnership), which covers over fifty percent of Scotland, plans to put forward a business case for the commercial deployment of ten Airlander vehicles to move passengers and freight in the region. Originally designed by UK-based company Hybrid Air Vehicles for military use, the helium-filled airships are each capable of carrying ten tonnes of cargo or one hundred passengers. With a top speed of 80 miles-per-hour, the Airlander employs a non-rigid inflatable hull and four combustion engines to manoeuvre. With a thin population spread out across challenging terrain, including mountainous countryside and islands whose only previous access was via ferry or helicopter, HITRANS hopes that these craft will enable transportation, tourism and public services to be deployed more effectively while simultaneously reducing emissions compared to similar aircraft.

A handful of other companies are also developing their own airship concepts, including Flying Whales, which has been funded by the French government, and LTA Research, which is backed by Google co-founder Sergey Brin and tested its rigid-bodied prototype *Pathfinder 1* in California in 2023.

Airships were a staple of early science fiction, with examples including the aerial destruction of London in E. Douglas Fawcett's *Hartman the Anarchist* (1893), to the flying machines of H. G. Wells's *When the Sleeper Wakes: A Story of the Days to Come* (1899), and the transatlantic postal service envisioned in Rudyard Kipling's *With the Night Mail: A Story of 2000 AD* (1905).

Airships have also been used as a kind of shorthand in more recent science fiction, their presence in the skies telling the reader that the story is happening in an alternate version of our Earth, with



GARETH L. POWELL

The rise of the airship

Whether it's the glamour of Jazz Age transatlantic travel or the adventure of the *Graf Zeppelin's* 1929 circumnavigation of the world, there's something inherently romantic about airships. As their revival makes news again, our resident science fiction author Gareth L. Powell looks at their enduring popularity in literature and asks where they might take us in the future

a different history. This is especially true of the Steampunk sub-genre, which imagines worlds in which the derring-do of Victorian-style exploration has given rise to a world of engineers and adventurers. This was prefigured by Michael Moorcock's *The Warlord of the Air* (1971), which sees airship armadas filling the skies of an alternative 1973, and continue through books such as Liesel Schwarz's *Sky Pirates* (2015) and others, which imagine a colourful world of romance and piracy among the clouds.

Other notable examples of airships in parallel timelines include Jonathan

L. Howard's *Johannes Cabal the Detective* (2010), Philip Reeves' *Mortal Engines* (2001), and Chris Wooding's *Retribution Falls* (2009).

My own novel, *Ack-Ack Macaque* (2013) features a kilometre-long, multi-hulled Zeppelin powered by nuclear electric engines, built by British shipyards that turned to airship construction to compensate for the drop in demand for more conventional ships after the end of the Second World War.

But what of the future? If Hybrid Air Vehicles and their competitors are successful, could we see lighter-than-air vehicles

becoming a common sight in our skies? With current advances in drone technology and artificial intelligence, it's not unreasonable to suppose the next few years might bring us autonomous, self-piloted cargo airships plying regular delivery routes between freight terminals. The ability to travel over both land and sea is a significant advantage over ships that have to follow coastlines or road and rail traffic that has to stop at a port and unload. Decarbonising the shipping and airline industries is a hot topic right now, but if the airships of the future are going to move the amount of cargo and number of passengers currently carried by ships and planes, they're going to have to become significantly larger and more numerous.

Another possibility is that luxury airships will appeal to the billionaire market, offering a more relaxed experience than conventional jet aircraft. A sky yacht would be more akin to a cruise ship than a Lear jet, able to treat the super-rich and their guests to spectacular views for days at a time. In fact, the writer in me is already dreaming about a *Glass Onion*-style murder mystery set on one of these expensive airships as it voyages across the Atlantic Ocean...

And talking of desperate criminals, will we ever see swashbuckling airship pirates raiding these airborne yachts and cargo vessels? Modern container ships have been hijacked, and in California, trains carrying Amazon parcels have been looted. It's no great leap to imagine some enterprising criminals will find a way to commandeer the enticing cargoes passing overhead, whether by somehow hacking and taking control of the airship's guidance systems, shooting it down with a missile, or utilising their own airships to riskily plunder it in flight. #ENGINEER

Gareth L. Powell is the award winning author of 20 published books. You can find him online at: www.garethlpowell.com



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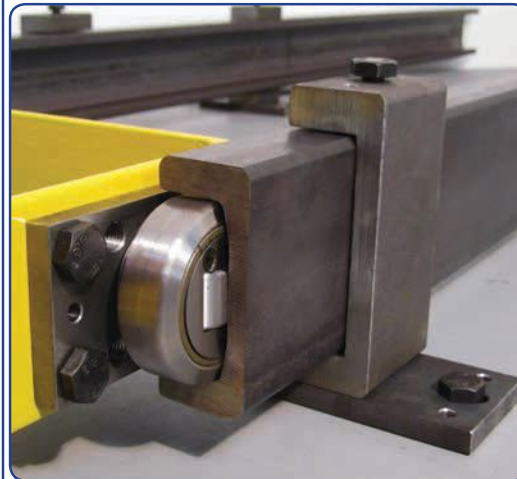
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JUNE 1917

New dry dock for Manchester Ship Canal

An increase in trade saw the need to build a new dry dock for maintenance and repairs

WRITTEN BY JASON FORD

1 June 1917 – Dry docks

The city of Manchester is 40 miles from the sea but being a landlocked metropolis didn't prevent its inhabitants from building a port of national significance.

In fact, when the Manchester Ship Canal opened in 1894 it was declared the largest river navigation canal in the world before going on to be the UK's third busiest port. According to Historic UK, the canal carried almost 20 million short tons of freight at its peak in 1958.

The steady rise in traffic along the canal had been noted 41-years previously when The Engineer reported on the opening of a third dry dock at Mode Wheel, which was owned by the Manchester Dry Docks Company Limited.

"A noteworthy feature of the work of construction is that the whole of it has been carried out by the contractors, Messrs Robert MacAlpine and Sons, since the commencement of the [first world] war, in spite of all the attendant difficulties with regard to labour, materials and transit, the first sod having been cut in May 1915," said The Engineer.

Our reporter went on to add that the dock was 450ft long, the breadth of entrance 65ft, and the depth of water on the sill 19ft.

"The quantity of material excavated was 60,000 cubic yards," The Engineer recorded. "The amount of concrete used was 25,000 cubic yards, brick work 3740 cubic yards, while for the sill and quoins 1700 cubic feet of granite ashlar was used, and for the copings 12,000 cubic feet of sandstone ashlar.

According to our report, an interesting feature in connection with the excavation work was the employment of a steam digger from Bucyrus (a company bought by Caterpillar in 2011 for \$8.8bn) that 'stripped the

whole site, or about 30,000 cubic yards, in nine weeks of ordinary working days.'

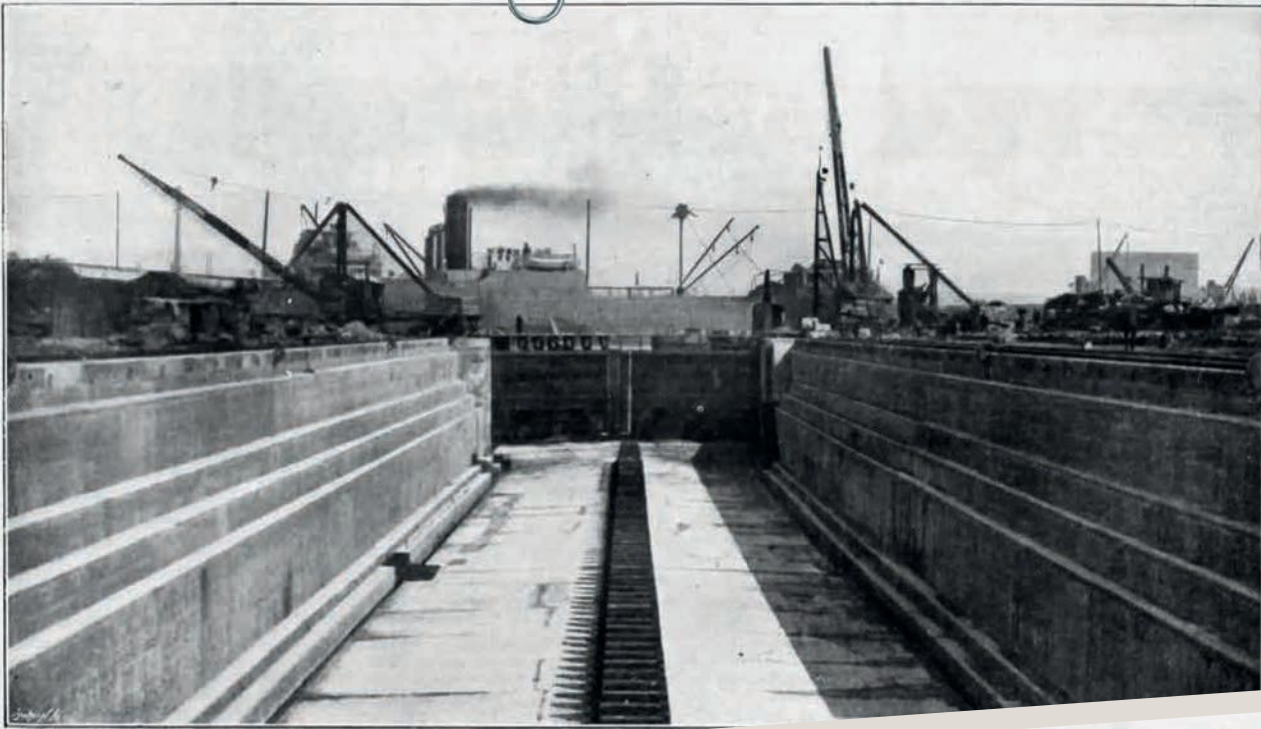
"This machine employs a grab line bucket which excavated the material and lifted it to waggons on a road at ground level," said The Engineer. "The concrete walls all around the dock were then constructed in timber trenches, and the excavation was subsequently carried

out for the floor in trenches and across the dock."

Our reporter added: "The dock is constructed of 1:3:6 concrete with displacers and is founded on red sandstone rock, with the exception of a small portion of the floor at the head, which is founded on hard boulder clay overlying the rock."

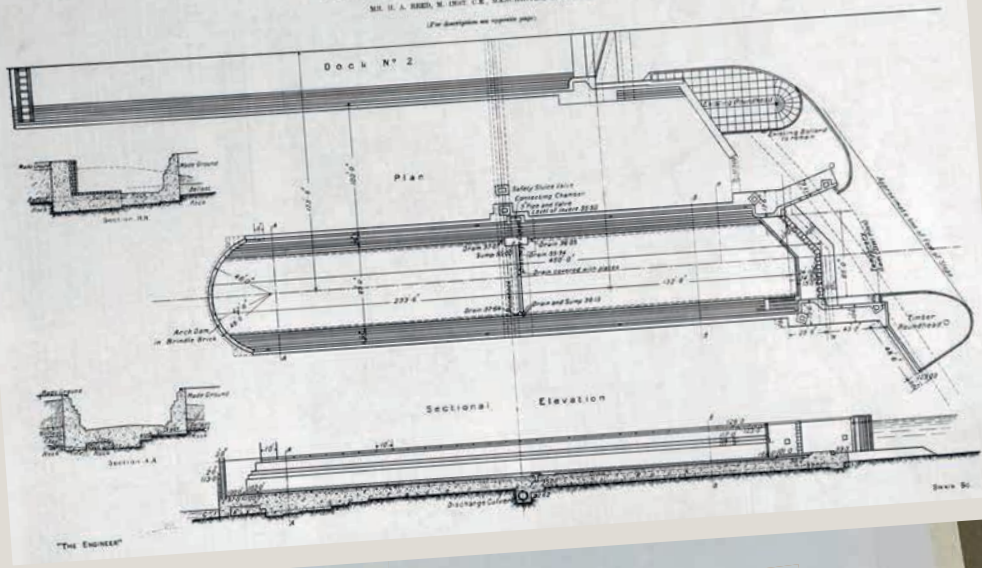
The floor was made entirely of concrete, the minimum thickness under the blocks being eight feet six inches. It was carried out in block sections, each section 'being of such a size as to constitute a day's work'. The joints with the adjacent blocks and the sidewalls were formed to approximately the radial lines of a concealed arch. The sidewalls were faced with brindle brickwork four and a half inches and nine inches thick, with bullnosed bricks on edge at each altar.

"The dock is set an angle with the water area of the adjoining Manchester docks, and the gates have been designed accordingly in order to obtain the greatest length, while leaving sufficient room at the head for a further extension if desired at some future time," said The Engineer. "To enable this extension to be easily and comparatively inexpensively carried out, it will be observed that the head has been built in the form of a brick arch, three feet six inches thick, which will be more readily removable than a concrete wall. The gates are of steel with greenheart mitres, heel posts and sill pieces



NEW DRY DOCK AT MANCHESTER

MR. H. A. REED, M. INST. C.E., MANCHESTER, ENGINEER.
(For description see opposite page.)



and opened and closed by hand winches. The gates were built by the Manchester Dry Docks Company Limited.”

Water was drained from the dock through a culvert connected to pumps, which dealt with the water from two existing docks belonging to the Dry Docks Company. This culvert was extended under the new dock, 'so as to be available for any future docks that may be constructed.'

“The filling water is admitted by means of four sluice valves in the gates. The engineer to the undertaking is Mr. H.A. Reed, M Inst. C.E., who is also engineer to the Manchester Ship Canal,” our reporter concluded.

According to the Institution of Civil Engineers, traffic declined on the ship canal in the 1970s and 1980s when containerisation saw ships becoming too big to navigate the waterway. Manchester Dry Docks Company Limited folded in 1980 but was revived in 1987 by former employees who operated under the name Lengthline.

The dry docks may have gone, but the canal remains a vibrant logistics hub. Operator Peel Ports Group reports that it can handle 7.5 million tonnes of cargo across Manchester Ship Canal's five terminals. “The Canal is thriving, and each year it handles and stores millions of tonnes of cargo from wind turbine blades to animal feed and biomass, to aggregates, sand, salt and chemicals,” the company says on its website. #ENGINEER

Here is, it seems, an awareness day for anything and everything. But one that truly deserves to be on everyone's radar, especially as we face serious workforce shortages, is International Women in Engineering Day, taking place on 23 June. Now in its 10th year, INWED celebrates the outstanding achievements of women engineers throughout the world and profiles amazing career opportunities available to girls in this exciting industry.

What difference can a day make?

Well, I believe stories matter. It's an opportunity for women in engineering to share their stories and inspire young people – and especially girls – who may think 'STEM is not for me'. It is also a time to collectively amplify and celebrate progressive companies with active inclusive recruitment, progression and retention policies.

While girls lead the way in STEM subject grades, most drop-off from studying these subjects post-16, and, particularly, in pursuing further education, training and careers in engineering or technology. More needs to be done to encourage girls and young women into these areas, by igniting passion, building confidence, and showing them how their own interests and values align with those of the profession.

EngineeringUK conducted a review (June 2023) examining evidence on interventions that aim to increase girls' aspirations for engineering and technology careers and key findings highlighted the importance of early engagement and ensuring activities challenge gender stereotypes around engineering and technology. Girls are empowered by seeing relatable female role models – clichés of men in hi-vis vests and hard hats do little to illustrate the fascinating roles the industry offers and draw women in. There is much to be done too, around adapting



DR HILARY LEEVERS

Raising awareness

In this month's column, Dr Hilary Leever, Chief Executive of EngineeringUK, discusses how employers and employees can inspire the next generation by getting behind International Women in Engineering Day

outreach programmes to the needs, interests and preferences of girls. At EngineeringUK, we test and iterate all our activities for young people to build up their impact especially from groups under-represented in engineering and technology.

In fact, we'll be putting this into action later this month when we'll be welcoming about 20,000 young people to The Big Bang Fair at the NEC, showcasing the breath of STEM careers and inspiring some of tomorrow's STEM professionals. We'll be

supported by many hundreds of volunteers and exhibitors – many thanks if you're joining us. It's a fantastic opportunity for industry professionals to meet with young people and inspire and encourage them. We'll also be celebrating The Big Bang Competition finalists and announcing the winners; the competition encourages and celebrates practical work which we know is really motivating to young people, especially girls.

At the Big Bang Fair, we'll be emphasising the many pathways into a career in engineering

and technology, especially the apprenticeships and T Levels which offer a real opportunity to young people who want more hands-on training. These varied pathways benefit young people and help widen the talent pool and increase diversity.

As well as inspiring young people, INWED might provide the prompt for some bold conversations needed across the workplace – the CEO, Board, and HR – to improve gender balance and achieve real change. Some companies are making strong commitments in this area. For instance, Siemens has pledged to see at least 30% of women in top management by the end of 2025.

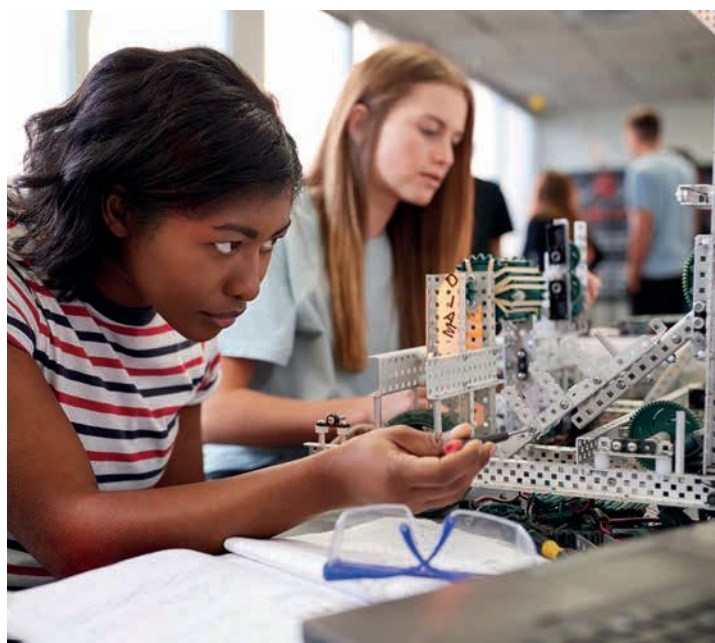
Another example is Emm, a female-led company producing smart menstrual products using tech working with the University of Cambridge, Innovate UK and Google for Startups. This example also conveys how increasing workplace diversity can ensure that the needs of the whole population are met, not just those who happen to be working in engineering and technology. Emm is also working with its subcontractors to improve their gender diversity.

Many organisations run diversity groups, like Rolls-Royce's UK Gender Diversity Network, overseen by Nipuni Karunaratne, a finalist in this year's IET Young Women Engineer award. Nipuni's view is that 'STEM is for everyone and has no barriers' and she's determined to be a role model. We need more women like Nipuni to share their inspiring stories because role models matter to young people – especially young girls.

It would be great to hear more from employers this International Women in Engineering Day on how they are working to recruit and retain talent.

And please do share your stories and celebrate the women you work with on #INWED24.

#ENGINEER



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Images: stock.adobe.com

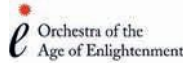
A brighter, fairer future for all

Mark Allen Foundation partners with a variety of amazing charities to support their work in the UK and internationally. The Foundation was established by Mark Allen Group to enable its employees to coordinate and amplify their fundraising efforts, as well as to raise significant funds for charity through its portfolio of client events.

Some of the charities and organisations supported previously include: YoungMinds, STOP THE TRAFFIK, Blind Veterans UK, The Felix Project, The Trussell Trust, BeeKind, Orchestra of the Age of Enlightenment, We Mind & Kelly Matters, Mates in Mind, NSPCC Childline and ANDYSMANCLUB.

We would like to extend our heartfelt thanks to everyone who very kindly supports our charity fundraising.

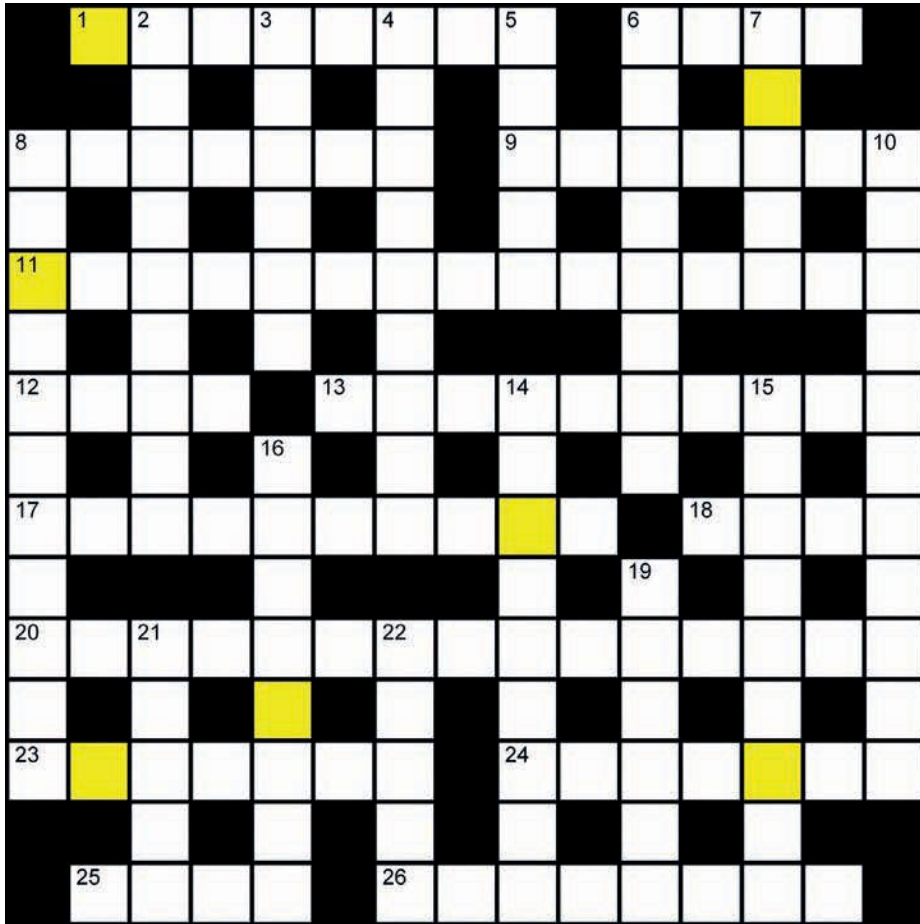
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CROSSWORD



Across

- 1 Trade in guns (4,4)
- 6 Become plastic or fluid from heat (4)
- 8 Get on the back of (5,2)
- 9 Grinding with a machine (7)
- 11 Belief accepted as authoritative by some group (6,2,7)
- 12 Set of questions evaluating skill or knowledge (4)
- 13 Body of Swiss water (4,6)
- 17 Able to cause disease (10)
- 18 Central area of a church (4)
- 20 Exhibiting magnetism produced by electric charge in motion (15)
- 23 Raise to a higher position (7)
- 24 Perplexing problem (7)
- 25 Infection of the sebaceous gland of the eyelid (4)
- 26 A basis for comparison (8)

Down

- 2 Coarse plaster for the surface of external walls (9)
- 3 Humorous T.V. drama (6)
- 4 Use of spies to get military or political secrets (9)
- 5 Greatest possible degree of something (5)
- 6 Topple forward and down (4,4)
- 7 Support made of cloth or rope (5)
- 8 Most outstanding work of a creative artist or craftsman (11)
- 10 Whitish rubber used for insulation of electrical cables (5,6)
- 14 Short part of the oesophagus (9)
- 15 Any of various elastic materials that resemble rubber (9)
- 16 Written computer programs (8)
- 19 Bent from a vertical position (6)
- 21 Construct or build (5)
- 22 Heating appliances (5)

When completed rearrange the highlighted squares to spell out a plant for treating lumber.
Email your answer to jon.excell@markallengroup.com

Last issues solution: Gangway

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