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Advanced Manufacturing
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Turning the tide on power generation
Navigating the future of aerospace innovation
Building an accessible future in immersive technologies

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Made in the UK: the next nuclear age



The manufacturing moment



Over the summer, I was transfixed by the brilliant leadership, physical skill, mental acuity and wonderful national pride watching the Lionesses play in the Euros football tournament – and bring home that trophy for a second time. Manager and head coach, Sarina Wiegman, has turned on a light in the team that has carried them far and gives us all something to learn from.

Wiegman's focus is powerful and how she worked the team to deliver this magic – let's not forget she is now the first manager ever to reach five international tournament finals in a row – was not on the back of business-as-usual approaches and the common rule book. It has been through the phenomenal relationships and connections she has built in the team, and being the cool head that is needed in those critical moments when the going gets tough.

When it comes to our critical moment in manufacturing, you could argue that there are parallels with how we as an industry mobilise to effect the change we need to see. That is precisely what Professor Ben Morgan explores in his first 'From the CEO' piece for the AMRC Journal.

In it, he argues that if we are to deliver on the ambition of a manufacturing resurgence and the government's Industrial Strategy, then business-as-usual – much like we have witnessed with Wiegman's approach to coaching the Lionesses to victory – is not good enough.

Our interim CEO says we need 'silo busting, high-value industrial programmes' that are not 'business-as-usual' which the UK must scale and replicate elsewhere. He points to projects at the AMRC, covering

sectors from energy to aerospace, as great examples of such blueprints that can help change the weather of UK manufacturing; a sector that contributes more than £200 billion to the economy and supports 2.5 million jobs.

Yet, it is a sector that faces serious headwinds with aging infrastructure, capability gaps, skills shortages and long standing underinvestment in R&D compared with our international peers.

Meanwhile, global competitors are doubling down on advanced manufacturing, digitalisation and green technologies.

But when the going gets tough, we can't lose focus. This is our moment. The UK has the talent, the institutions and the industrial heritage to lead a manufacturing resurgence. But leadership requires action. It requires bold thinking, strategic investment and a willingness to challenge the status quo if we want to turn ideas into impact, and potential into performance.

We need to be, dare I say it, more Wiegman.

Katia Harston
Editor

“We can't lose focus. This is our moment. The UK has the talent, the institutions and the industrial heritage to lead a manufacturing resurgence.”



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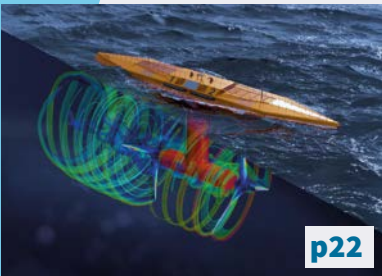
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Business-as-usual is not good enough



By Professor Ben Morgan,
interim CEO, University of Sheffield AMRC

This is a critical moment for the UK. The geopolitical context is at fever pitch. The need for regional economic growth with investment and jobs is ever growing. And the opportunity of technology abounds. This is a complex and uncertain time.

The government has listened and put in place an ambitious Industrial Strategy with a very welcome emphasis on advanced manufacturing, defence, digitalisation and clean energy, alongside a small number of other sectors. The value of a resilient, innovative and future-ready manufacturing sector has been fully acknowledged, as has the need for big bets to build sovereign capability, whether in defence, offshore wind or small modular reactors.

The growth mindset

For the AMRC, the High Value Manufacturing (HVM) Catapult, universities and wider knowledge creation ecosystem, our role is to act as national catalysts for derisking investment in capabilities, capacity and skills. Standing still is not an option, we need to move forward, together with our partners and collaborators, focused on delivering impact.

The AMRC has a great track record. The potent transformation at Orgreave, bringing high-value investment on the back of innovation and workforce development has not happened by chance, but the

excellent delivery of innovation that has de-risked investment and brought growth. Our partnerships with global giants like Rolls-Royce, BAE Systems, Airbus, Boeing and Leonardo are not just collaborations – they are monuments to what is possible when academia, industry and government gather around a shared vision and mobilise.

Take our work with Rolls-Royce SMR, where we are helping to shape the future of how we manufacture nuclear power generation in the UK for a global market. Or consider Composites at Speed and Scale (COMPASS) and our collaboration with Boeing, which is redefining the manufacturing methodology for the aerostructures of future passenger planes.

These pathfinder innovation projects are not isolated wins, nor are they business-as-usual – they are blueprints for silo busting, harmonising technology disciplines; high-value industrial programmes that the UK must scale and replicate elsewhere. It is these projects that, over the years to come, will help to change the weather of UK manufacturing.

The AMRC's evolving mission

Since starting this role at the beginning of 2025, I have been clear that growth is a vital part of our agenda. It is not our own balance sheet growth that drives me, but how we grow our impact for the manufacturing sector and the economy.

Our focus is threefold:

- Sectoral focus
- Delivering the economic dividend across the whole ecosystem
- Workforce

Let me explain how we are approaching each of these imperatives.

Sectors

In aerospace, defence and nuclear energy, I see the greatest potential for us to deliver impact.

Aerospace: This is about the next generation aerostructures and single aisle engines. The UK has long held comparative strengths in these areas. The national pursuit is to take a significant global market share of next generation developments for future single aisle platforms.

Defence: We are supporting the government's ambition to build sovereign capability. As is often said, the manufacturing base of the UK is a vital part of our country's national security and whether it is the creation of a future combat aircraft, the new munitions factories announced by the Prime Minister, or future at sea capabilities, innovation and the wider manufacturing supply chain will be part of how we meet the political ambition and deliver a strong economic dividend for the UK.

Nuclear energy: The recent announcement by Great British Energy – Nuclear was a strong endorsement of bringing small modular reactors and their role in delivering clean energy to our homes and factories. And, critically, a substantial demand signal to the UK's manufacturing sector, which can support the UK's capture of a growing global market. We have been supporting the most advanced protagonist – Rolls-Royce SMR – in this area for nearly a decade and look forward to continuing being its strategic research and development partner for the long term. Our focus will also be to support the longstanding work on how we decommission nuclear power stations at the end of their lifecycle.

Delivering the economic dividend across the whole ecosystem

Innovation is the lifeblood of manufacturing competitiveness. Yet, too often, innovation is siloed – confined to large original equipment manufacturers (OEMs) or elite research labs. We must democratise innovation, making it accessible to small and medium-sized enterprises, regional clusters and emerging sectors. This is not just about national security – it's about economic sovereignty. It's about ensuring that UK manufacturers can compete on quality, speed and innovation – not just cost.

The AMRC is uniquely positioned to do this. With our world-class facilities, cross-sector expertise and deep industry networks, we are a national innovation engine – translating cutting-edge



research into real-world impact. Our collaboration with the University of Sheffield aligns its academic excellence with industrial relevance. Together, we are creating a seamless pipeline from discovery to deployment.

And it is about enabling new entrants to the manufacturing sector. We are actively working with hardtech startups and scaling enterprises to build their capabilities, verify their technical ideas and de-risk investment. Equally important is building their visibility with our industrial partners and wider manufacturing relationships.

Workforce

None of this is possible without people. The UK's manufacturing future depends on a skilled, diverse and adaptable workforce. Yet we face a growing skills gap.

At the AMRC, we are committed to closing this gap. With an annual intake of more than 200 apprentices, the University of Sheffield AMRC Training Centre is a national model for industry-led education – offering apprenticeships, degree programmes and

training opportunities that are directly aligned with employer needs.

We are also working to inspire the next generation. Through STEM and schools outreach, partnerships and inclusive recruitment, we are making manufacturing an ambition for young people from all backgrounds.

But we must think bigger to meet the growing workforce demands, both from within our sectors of focus and the economy more generally.

Looking ahead

My message is clear: if we are to deliver on the ambition, we need to move beyond usual. The AMRC was founded on a simple but powerful idea: collaboration drives innovation. That idea is more relevant today than ever before.

As interim CEO, I am proud of our legacy, but I am even more excited about our future. We will continue to push boundaries, challenge conventions and deliver solutions that matter.

Let's seize this moment.

“We must democratise innovation, making it accessible to SMEs, regional clusters and emerging sectors. This is not just about national security – it's about economic sovereignty.”

By Professor Ben Morgan, interim CEO, University of Sheffield AMRC.

Navigating the future of aerospace innovation

The aerospace sector is a realm of grand ambitions where the future is constantly being designed, tested and precisely brought to life. Yet, it's also a landscape grappling with long timelines, complex funding and the ever-present demand for a skilled workforce.

Mrudula Jadhav sat down with **Stephen Beecher**, senior sector engagement manager for aerospace at the University of Sheffield AMRC, and **Alun Reece**, chief executive officer at Loop Technology, to explore the dynamic forces shaping flight; South Yorkshire's pivotal role in driving manufacturing innovation; and the sheer grit required to bring tomorrow's aircraft onto the runway.



Stephen Beecher, senior sector engagement manager for aerospace, the University of Sheffield AMRC.



Alun Reece, chief executive officer at Loop Technology.



“The unwavering commitment to net zero by 2050 and the UK’s ambitious 77 per cent emissions reduction by 2035 means the pressure for greener, more efficient manufacturing is only intensifying,” says Stephen.

Delivering on this ambition, he says, demands an outlook stretching far beyond months or even a few years – it requires looking decades ahead. And recent major announcements, such as Airbus’ revised roadmap for its ZEROe project with the hydrogen aircraft

expected to come later than 2035, only serve to underscore the waiting game that has to be played in aviation.

The mass adoption of hydrogen, while significant, highlights a far greater challenge for the industry in reaching its ambitions to reduce emissions, and that is the long runway between brilliant research being undertaken and taking it into production.

For Alun Reece, whose company Loop Technology specialises in advanced composite manufacturing,

this pressure translates into a strategic imperative. “We’ve been working since about 2010 to develop our FibreLINE technology that will address the needs of these global players,” he reveals.

The push for lightweighting and staggering order backlogs – thousands of aircraft for both Boeing and Airbus – calls for nothing less than a revolution in production.

“Moving from typical production rates of 30 aircraft sets a month to between 75 and 100 requires a

fundamental shift away from manual techniques,” stresses Stephen.

This means adopting automated solutions, human-assistive systems and smart workbenches, all underpinned by crucial in-process inspection and integrated data connectivity. As Stephen puts it: “You can’t afford to find problems at the end of the line.”

The long runway to production

The path from cutting-edge research to full-scale production is littered with obstacles due to what Stephen calls a shifting ‘valley of death’ for technology, referring to the critical gap where proven research technologies struggle to secure funding for industrial-scale maturation.

He adds: “The ‘valley of death’ for technology is potentially moving now to be at technology readiness level (TRL) seven and beyond, as compared to what used to be at TRL three to six that the High Value Manufacturing Catapult, which is the national network of research centres the AMRC is a member of, were initially targeted to address.”

Alun couldn’t agree more. He said: “The biggest challenge is proving and driving the level of maturity where, when your machine hits the shop floor, they press a button and it spits out the product without any intervention.”

He candidly describes the current landscape as one of unpredictable demand, with companies like Loop Technology engaged in a long R&D phase, as award-winning systems such as FibreLINE wait to transition into production.

“At the AMRC Training Centre, we’re not just training people in the latest manufacturing techniques; we’re instilling a passion for innovation.”

Stephen Beecher, senior sector engagement manager for aerospace, University of Sheffield AMRC.

Stephen emphasises that while the ambition to build more advanced aircraft at a significantly higher rate presents a huge opportunity, it critically requires manufacturing systems that are robust and proven – something which Alun notes ‘are not built overnight’.

This challenge is compounded by design philosophies which, Alun explains, means aircraft manufacturers are likely still determining the precise architecture of future airframes. Stephen agrees and says that while design for manufacturing is often discussed, aircraft performance still takes precedence, leading to radical geometries that present greater manufacturing challenges.

How do we bridge the gap?

What is needed, according to Stephen and Alun, is ‘a clearer, more concrete steer on timelines’ to provide more confidence for investment. Stephen believes there is a clear need for government and funding bodies to rethink their approach to supporting aerospace, specifically to bridge this gap at high TRL.

For Stephen, the AMRC stands ready to play a critical role in this shift. He envisions fostering deeper, more inclusive collaboration with industry partners, moving beyond transactional relationships with industry and sharing more information that would generally be withheld due to intellectual property or sensitivity concerns.

He even raises the idea of whether the AMRC should extend its support to more mature TRLs, helping companies bridge that precarious gap into production.

“Is there a call for more involvement and support when technology moves into production?” Stephen asks, seeing a role for the AMRC in ensuring a right-first-time approach and providing mentorship.

Nurturing the talent pipeline

Beyond the technical and funding hurdles, the aerospace sector grapples with a fundamental human challenge: finding, nurturing and retaining the right talent.

Stephen notes that part of this challenge stems from a skewed perception of what a career in aerospace actually looks like.

“Aerospace is sometimes seen as a ‘dirty’ sector,” he says, highlighting how this might deter young people from considering it as a career. Adding to this, Alun points to the difficulty in sourcing multi-skilled individuals, particularly electrical designers.

“However, we’re actively countering these challenges and building the workforce of tomorrow through our apprenticeship programmes at the University of Sheffield AMRC Training Centre,” Stephen explains.

“We’re not just training people in the latest manufacturing techniques; we’re instilling a passion for innovation and showing them the exciting, high-tech reality of modern aerospace, while also upskilling the current workforce.”

Echoing this proactive spirit, Loop Technology is also involved in engaging students from primary school through robotics programmes. Both Stephen and



Loop Technology’s cutting-edge automated composite preforming system, FibreLINE, will feature at the AMRC’s new COMPASS innovation facility in South Yorkshire.



Modular automation.

Alun advocate for a shift in educational culture, making science and engineering more fun and embracing mistakes as part of the learning journey. “Not being scared to make mistakes – that’s how you learn,” Alun says.

South Yorkshire: forging the future of manufacturing

Amidst these significant challenges, Stephen and Alun find a powerful undercurrent of hope, flowing closer to home in South Yorkshire.

For Alun and Loop Technology, a recent industry arrival to the region, the decision to establish a new facility in Sheffield – strategically located next door to the AMRC – was ‘unequivocally the right one.’ “Here, we have a good pool of talent to pick from,” he explains, praising the region’s strong talent ecosystem and the pipeline coming through from its two universities.

Loop Technology is now building and testing its automation systems at its new Sheffield facility for the AMRC’s

Composites at Speed and Scale (COMPASS) programme, some of which will ultimately go into the new nearby COMPASS facility. “We’ve got five robots over there that will form part of the state-of-the-art equipment at the COMPASS facility,” adds Alun.

Alun speaks with genuine admiration for the Mayor of South Yorkshire, Oliver Coppard, whose ‘dynamism and enthusiasm for manufacturing and the region is contagious’. This welcoming environment, coupled with the Advanced Manufacturing Park’s growth – home to many other global players, including Boeing and Rolls-Royce – has created a ‘critical mass’ of expertise.

“There’s a kind of energy,” Stephen says, highlighting the unique cultural appreciation for manufacturing in South Yorkshire: “It’s almost seen as a catalyst for the region’s renewal, carrying the legacy of its industrial past into an innovative future”.

He concludes: “The AMRC is a national asset for manufacturing and what we’ve got here in South Yorkshire, with the AMRC

right at the centre, is not just good for local businesses. This regional cluster truly puts the UK in a strong position for aerospace, providing the vital testbed and talent pipeline the whole nation needs to hit those net zero targets.”

Looking ahead – what is next?

Both Stephen and Alun are deeply excited about what the next five to ten years may hold.

Stephen shares this anticipation, particularly for the outcomes of Boeing’s Isothermic High-Rate Sustainable Structures – the first project to utilise the AMRC’s open-access COMPASS facility. He envisions a ‘strong consortium of technologically advanced companies’ making significant advancements supported by the AMRC. The ultimate goal, he hopes, is to see these innovations in production before he retires.

For Alun, the collaboration with the AMRC and Boeing is a fundamental catalyst. This partnership has already led to some great conversations, building trust and showcasing Loop Technology’s capabilities.

In South Yorkshire, amidst the challenges of lengthy development cycles and complex funding, a powerful synergy is strengthening. It’s a blend of cutting-edge research, regional dynamism and a deep-seated commitment to skills that builds the future of flight.

The journey certainly is long, but with this collaborative spirit and manufacturing roots, the UK aerospace sector is reaching new heights.

“There’s a kind of energy. Manufacturing is almost seen as a catalyst for the region’s renewal, carrying the legacy of its industrial past into an innovative future.”

Stephen Beecher, senior sector engagement manager for aerospace, University of Sheffield AMRC.

Backing bold ideas to grow new business



What happens when ambitious entrepreneurial vision meets world-class engineering innovation? You get AMRC FerretWorks: Startup. **Richard Gardiner**, senior innovation fellow at the AMRC, sits down with **Christie Collins**, to explain how the new programme will support and grow early-stage engineering innovation.



The mission for AMRC FerretWorks: Startup is clear: turn ambitious ideas into investable ventures, drive the growth of high-value jobs and contribute to the development of a thriving, innovation-led economy in South Yorkshire.

“We’re not just supporting innovation,” Richard says. “We’re helping create the right environment for it. One that gives business founders

the confidence, technical backing and commercial structure to succeed.”

In its first year, AMRC FerretWorks: Startup, is being co-funded by the South Yorkshire Mayoral Combined Authority (SYMCA) and the University of Sheffield. It will support entrepreneurs with the tools, resources and expert guidance needed to help founders develop their product and build scalable, sustainable businesses.

By providing early-stage founders access to world-class engineering capabilities, commercial guidance and investment networks, AMRC FerretWorks: Startup is helping de-risk innovation at its most vulnerable stage.

The programme focuses on assisting early-stage companies with strong potential in one or more of the AMRC’s supported sectors, including: aerospace, energy, defence, automotive,

“The ripple effects of engineering innovation don’t end at the lab bench or the pitch deck – they reach into the communities where real change happens.”

Richard Gardiner, senior innovation fellow, University of Sheffield AMRC.

construction, medical and healthcare, space, food and drink, agri-tech and rail. These are not only areas of national strategic importance but in many cases are areas of strength for the regions the AMRC operates in.

Richard explained: “Through the programme, participants will work closely with our AMRC engineers to refine their ideas, develop their prototypes and accelerate their route to market. They’re gaining access to more than £200 million of advanced manufacturing capability, from design for manufacture and product testing, to state-of-the-art machinery and technical expertise. This is all supported by commercialisation frameworks, mentorship and visibility to investors and industry partners.”

AMRC FerretWorks: Startup is open to entrepreneurs who are based in South Yorkshire, or are planning to base their business in the region. The programme has backing from three key commercialisation partners, which form the entry points to the programme: the Royal Academy of Engineering’s Regional Talent Engine (Yorkshire), Sheffield Technology Parks’ Cooper Project and the University of Sheffield’s own Commercialisation Journey. Each partner will identify promising candidates from their respective programmes and nominate them to participate in AMRC FerretWorks: Startup.

Sarah Gummer, senior manager for regional entrepreneurship programmes at the Royal Academy of Engineering, said: “We are thrilled to work with the AMRC on this new initiative, welcoming more support for deep tech and life sciences startups in the North.

“We support incredibly talented entrepreneurs to turn their idea into a startup. Through the Regional Talent Engines programme they develop commercialisation skills, access critical networks and build supportive communities.

“Being able to access manufacturing capability and targeted support from the AMRC will now enable them to further develop their innovations, taking the next step in their startup journeys.”

Richard explained that applications are carefully reviewed by the AMRC FerretWorks: Startup team to ensure they are technically feasible, aligned with AMRC capability and achievable within the scope of the programme.

“Ultimately, participants will be awarded project support worth up to £45,000 to co-develop their innovation with AMRC teams,” Richard added.

Rose Tran, incubation manager at Sheffield Technology Parks, said: “We are excited to become a partner of AMRC FerretWorks: Startup because of the rare and unique opportunity it will give to founders of innovative products, providing real solutions to real-world problems.

“With access to the cutting-edge facilities at the AMRC, expert engineers and its networks, the programme has potential to substantially accelerate successful applicants from idea stage, through to creating an innovative and scalable product – ready for market; and we cannot wait to see the impact they will deliver.”

The programme has been designed to align with the SYMCA Strategic Economic Plan, which sets out a vision to grow the region’s innovation ecosystem, increase high-quality employment and position South Yorkshire as a leading destination for entrepreneurship and investment.

Richard explained that while AMRC FerretWorks: Startup directly supports this SYMCA vision by giving business founders a compelling reason to start and scale their businesses in the region – it also reflects broader national goals.

He said: “The UK government’s Independent Review of University Spin-outs called for more support at the proof-of-concept stage, greater integration between academia and industry and improved access to funding and technical resources for early-stage founders.

“We believe AMRC FerretWorks: Startup meets these recommendations head-on, offering a joined-up, structured pathway that supports the commercialisation of innovative ideas with high industrial relevance.”

Participants are encouraged to establish their base in the South Yorkshire region and to make use of its regional assets such as the Sheffield Innovation Spine, which spans key areas close to the city centre, and is where early-stage innovators can connect with peers and support networks during the formative years of their business. As they grow and scale, they can take advantage of the Advanced Manufacturing Innovation District (AMID) – a national hub for high-tech industrial growth.

Beyond engineering advancements, AMRC FerretWorks: Startup is also focused on wider economic and societal impact. By helping business founders move faster and smarter through early stages of growth, the programme supports job creation, shared knowledge and long-term value generation for the region.

“This is not just about startups, it’s about strengthening the foundation of the UK’s industrial future,” says Richard. “It’s not just about building better products. It’s about accelerating the journey, reducing risk, improving quality to ultimately attract greater investment. And that leads to something real: jobs, livelihoods and economic opportunity.”

The ripple effects of early-stage innovation are far-reaching, says Richard.

“From lab benches and design studios, to factory floors and investment rooms, the outcomes shape industries and communities,” he said. “AMRC FerretWorks: Startup is built to ensure those outcomes stay local, scalable and sustainable.

“It’s not just an idea. These are people’s lives, their families, their support networks. That’s what makes it all so worthwhile. The impact of the engineering-led innovation does not end at the lab bench or the pitch deck – it reaches into the communities where real change happens.”

For startups with visionary ideas, AMRC FerretWorks: Startup offers much more than just support; it is a springboard. A rare opportunity to help entrepreneurs build, grow and lead – with impact that stretches across industries and into the heart of South Yorkshire, where the journey begins.

How UK defence coordination, innovation and funding can unlock national resilience and industrial growth

By Katia Harston

How can the UK translate world-class defence innovation into deployable capability – while building a more resilient industrial base and supporting the broader economy? That's the challenge at the heart of a **new study by the University of Sheffield Advanced Manufacturing Research Centre (AMRC) and EY-Parthenon**, developed in the run-up to DSEI UK 2025.

Turning ideas into capability – and capability into competitive advantage – will require a more connected, agile and scalable ecosystem, a new study has found.

Drawing on 360-degree insights from defence primes and stakeholders – including original equipment manufacturers (OEMs), small and medium-sized enterprises (SMEs) and the Ministry of Defence – the joint paper by EY-Parthenon and the AMRC explores the challenges facing the UK's defence ecosystem to meet future demand requirements, both in capability and capacity.

The central finding is this: the UK is not short of technical innovation – whether in autonomy, digital engineering, modular design or advanced manufacturing. However, not enough innovations are reaching scale.

Unclear demand visibility, long qualification times, capability constraints and short-term signalling make it difficult for suppliers to invest in capacity and capability. Fragmented procurement, underdeveloped scale-up support – particularly for regional SMEs – and limited awareness of how to access and deploy grants or innovation funding are leaving value on the table. Feedback loops between SMEs and end users need to be strengthened.

Structural factors like planning delays, skills availability, regulatory environment and a complex incentives structure continue to inhibit entry, investment and responsiveness.



A new study is exploring challenges facing the UK's defence ecosystem in order to meet future demand.

The report highlights potential solutions by exploring how other countries and adjacent sectors have built more responsive, feedback-rich innovation ecosystems. These include clearer alignment on capacity, capability and funding needs, with better coordination across the value chain, more efficient grant navigation and deployment processes, and investment in manufacturing platforms with latent capacity to support surge demand.

With defence spending set to rise and the urgency around sovereign capability intensifying, a strategic inflection point is on the horizon. The UK can turn innovation into long-term advantage – as it has done before. Doing so means addressing the root causes of system-level fragmentation and building the enabling conditions for scale.

Full findings of the report are to be released by EY at DSEI UK 2025 event, with key messages discussed at a roundtable event at the conference.

Manufacturing the future of nuclear

The UK's ambition for a revitalised nuclear sector is clear: a secure, low-carbon energy supply that underpins national prosperity and delivers on net zero commitments.

Katherine Bennett, chief executive officer at the High Value Manufacturing (HVM) Catapult, explores the fundamental pillars of policy, technology and skills required to achieve this ambition; and **Charles Carpenter, head of research for the AMRC's nuclear manufacturing group**, shares why nuclear must turn to advanced manufacturing technologies to catch up with surging demand.



The nuclear equation: policy, skills and technology

*By Katherine Bennett
Chief executive officer, High Value Manufacturing Catapult*

Global demand for affordable, resilient, secure and clean energy is rising – and nuclear is part of the answer. As the UK stands on the cusp of a nuclear renaissance, the crucial question isn't just *if* we can build new plants, but *how* we industrialise their manufacture at scale and pace.

I believe success hinges on three areas: coherent policy, cutting-edge technology and a highly skilled workforce. Without alignment and sustained investment across these critical areas, the promise of a secure, low-carbon energy future for the UK will remain out of reach.

At the High Value Manufacturing (HVM) Catapult, a network spanning 23 sites, employing 3,500 people and having driven over a billion pounds of investment since 2011, we are uniquely positioned to accelerate industrial transformation by helping academia, industry and government tackle manufacturing's toughest challenges across these very pillars.

Policy is the first pillar, providing essential market certainty.

According to the recent Clean Energy Industries Sector Plan, there are huge opportunities for the UK, especially as an exporter in the global civil nuclear market, projected to be worth one-trillion pounds by 2030. Government decisions backing Sizewell C and selecting Rolls-Royce SMR as the preferred bidder demonstrate a real vote of confidence in UK manufacturing – signalling to investors, supply chains and future

engineers that the UK is committed to clean energy.

However, fully seizing these opportunities will require investment, scale, rate and certainty to boost capacity; and the existing capacity deficit necessitates direct, coordinated action from industry, regulators, government and academia – with HVM Catapult as a core delivery partner.

To meet the unprecedented demand, we must rethink how nuclear components are made. This brings us to the second pillar of technology.

We are working with industry and regulators to turn engineering challenges into opportunities. Our programmes actively support the government's nuclear ambitions by mobilising UK manufacturers for the global market, accelerating new nuclear builds and providing crucial innovation support for small modular reactors (SMRs) – critical for data centres and sustainable aviation fuel.

We're unlocking opportunities with partners like Sellafield, in decommissioning and increasing domestic testing and validation capacity to ensure components are manufactured and assured in the UK before being sold worldwide.

This is built on a strong foundation of collaboration between our six centres and the nuclear industry, with the AMRC delivering a strong pipeline of projects for Sellafield, the UK Atomic Energy Authority, Cavendish and Rolls-Royce, among others.

Earlier this year, the AMRC created a new nuclear manufacturing group, following the integration of staff from the former Nuclear AMRC. This move retained talented engineers and researchers, and over £35 million of production equipment within the network. These changes aim to safeguard the UK's renowned nuclear

“Global demand for affordable, resilient, secure and clean energy is rising – and nuclear is part of the answer.”

Katherine Bennett, chief executive officer, High Value Manufacturing Catapult.

expertise, strengthen HVM Catapult's support for the sector and ultimately increase its scale, competitiveness and future investment.

But cutting-edge technology and robust policy mean little without the skilled individuals to bring them to life. This is where the third pillar – skills – becomes paramount.

Our centres are foresighting future needs and training the next generation, as demonstrated by the AMRC Training Centre's nuclear degree apprenticeship. Beyond new talent, they're upskilling current workforces and helping staff transition from declining industries to emerging ones. For the UK to extract maximum economic value and create

thousands of well paid, secure jobs, we must invest and modernise now. No single organisation can do it alone. This once-in-a-generation opportunity demands a strategic, multi-partner approach – and HVM Catapult stands ready to play its full part in solidifying the policy, skills and technology bedrock for our nuclear future.

Industrialising innovation: the AMRC's blueprint for nuclear manufacturing

By Charles Carpenter

Head of research for the AMRC's nuclear manufacturing group

Over 12 years ago I moved to the UK, arriving amidst the buzz of a nuclear renaissance.

The world was eager to build new nuclear plants, but that momentum sadly faded. Now, a decade later, it's back – and stronger than ever.

Today, the conversation has fundamentally shifted. It's no longer just 'what are we building?', but 'why now? This global commitment, fuelled by the energy crisis, net zero targets and the imperative for clean, affordable, secure and resilient energy, suggests the current momentum is here to stay. We're witnessing nations commit to tripling nuclear energy, financial institutions seeing nuclear as an investable sector, and tech giants like Google and Microsoft partnering to deploy nuclear solutions.

With the world watching, now is our time to deliver.

But this sheer demand raises a vital question: Can we actually manufacture all required components at scale? Think beyond the reactor pressure vessel, consider the kilometres of piping, thousands of pumps and valves that would be needed to construct every new reactor.

Delivering on time and within budget isn't just about efficiency; it requires a crucial shift towards digital technologies and 'fast-follower' approaches – quickly applying lessons learned from other sectors. This is precisely what we're doing at the AMRC.

Our work demonstrates how advanced manufacturing technologies are making the UK's nuclear ambitions a reality. We stand at the forefront, supporting the sector with innovative manufacturing and material methods, such as electron beam welding (EBW), powder metallurgy hot isostatic

pressing (PM HIP), additive manufacturing, cold spray and diode laser cladding (DLC).

For example, EBW, an autogenous method requiring no welding wire, significantly reduces material usage, heat input, distortion, energy consumption and carbon dioxide emissions.

Another technology, PM HIP, is for large, high-integrity components. This method addresses the challenge of expanding the supply chain beyond traditional forging and casting, which often face long lead times and limited availability – offering a vital alternative manufacturing route for critical components.

Our project with the U.S. Department of Energy and Electric Power Research Institute to reduce nuclear pressure vessel manufacturing time for SMRs is a powerful example of advanced technology in nuclear.

The results are transformational. Utilising techniques like electron beam welding and diode laser cladding, we cut production time by 50 per cent, cost by 40 per cent and slashed the lead time from 2.5 years to under 12 months.

For the lower assembly of the vessel, using just two EBW welds, we reduced welding time from 538 hours to 5.4 hours. Energy usage plummeted from 3,200 to 170 megajoules, a 174 kg CO₂e reduction, and material usage was cut by 584 kilograms.

For the two-meter diameter upper assembly demonstrator, we anticipate further reductions in machining time, energy and emissions, material usage and welds and inspection, and expect to share

results in 2026. This vessel serves as a vital demonstrator, de-risking the adoption of these processes for other critical plant items like pipes and valves.

How do these innovations fit within industry standards and regulatory frameworks? Integrating these advanced methods into established codes and standards is a significant part of our work. The AMRC engages with international bodies like the American Society of Mechanical Engineers, who are strategically incorporating advanced manufacturing.

Equally, the role of regulators is crucial in ensuring safe technology adoption. The AMRC regularly engages with UK regulators, including the globally recognised Office for Nuclear Regulation, which leads international collaborations to streamline regulations for advanced manufacturing and materials. Such collaboration between research, industry and regulators is vital for truly accelerating the delivery of the UK's nuclear future.

My message to UK manufacturing, particularly those navigating declining industries or grappling with rising material costs, is clear: demand is coming rapidly.

Whether from nuclear, hydrogen or other energy sectors, the need for components is immense. And those ready to embrace advanced manufacturing technologies will discover incredible opportunities.

To become preferred domestic suppliers, we must invest in digital methods and advanced manufacturing now. This commitment will allow us to build the critical components that power Britain's clean energy future.



“This global commitment, fuelled by the energy crisis, net zero targets and the imperative for clean, affordable, secure and resilient energy, suggests the current momentum is here to stay.”

Charles Carpenter, head of research, University of Sheffield AMRC nuclear manufacturing group.

Rolls-Royce SMR will build Britain's next generation of nuclear power plants

By Mrudula Jadhav

The University of Sheffield AMRC has welcomed news that Rolls-Royce SMR has been selected as the preferred bidder to partner with Great British Energy – Nuclear to develop small modular reactors for the UK.

The announcement from the government in June this year confirmed Rolls-Royce SMR as the selected technology for the UK's next generation of nuclear power stations, subject to final government approvals and contract signature, which the British company says will create thousands of jobs, boost the supply chain and create growth for the economy.

The AMRC is a key partner in helping Rolls-Royce SMR develop a factory-manufactured nuclear power station, using its research expertise to create an advanced manufacturing process for mechanical, electrical and plumbing (MEP) modules, incorporating Industry 4.0 technologies.

Ben Morgan, interim chief executive officer at the University of Sheffield AMRC, said: "We're absolutely delighted that our friends at Rolls-Royce SMR has been selected for Great British Energy – Nuclear. This is a truly fantastic outcome, representing a powerful signal to the world that our nation is committed to a clean, secure energy future, and shows global investors that Britain is building and providing a massive opportunity for manufacturers and those seeking high-skilled jobs.

"The University of Sheffield AMRC, which is part of the High Value Manufacturing Catapult, has been actively working with Rolls-Royce SMR for many years to solve the complex manufacturing challenges central to their SMR design.

"Rolls-Royce SMR's selection is a brilliant illustration of how strategic innovation, collaborative research and a shared vision

can not only accelerate technological development, but also unlock monumental industrial opportunities for the UK. The AMRC is proud to be at the forefront of the industrial renaissance with Rolls-Royce SMR."

The new era for nuclear energy in the UK comes after a two-year selection process in which Great British Energy – Nuclear assessed leading technologies from around the world. Rolls-Royce SMR is now progressing through the final stage of the assessment by the UK nuclear industry's independent regulators – further ahead than any other SMR technology.

Rolls-Royce SMR chief executive, Chris Cholerton, said: "This is a day to celebrate a milestone achievement. This success is testament to our incredible team, which has developed a world-leading technology and worked tirelessly over the last two years to ensure we could provide a winning tender to GBN.

"As well as delivering affordable, clean energy to support our nation's energy independence, deploying three of our units will drive domestic growth by creating thousands of highly skilled, well-paid jobs and supply chain opportunities. We are the only SMR company with multiple commitments to build projects in Europe, testament to our differentiated design and compelling offer".

Rolls-Royce SMR has already been selected by leading European utility, ČEZ, to deliver up to three gigawatts of electricity in the Czech Republic. Further success at home will support success in a range of international markets – including potentially in Sweden, where Rolls-Royce

SMR is in the final two SMRs in their technology selection process.

Chancellor of the Exchequer, Rachel Reeves, said: "The UK is back where it belongs, taking the lead in the technologies of tomorrow with Rolls-Royce SMR as the preferred partner for this journey.

"We're backing Britain with Great British Energy – Nuclear's ambition to ensure 70 per cent of supply chain products are British built, delivering our Plan for Change through more jobs and putting more money in people's pockets."

As part of the government's modern Industrial Strategy to revive Britain's industrial heartlands, the government is pledging over £2.5 billion for the overall small modular reactor programme in this Spending Review period – with this project potentially supporting up to 3,000 new skilled jobs and powering the equivalent of around three million homes with clean, secure, homegrown energy.

The biggest nuclear rollout for a generation will support the clean power mission – boosting energy security and protecting families' finances. Great British Energy – Nuclear is aiming to sign contracts with Rolls-Royce SMR later this year and will form a development company.

Great British Energy – Nuclear will also aim to allocate a site later this year and connect projects to the grid in the mid-2030s. Once small modular reactors and Sizewell C come online in the 2030s, combined with the new station at Hinkley Point C, this will deliver more nuclear to the grid than over the previous half century.

AMRC to fuel zero-emission flight with £1.3m ATI funding

By Mrudula Jadhav

The University of Sheffield AMRC is part of a new groundbreaking £17 million programme to fast-track the development of a new zero-emission hydrogen fuel cell system that could be powering commercial aircraft within the decade.

Project HEIGHTS is a three-year programme that aims to develop Intelligent Energy's (IE) current 300kW modular aviation fuel cell platform, IE-FLIGHT™ 300, for next-generation aircraft. The AMRC has secured £1.3 million in funding from the Aerospace Technology Institute (ATI) as part of this wider initiative.

The project consortium, steered by IE, a leading UK hydrogen fuel cell manufacturer, is a collaboration

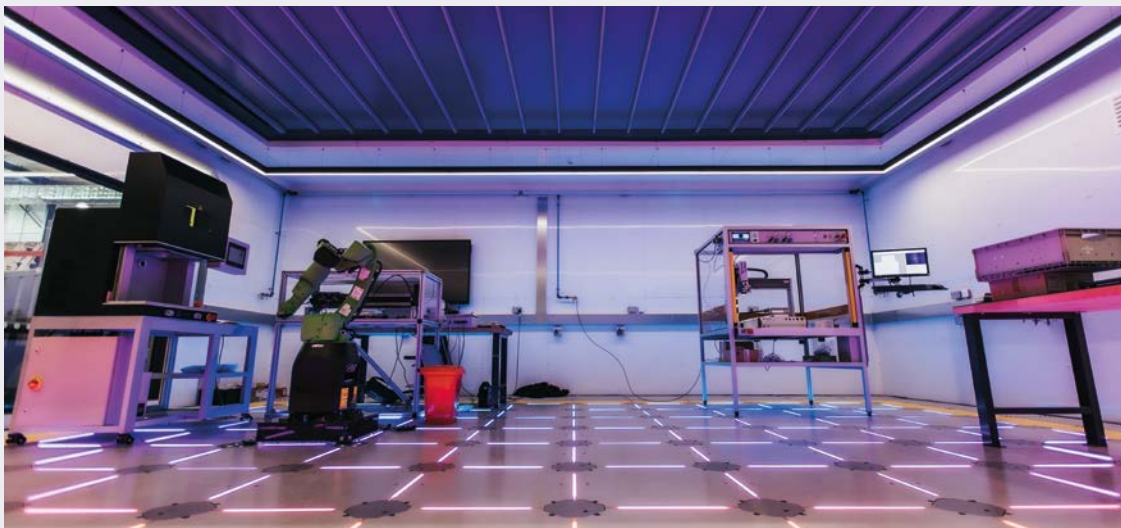
involving the AMRC, Qdot Technology, the Manufacturing Technology Centre and several supply chain businesses.

The AMRC, part of the High Value Manufacturing Catapult network, will provide its extensive expertise in hydrogen propulsion, advanced design and simulation and high-performance electrical machines, to support mass reduction and optimising manufacturing processes for Intelligent Energy's novel evaporatively cooled fuel cell system.

Initial applications of the technology include electric vertical take-off and landing (eVTOL) aircraft and short-range commuter planes.

The new fuel cell system is expected to enter early service in normal, utility, acrobatic and commuter aircrafts by the end of the decade, with scale-up plans targeting larger transport category regional aircrafts from the mid-2030s.

James Hunt, future propulsion lead for the AMRC, said: "When Intelligent Energy



The project will leverage the Hydrogen Electric Propulsion Systems (HEPS) testbed at AMRC Cymru to optimise the fuel cell stack assembly processes, ensuring efficiency and scalability.

approached the AMRC about project HEIGHTS, we saw a pivotal opportunity to leverage the investments we've made in cutting-edge technology specifically aimed to address the challenges to decarbonising transportation."

The AMRC's contributions will focus on critical areas, utilising its state-of-the-art facilities and expertise:

- **Hydrogen Electric Propulsion Systems (HEPS) testbed at AMRC Cymru.** The capability will be crucial for optimising the fuel cell stack assembly processes, ensuring efficiency and scalability.
- **Design and manufacturing of a high-speed electric motor.** Building upon the foundations established through the EPSRC-funded Future Electrical Machines Manufacturing (FEMM) hub, the AMRC will develop a high-speed electric motor for the compressor, a vital component in the fuel cell system.
- **Design and simulation.** The AMRC will help optimise the design and manufacture of some of the key sub-system elements of the fuel cell system, ensuring maximum efficiency and performance.

Project HEIGHTS addresses a key challenge in traditional fuel cell systems – how to keep the fuel cells at the correct operating temperature without introducing significant drag in cooling systems. In aviation particularly, minimising the heat exchanger size is critical to reduce mass and drag, and to optimise overall efficiency.

IE's patented direct water-injection technology uses air-cooled condensers with a 20–30 per cent smaller frontal area than rival liquid glycol radiators. Project HEIGHTS will develop this novel cooling method further to achieve an additional 30–40 per cent cut in heat exchanger size with support from partners.

James added: "This transformative work is happening right here in the UK, fostering new, high-value supply chains and creating skilled jobs. It is absolutely crucial for the UK to solidify its leadership in hydrogen fuel cell-



The project will leverage the Hydrogen Electric Propulsion Systems (HEPS) testbed at AMRC Cymru to optimise the fuel cell stack assembly processes, ensuring efficiency and scalability.

powered flight, and projects like HEIGHTS are central to achieving that ambition.

"This collaboration is not just technical; it's about actively pioneering the pathway to zero CO₂ emission flight in commercial aviation."

David Woolhouse, Intelligent Energy chief executive officer, said: "This is about getting hydrogen-powered aircraft in the air, and into service at scale, as quickly as possible. We firmly believe that hydrogen will be the primary energy source for flight, initially for smaller aircraft but eventually in the longer term for everything that flies.

"At Intelligent Energy, we have the IP built on 24 years' experience to give us confidence we can be the technical leader in this sector. This project supports us making our modular system even smaller, lighter and more scalable."

The investment comes as aviation faces rising pressure to cut emissions. Batteries remain constrained by weight

and range, while hydrogen-electric propulsion is gaining traction as a cleaner, scalable alternative.

Jacqueline Castle, chief technology officer at the Aerospace Technology Institute, said: "Hydrogen as a fuel source is an essential part of the ATI's technology roadmaps for future power and propulsion systems.

"We are delighted to be supporting Intelligent Energy's HEIGHTS programme, which builds upon its prior expertise in fuel cell development to encompass novel means of addressing thermal management challenges associated with aircraft integration.

"The ATI's FlyZero project identified the need for high-temperature fuel cell systems and world-class expertise on thermal management within the UK. This project brings the two together to develop what we expect to be a compelling, power dense solution for zero-carbon flight."

"This collaboration is not just technical; it's about actively pioneering the pathway to zero CO₂ emission flight in commercial aviation."

James Hunt, future propulsion lead, University of Sheffield AMRC.

From the AMRC to Tennessee: Kairos Power successfully installs reactor vessel fabricated in South Yorkshire

By Mrudula Jadhav

A test unit small modular reactor (SMR) vessel, fabricated in partnership with the University of Sheffield Advanced Manufacturing Research Centre (AMRC) and Cambridge Vacuum Engineering (CVE), has been successfully installed by the US-based nuclear energy company, Kairos Power, at its USA campus in Tennessee.

The 14-foot-high reactor vessel is the central component in Kairos Power's non-nuclear reactor mockup, and its installation marks a significant milestone for the US-based company in the construction of its third Engineering Test Unit (ETU 3.0).

Supported by the US Department of Energy, Kairos Power is using its Engineering Test Unit programme to validate a safe, cost-effective pathway for the future deployment of advanced nuclear reactors in the United States.

Leveraging industry and academic partnerships, Kairos is piloting the use of innovative engineering techniques and construction processes that can help lower costs and accelerate production timelines for a future commercial fleet of SMRs that will support the clean energy transition in the United States of America.

The University of Sheffield AMRC brought its unique expertise and capability to the ETU project, integrating various advanced manufacturing technologies under one roof – including CVE's advanced welding technology. The AMRC's capability to manage machining, welding and

inspection in a single location allowed for the fabrication of a complete vessel, rather than individual parts, proactively addressing potential future issues.

Ben Morgan, interim chief executive officer at the University of Sheffield AMRC, said: "Large demonstrators like the ETU 3.0 reactor vessel are vital for effectively bringing advanced manufacturing methods into industry, offering a holistic solution for fabricating complex, large-scale components.

"The collaborative efforts of CVE, Kairos Power and the AMRC in addressing the complexities of welding, fixturing, machining and inspection for ETU 3.0 will undoubtedly accelerate the deployment of advanced nuclear technologies for clean, affordable and secure power."

The ETU 3.0 reactor vessel was fabricated using a cutting-edge electron beam welding technology from CVE, which produces high-quality welds at least an order of magnitude faster than conventional arc welding. For example, welds that previously took one week during the fabrication of the ETU 2.0 vessel were completed in approximately ten minutes for ETU 3.0.

Bob Nicolson, CVE managing director, said: "Our collaboration with Kairos Power and the team at the AMRC underscores the transformative potential of electron beam welding in advanced manufacturing. The technology scales well to the precise and demanding requirements of nuclear construction, and this partnership represents a significant step forward in SMR commercialisation."

The ETU 3.0 project allowed Kairos Power to evaluate the use of electron beam welding to enable faster, more cost-effective production of reactor vessels with precise tolerances for its future commercial fleet.

Craig Gerardi, vice president for manufacturing at Kairos Power, said: "The ability to test innovative production methods using full-scale non-nuclear hardware is a game-changer for Kairos Power.

"Collaborating with CVE and the AMRC let us rapidly gain hands-on experience with electron beam welding that could transform how we deliver reactors for customers."

Beyond its manufacturing innovations, the ETU 3.0 facility will serve as a vital



The University of Sheffield AMRC brought its unique expertise and capability to the ETU project, integrating various advanced manufacturing technologies under one roof – including CVE's advanced welding technology.

proving ground to refine civil construction methods and quality assurance procedures for the Hermes Low-Power Demonstration Reactor, and will ultimately support the Hermes reactor as an operator training centre and test platform for remote handling and maintenance equipment.

Edward Blandford, chief technology officer and co-founder of Kairos Power, said: "The installation of our third ETU reactor vessel marks a significant moment on our commercial development pathway.

"ETU 3.0 will serve an important mission as a testing and training platform to ensure safe and efficient operations for the Hermes reactor. But, more broadly, the expertise and capabilities we gain from the ETU programme will help pave the way to successfully deploy Kairos Power's commercial fleet."

The facility will help improve operator safety and reduce downtime by prequalifying procedures for maintaining and replacing high-temperature reactor systems and components. Capabilities

to be tested will include shielded component transfer systems, heavy-lifting and positioning systems, and remote vision, control and feedback.

The ETU 3.0 building will also house a modular systems facility where plant equipment modules for ETU 3.0 and the Hermes reactor will be staged, assembled and tested prior to installation. The modular reactor construction methods being piloted with the ETU series and Hermes will be foundational to reducing construction costs and timelines for future plant deployments.

"The ability to test innovative production methods using full-scale non-nuclear hardware is a game-changer for Kairos Power. Collaborating with CVE and the AMRC let us rapidly gain hands-on experience with electron beam welding that could transform how we deliver reactors for customers."

Craig Gerardi, vice president for manufacturing, Kairos Power.

Turning the tide on power generation

By Lucy Hilton

AMRC Cymru has teamed up with the Welsh Government to develop the next generation of tidal stream turbine blades.

Collaborating with Menter Mon and the Offshore Renewable Energy (ORE) Catapult's Welsh team, the Blades Tidal Energy Mill 2.0 (BLATEM 2.0) project looks to improve the efficiency, durability and overall performance of tidal energy blades, with the potential to transform the tidal energy industry.

The project is one of five to receive a share of £1 million from the Welsh Government as part of the VInnovate programme, which is run by the Vanguard Initiative (VI) to promote collaborative innovation across industrial regions in Europe, with a focus on small-to-medium-sized enterprises (SMEs).

Andy Billcliff, chief executive at Menter Môn Morlais, sees the project as a key investment to drive growth for Wales. He said: "This project promotes international collaboration and supports long-term economic benefits for Ynys Môn, in terms

of jobs, skills, innovation and clean energy. It's a step towards making tidal a reliable, scalable part of our net zero future in Wales."

Also involved in the project are two Galician firms – Magallanes Renovables, a marine renewable energy infrastructure manufacturer, and D3 Applied Technologies, a research organisation specialising in the fields of aerodynamics and hydrodynamics.

For Alejandro Marques de Magallanes, chief executive officer of Magallanes, the BLATEM 2.0 project represents a significant step forward in the refinement of Magallanes' commercial tidal device, the ATIR 2.0. He said: "It will allow us to strengthen strategic collaborations with both national and international partners, reinforcing Magallanes' role in a growing global ecosystem and positioning us at the forefront of cutting-edge tidal technology.

"By advancing a fully validated, next-generation tidal technology, this project brings us closer to unlocking a long-underused renewable resource – paving the way for a resilient, sustainable and transformative new energy sector."

AMRC Cymru, alongside Menter Mon and the ORE Catapult, will be supporting Magallanes in a review of their current design process, looking into more sustainable composite materials, as well as the decommissioning process and manufacturing layout.

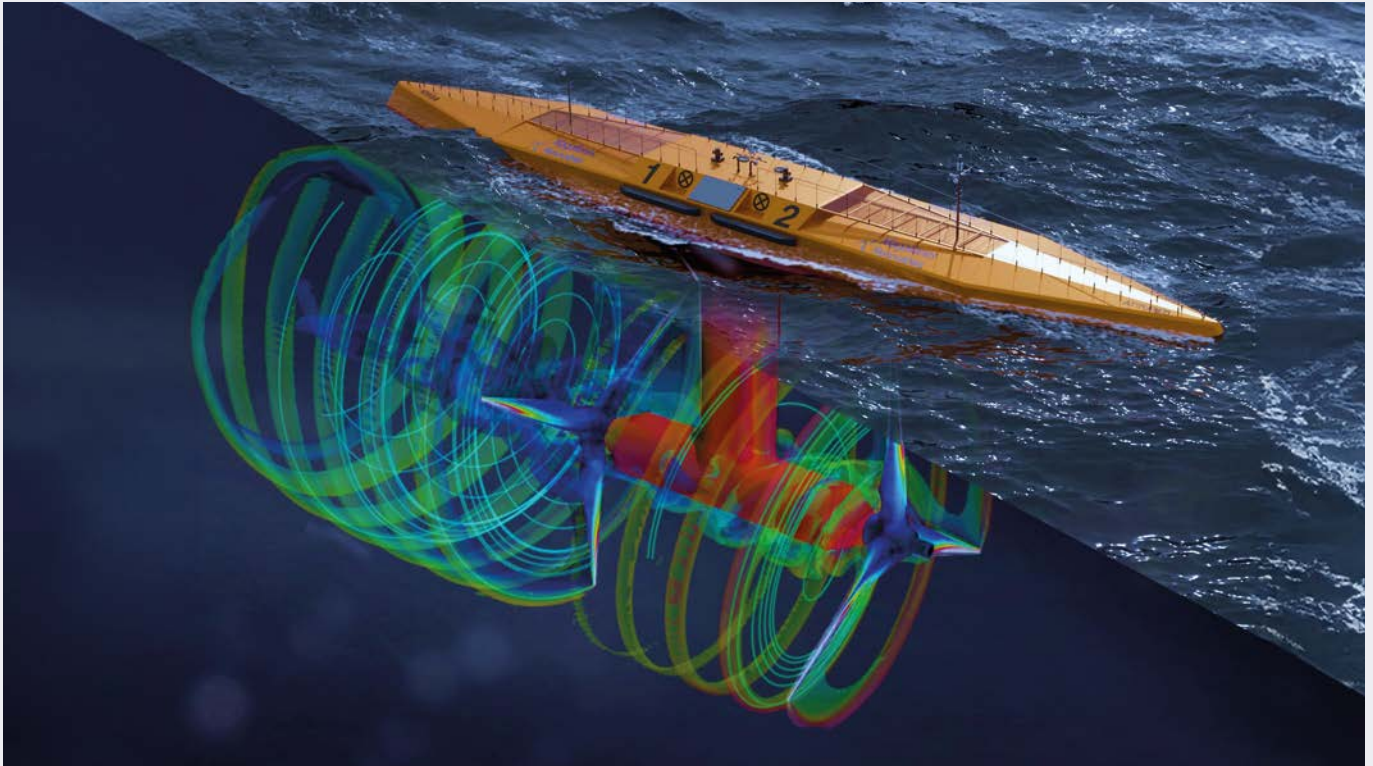
Andy Silcox is interim chief technology officer at the AMRC, which is part of the national network of High Value Manufacturing Catapult research centres. He said: "Wales is already recognised as a trailblazer in the establishment of tidal energy sites, and a hub for cutting-edge marine energy research, contributing its extensive knowledge and experience.

"This collaboration between AMRC Cymru, the Offshore Renewable Energy Catapult and Menter Mon will create a strategic partnership among the regions of Wales and Galicia, bringing together a unique blend of expertise and innovation in the field of renewable energy.

"Supporting the design and development of the newest tidal turbine blades, the project will lay the groundwork

"The project will lay the groundwork for a lasting collaboration, driving future innovations and projects in renewable energy."

Andy Silcox, interim chief technology officer, University of Sheffield AMRC.



ATIR 2.0, Magallanes' world's first future tidal energy converter.

for a lasting collaboration, driving future innovations and projects in renewable energy to contribute to a more sustainable energy landscape.”

Projects anchored in Wales received the highest share of funding in the 2024 VInnovate funding tranche, more than any other region. Welsh SMEs and organisations are now being invited to apply for VInnovate 2025 funding.

Rebecca Evans, the Welsh Government’s Cabinet Secretary for Economy, Energy and Planning, said: “Wales’ research and development sector is internationally renowned, with academia, industry and government working together to deliver big leaps in renewable energy innovation in particular.

“This culture of innovation has been championed and guided by our Wales Innovates strategy, laying the foundations for a green and prosperous future for Wales, driven by collaborative innovation and new technologies that can have a real and lasting positive impact on every part of our society.

“I encourage organisations to seize the opportunities presented by programmes such as this to think big, collaborate internationally and further strengthen our innovation ecosystem and advanced manufacturing capabilities.”

“This project brings us closer to unlocking a long-underused renewable resource – paving the way for a resilient, sustainable and transformative new energy sector.”

Alejandro Marques de Magallanes, chief executive officer, Magallanes.



ATIR 2.0, Magallanes' world's first future tidal energy converter.

Building an accessible future in immersive technologies

Interoperability – the ability to work together with other systems or pieces of equipment – is only achievable if everyone works to the same standards. But how do we decide those standards? **Sharan Kaur, cognitive robotics and automation lead at AMRC Cymru**, is at the forefront of that very challenge as the new chairperson for the British Standards Institution (BSI) immersive technologies committee, where she represents the UK's contributions at an international level.



Sharan Kaur, cognitive robotics and automation lead at AMRC Cymru.

Advanced manufacturing is about innovation; novel ideas, research and new concept technologies that haven't been tried and tested yet. But there has to be a balance. The International Organisation for Standardisation's ISO standards set out rules and guidelines to be used when developing new technologies and processes. They allow industry to follow the same approach, saving time by working collaboratively, and making technologies work together.

There's a danger in holding back our own advancement if everyone works individually; we'd be repeating the same work. That's why standardisation,

and international committees like the BSI, are particularly important for the advancement of immersive technologies. Getting diverse views from across academia, industry and technology providers, internationally, gives us the space and time to focus on the future.

There is, of course, always more than one way of doing something. But by defining a standard or standardised approach, we're allowing interoperability, where systems or equipment are able to work together, and giving people back the time to focus on the innovation, rather than repeating work that has already been done – and

done well. Interoperability makes innovation a more streamlined process.

For metaverses, a shared virtual world in which users can interact, interoperability is a big issue; they're only useful if everyone gets these technologies working in the same way. Post-Covid, with the rise of hybrid working and international collaborations, virtual reality (VR) is moving away from being a gimmick as it has become more accessible, with improved technology and lower costs. As more people are able to use these systems, and a mix of systems, interoperability is non-negotiable. Standardisation here means your

representation can work across multiple formats and systems, whether on screen or through earphones, a desktop monitor or a VR headset.

Bridging the gap between research and standardisation

There are lots of immersive technologies, like metaverses, that have a huge amount of applications – teleoperations, telepresence, virtual reactions. This is where my PhD research leans into my new chairperson role. Part of my research is around digitalising human states, and representing humans digitally, both physically and cognitively. It's historically been difficult to have a representation that is true; typically based purely on height and not considering mobility and individuality of people.

We need to move away from the one-size-fits-all approach, into customised digitalisation, to make these virtual environments more effective, immersive and comfortable. This customisation creates a much more accessible system. If you're represented better, particularly during, for example, joint tasks across the world, your performance would be more seamless.

There's a lot of really good work happening in interoperability, its technical aspects and its integration – the human representation and accessibility is a newer side that I'm really passionate about. Because technology should be inclusive. Anyone should be able to go up to a system and be able to use it, or have a way to adapt it for their use. The AMRC is doing powerful virtual reality work, showing that

the world can adapt to individuals; why not have standard accessibility requirements?

Making systems interoperable, and making interoperable systems accessible

We have to have responsibility in what we do. When people introduce a robot to help with repetitive strain, they're alleviating the physical burden, but potentially adding to the mental burden – removing physical tasks might change someone's job entirely, and instead introduce cognitive overload. Similarly, if we're automating a task, and introducing more mental tasks in its place, are we creating too much of a cognitive load?

It's difficult to include things like cognitive load when you're looking at metrics to measure someone's performance, but my research at the AMRC has been looking at digitalising human states, including the mental aspect as much as the physical when representing people as part of a system. Cognitive load is less straightforward to measure, and also depends on individual preferences and ways of working; it's simpler to capture machine performance data.

With innovation like immersive technologies, we can build accessibly and inclusively from the very beginning. A lot of work in ergonomics has been done around height and body proportions, but ignoring mobility, so the work I'm doing includes mobility using motion capture. If everyone used an accessible approach in their virtual environments, virtual worlds – which we have full control over – would be adapted to mobility.

In my biometrics work, it's important to understand what type of sensors will work for which type of person. Someone who is neurodivergent might not express facial expressions in the same way as others, so whilst facial expression analysis is useful, more is needed. A heart rate measurement to monitor stress might show similar rate variability with excitement. Using analyses in conjunction with one another provides more context; combining them helps you understand.

This is why I'm also looking at machine learning and artificial intelligence (AI) modelling for individual profiles. This method means people don't have to wear sensors all the time, but can go through a model so that a machine, robot or any digital interface can understand how the individual works. With a digital representation of a person, we can instead

“With innovation like immersive technologies, we can build accessibly and inclusively from the very beginning.”

Sharan Kaur, cognitive robotics and automation lead, AMRC Cymru.



Sharan Kaur using AMRC Cymru's extended reality and motion capture equipment.



Sharan Kaur with WMG's Professor David Greenwood and HVM Catapult's Katherine Bennett at HVM Catapult Baglan.

get the machine to predict outcomes. It's an involved process to consider an individual, see what task they're doing, identify the right sensors – with the power of machine learning and modelling, we only have to go through that process when renewing or updating the model.

It's beginning a lean towards improving social sustainability, which is often overlooked in comparison to environmental sustainability. Individualised support is the approach that's needed, and what we should care about, especially when considering matters of safety. Risk assessments, for example with robotics, look at general guidelines of height, but someone else's chest height could be another's head height.

The cost of individualisation is complex, because it can have long-term benefits. On a national level, there are a lot of preventable workplace injuries, both physical and mental, which add a financial burden. At a business level, legal claims for preventable injuries could be reduced by individualisation; if physical and mental health are more considered, there can be an increase in comfort, productivity and efficiency. Challenges also come with healthy ageing. Whilst there are a number of government initiatives supporting healthy ageing, the majority combat issues when they have already occurred, but prevention is always the best way.

“What makes the AMRC really powerful is its existence in the space between academia and industry.”

Sharan Kaur, cognitive robotics and automation lead, AMRC Cymru.

Keeping staff happy and healthy at work can improve staff retention and quality. It's not generating more money in the short term, but it prevents the hidden costs associated; training new staff, exit interviews, recruitment. We can look at the root of a problem being a human-centred issue – if a process is being automated because a company is finding it difficult to maintain skills, why are they finding it difficult? If it's difficult because of staff retention issues then that is the part to fix; the question isn't 'how do we make this faster', it's 'why do we need to make it faster?'

Working at the AMRC, I have an interdisciplinary mindset because we have the advantage of working across a number of different sectors, and can see translatable learnings. If you're developing a technology, and only looking at your applications or what you're familiar with, you could be closing doors in the future. That's where it's incredibly beneficial to be part of

committees. Where we have new emerging technologies, we can see what people are thinking about in the next ten to 20 years, and the standards change with them; they're constantly reviewed and updated.

What makes the AMRC really powerful is its existence in the space between academia and industry. In my chairperson role, I need to balance these views, and I already have an appreciation of both sides; we want things to be open enough to innovate, but closed enough to remain robust and usable. That balance will be one of the biggest challenges in immersive technologies; freedom within structure and accessible boundaries.

The future of immersive technologies is ready to be shaped by us; through standards, through accessibility. The best way to play your part in that future is to get involved. Apply to be a committee member, feedback on any documents and publications the committees release, and help build a future that's accessible to all.

AMRC spin-out company set to revolutionise advanced manufacturing

By Katia Harston

Silicon Valley veterans have partnered with the University of Sheffield AMRC and one of its leading industrial research fellows to launch DigitalCNC, a groundbreaking AI-driven precision manufacturing software company that promises to revolutionise industry.

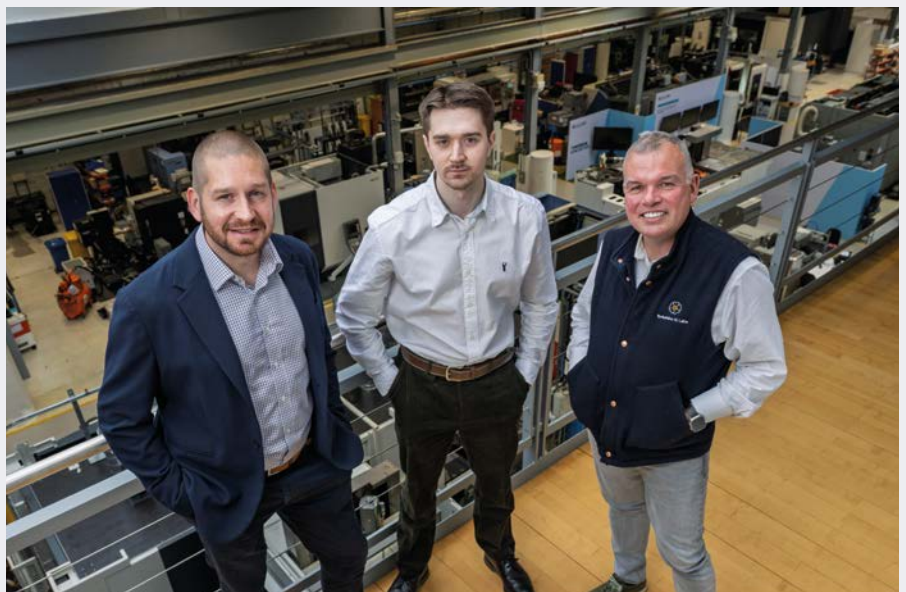
Yorkshire AI Labs has teamed up with Dr Rob Ward to back the innovative AMRC spin-out venture, which represents a significant leap forward in applying artificial intelligence (AI) technologies to the manufacturing industry – reinforcing Sheffield’s status as a global centre of industrial innovation.

DigitalCNC is set to transform precision manufacturing by leveraging cutting-edge AI technologies to dramatically improve quality, efficiency and productivity. Its pioneering solutions have already drawn strong interest from leading aerospace manufacturers, including Rolls-Royce and Boeing.

Dr Rob Ward, who holds a joint academic position between the University of Sheffield School of Electrical and Electronic Engineering and the AMRC, is chief executive officer of DigitalCNC.

He said: “DigitalCNC represents the culmination of years of research and development in artificial intelligence and advanced manufacturing. With my chief technology officer, David Wilkinson, we have taken our fundamental research and transformed it into an industry-ready product, which has already seen tangible benefits to UK manufacturing.

“Partnering with Yorkshire AI Labs to co-found DigitalCNC was the smart



Dr Rob Ward, David Wilkinson and David Richards.

choice, bringing together our deep expertise in AI and manufacturing with a world-class team of Silicon Valley veterans, renowned for building and scaling successful businesses.”

Yorkshire AI Labs is an ensemble of Silicon Valley luminaries that specialises in nurturing early-stage tech companies by combining strategic investment with

practical expertise. Its involvement in DigitalCNC underlines its commitment to fostering technological innovation in the Yorkshire region.

David Richards, co-founder of Yorkshire AI Labs and a technology entrepreneur with a 25-year career in Silicon Valley, said: “DigitalCNC is built upon rigorous academic research, sophisticated mathematical

modelling and real-world validation by the University of Sheffield AMRC.

“Dr Rob Ward’s globally-recognised expertise in machining science and control engineering is central to this pioneering venture.

“We are proud to support such innovative initiatives that reinforce Yorkshire’s position at the forefront of global technology developments.”

DigitalCNC’s advanced technology has been extensively developed and validated through many years of collaborative research and development with the AMRC, renowned internationally for its excellence in translational manufacturing research, and with the School of Electrical and Electronic Engineering, which has been the world leader in control and systems engineering for more than 50 years.

Its core engine is a digital computer numerical control (CNC) system that operates entirely within the computer-aided manufacturing (CAM) environment, providing kinematic insights for manufacturers to view and optimise machine-specific toolpath performance in the digital space.

The software includes a cycle time optimiser, which delivers instantaneous cycle time optimisations, and a toolpath analyser, which provides graphical insights into achievable feed rates and tool centre point (TCP) positions. It also offers a machine comparator to help users choose the best machine for a toolpath-machine combination, enabling better resource allocation and capital investment decisions.

Professor Ben Morgan, interim chief executive officer at the University of Sheffield AMRC, said: “DigitalCNC’s launch is testament to Rob’s innovative work in the field of artificial intelligence, and to the extensive opportunities South Yorkshire offers as a site of regional growth.

“The AMRC and the University of Sheffield both champion this kind of innovation-led growth, knowing the value of region-based capability to make South Yorkshire even more competitive in the advanced manufacturing sector.



Dr Rob Ward and David Wilkinson.

“The impact which spin-outs like DigitalCNC can have spans beyond their regions too, positioning Sheffield further at the forefront of the UK’s globally-orientated innovation capabilities.”

Professor Ashutosh Tiwari, deputy vice-president for innovation at the University of Sheffield, said: “Sheffield’s position as a global centre for manufacturing innovation, along with the strength of our support for commercialisation of research, continues with DigitalCNC.

“As a University of Sheffield spin-out, it demonstrates our commitment to turning world-class research into real-world impact. DigitalCNC is poised to transform advanced manufacturing worldwide by applying cutting-edge AI to drive greater productivity, operational efficiency and global competitiveness at scale.”

Since its launch in June, DigitalCNC has continued to make strides in its commercialisation journey, with a team now including dedicated software developers, sales professionals and interns from robotics and autonomous manufacturing systems labs, with

Professor Keith Ridgway, who helped to found the AMRC, joining as chair.

Speaking about Keith’s appointment, Rob said: “Professor Ridgway’s extensive experience and leadership will be invaluable as we continue to grow and develop our product and company.”

The team has also expanded its offering beyond aerospace machining, and is currently undertaking proof-of-value trials with a range of manufacturers to demonstrate the tangible benefits of its software in improving productivity, accelerating time to market and reducing manufacturing costs cross-sector.

“Our solution is secure, on-premise and integrates seamlessly with CAM systems such as Siemens NX, CATIA and Autodesk Fusion 360. All analysis is performed offline, ensuring no machine downtime or interruption to production,” added Rob.



Find out more
about DigitalCNC

“We have taken our fundamental research and transformed it into an industry-ready product, which has already seen tangible benefits to UK manufacturing.”

Dr Rob Ward, chief executive officer, DigitalCNC.

Digital thread: why should you care?

Ignoring the digital thread could leave you behind the curve on data reporting, product development and regulatory compliance, **writes Gavin Hill, senior theme lead for digital at the University of Sheffield AMRC.**

Adopting digital thread technologies empowers manufacturers with faster product development, real-time efficiency gains, proactive quality control, regulatory compliance and supply chain resilience. It drives customer satisfaction, sustainability and competitive advantage, while avoiding costly disruptions and inefficiencies.

But how does the digital thread deliver these outcomes?

Depending on your mindset, you may look at the digital thread as an opportunity or a threat. For the early adopters it poses a competitive advantage, as the availability of data allows you to offer unparalleled visibility and confidence to your customers and supply chain. It gives you the information you need, providing data immediately, to pinpoint issues and make fast decisions to optimise your business output.

Utilising the digital thread can provide not just data, but contextual insight to both your internal stakeholders and customers. Instead of telling customers their order will be with them in ten days due to a production delay, you can access granular

updates to help them understand why that delay exists, providing them with options to mitigate knock on effects.

For example, if my heat treatment system broke and it's going to delay delivery of a product to you by a few days, by enacting a transparent digital thread, you can understand that expected delay ahead of time and change tactics. You could instead choose to receive your un-heat-treated products today, and use your own heat treatment capability instead of mine, helping you to meet customer timelines.

If you are a more risk averse organisation, preferring to follow technology adoption rather than be an early adopter, the equation looks different.

You will start to see that your customers demand data that a digital thread enables, particularly as they see other, early-adopting suppliers offering it as standard, bringing advantages to their business. You will have to either provide that data or lose business.

This will be coupled with regulatory requirements which may take you out of an industry altogether. We are already seeing this with digital product passport (DPP) regulation on battery technology expected

to be live in the European Union (EU) from February 2027, with consumer electronics, fast fashion and others set to follow. This will push wider and affect more products, industry areas and geographical regions.

Refusing to adopt the digital thread will also make it harder to report on required environmental, social and governance metrics. You will see yourself losing business to competitors because customers can get more data and insight elsewhere, potentially at a lower price, due to business optimisation activities enabled through digital thread adoption.

A holistic digital thread gives you data and insight into how your product is used in the wild, not how you think it's being used through focus groups, spot tests, or user stories. It allows you to get feedback on what your next version of that product should look like and perform. Or you could reassess safety factors of a component due to real world usage, making different versions of a product for different types of users.

For a lot of us, a more contextual description helps to hit things home. To help with that, I've created two example user stories, showing how aspects of the digital thread can be implemented to overcome current day- to-day business challenges.

A supplier who is losing business with established customers

Clara works in procurement and scheduling for your biggest customer. You have had a long standing relationship with Clara, but

“Adopting digital thread technologies empowers manufacturers.”

Gavin Hill, senior theme lead for digital, University of Sheffield AMRC.

she has been letting you know that they have lowered your net promoter score (NPS) over the last 12 months, as other suppliers have been more reactive to her requests for information. As such, she is reluctantly looking at reducing order quantity with you. You can't seem to improve your NPS using the traditional routes without incurring an additional overhead.

By embracing digital thread technology through a supply chain management software, alongside a scheduling and planning system, you could improve NPS significantly, while reducing the bottlenecks of the production process and reducing the overall team workload. The digital thread enables you to update Clara on the order status with a single click, sending automated messages at the earliest opportunity if changes to schedule occur.

As a result of your trusted relationship with Clara, you've given her access to see data about her orders herself in your system and she is happier with your service. Relationship transparency has increased and, as a result of the more automated system, both you and Clara have significantly reduced non-value added tasks, like phone calls or chasing order status'.

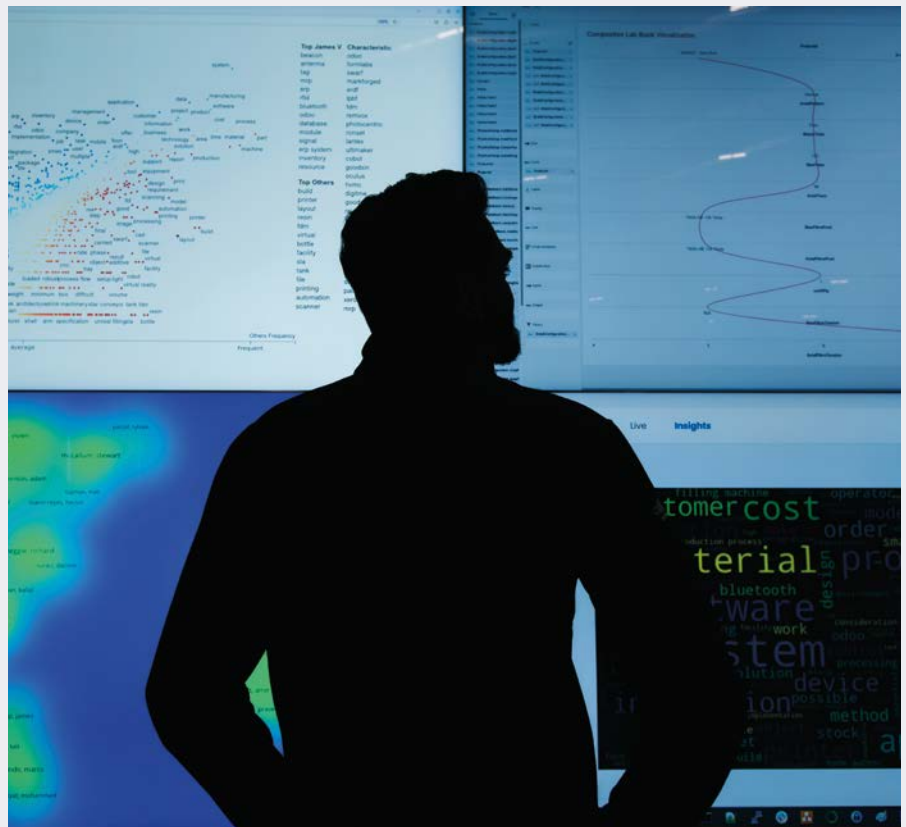
A maintenance team that is being asked to do more with less

Delores runs the maintenance team for an automotive supply chain manufacturer. Her managing director has told her to cut maintenance costs by 15 per cent this year, without increasing downtime. Delores' team is constantly busy and does routine maintenance on all machinery per the machine builders guidance, resulting in fewer unexpected downtime instances.

However, she is aware that a lot of parts her team replace have a significant amount of run time left in them – she doesn't have the information to make better decisions about when to continue running machines for longer periods between maintenance.

To solve this, she secured funding to add a maintenance management module to their existing manufacturing execution system (MES) and shop floor connectivity system. It resulted in Delores being able to understand more granular information about machine usage, like operating speed and actual runtime, rather than just using a simple hourly metric.

With this new insight, she has extended the time between scheduled maintenance for most assets – and also reduced the need for spare parts and cut down planned



The digital thread is a capability area the AMRC has been researching to help provide support to other businesses who want to learn more.

“A holistic digital thread gives you data and insight into how your product is actually used in the wild.”

Gavin Hill, senior theme lead for digital, University of Sheffield AMRC.

downtime. The team is now working less overtime, and able to keep the equipment running more efficiently.

The knowledge from a digital thread allows you to make adjustments that can result in speed and efficiency gains – while giving you insight into what you and your supply chain contribute to the story of a product.

The adoption of digital thread technologies can provide a critical strategic decision for manufacturers, presenting a choice between being proactive or reactive.

For the early adopters, it can be a powerful engine for competitive advantage. It can deliver data visibility and collaborative problem-solving, and

creates a vital feedback loop—using real-world product data to drive next-generation innovation.

However, organisations face dual pressures of losing business to more transparent competitors or being excluded from markets by looming regulatory mandates. The EU's DPP, expected from February 2027, is a clear signal that digital traceability could soon be a requirement.

Embracing this technology is the definitive path towards securing future resilience, customer loyalty and market leadership in an increasingly data-driven and regulated world.

Recycling fleet seats: sustainability in aerospace supply chains

By Lucy Hilton

Across the world, the aviation industry is looking for ways to become more sustainable. While work is advancing on in-flight emissions, from reducing aircraft weight to creating sustainable fuels, one area is often overlooked – the cabin itself. While much of the structure of an aircraft is governed by strict regulations, the interior is less safety-critical, providing an as-yet-untapped opportunity to make major improvements to the design and supply chain.

Currently, passenger seats are replaced several times throughout the life of a plane. The old seats are typically discarded, creating tens of thousands of tonnes of waste material lying in 'aircraft graveyards'. Looking at how these components can be recycled, there's a large opportunity in introducing circularity systems into the supply chain. In other words, can aircraft seats at the end of their life be recycled into new seats? And is this both feasible and economically viable?

The AMRC wanted to find out.

The design phase of a product life cycle is critical, as it is during this stage that the factors which determine environmental impact are largely set in place, so it's key to improving both operational and non-operational sustainability.

The project, commissioned by the High Value Manufacturing (HVM) Catapult, recognised the strategic importance of circularity in aerospace supply chains. Engineers at the AMRC's integrated manufacturing group designed and ran a discrete event

simulation (DES) – a computer model which tests how a new, complex system or network will work. It is a powerful tool, which can be used to evaluate the impact of making changes to the aircraft cabin supply chain over time, and takes into account many different factors, and can even include uncertainties – analysing statistically the consequences of various processes. It provides a risk-free environment to gain deep insights and to test decisions before making changes in real-life manufacturing operations.

Simulating the future

The simulation assessed and compared different ways of introducing recycling to the process of replacing aircraft seats, looking at material types, costs and quantities, and the emissions associated with producing each material.

Focusing their model on Western Europe, as there was sufficient data available through open-source databases for the aeroplane fleets across the region, the team first mapped a snapshot of the current state of play. This included how old each plane was, how the cabin of each aeroplane was configured, when the seats would require replacing, and when new seats would need to be produced to replace existing seats or be put into new aircraft. They were then able to run a simulation model for the next five years, taking into account each fleet's need for new seats and new planes, and the reverse flow of retired aircraft and overhauled cabin seats.

Starting in August 2024, the five-year simulation looked at material composition, costs and emissions. Engineers found that, due to the age

“Working on this project has shown how simulation can turn complex sustainability challenges into practical insights.”

Marco Franchino, lead engineer for manufacturing intelligence, University of Sheffield AMRC.

of the fleet and increased production levels within Airbus, there is a need for about 250,000 new seats over the timeframe. Running various scenarios using different processes, from the current situation involving no recycling to a process where a recycling centre disassembled each seat and used the materials to make new ones, different types of materials were studied, looking at how they would affect the overall process and feasibility.

At the seat recycling centre, the materials – leather, foam, plastic, fabric and aluminium – are separated and processed. Recycled materials are then delivered back to seat manufacturers,

reducing dependency on virgin raw materials. The percentage of recycled material incorporated into new seats, along with the resulting cost evaluation and emissions reductions, is all calculated within the AMRC's model.

The simulation showed that it was possible to recover enough material to account for 70 per cent of that required for new seats, reducing carbon emissions in the process by more than half. It also showed that introducing the recycling element could be as financially profitable as the current system; a result vital in encouraging the industry to make the change.

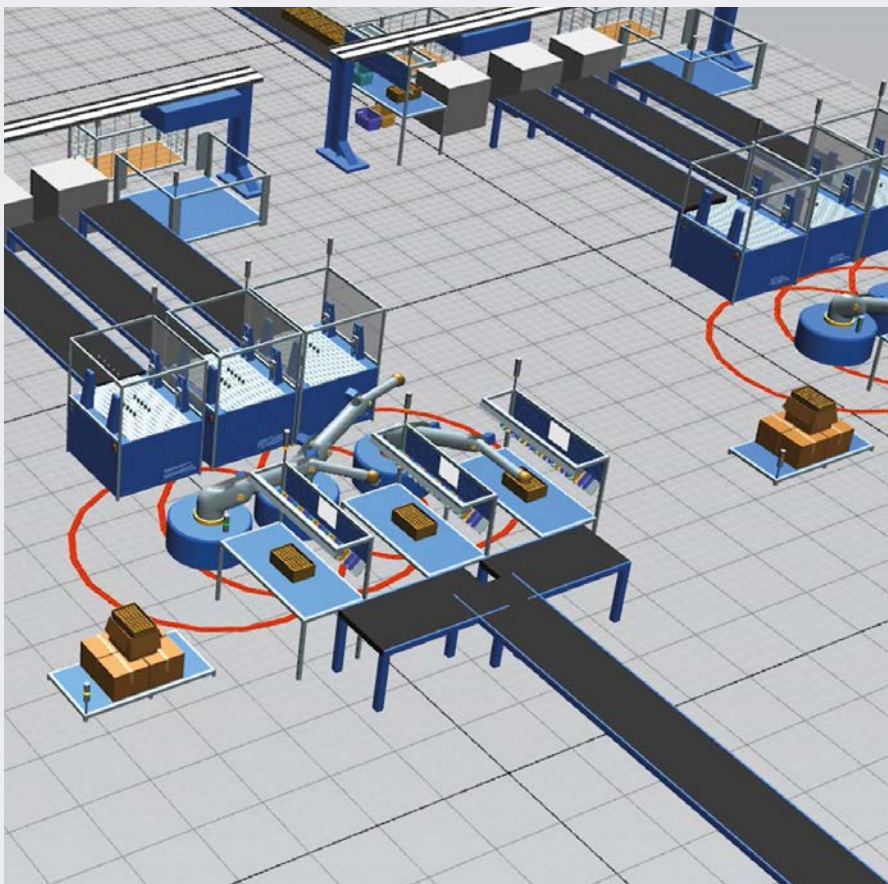
A scalable solution

Through multiple scenario variations being tested, the team were able to present the most balanced scenario, chosen based on its environmental impact and cost-effectiveness, offering the most feasible and scalable solution within the scope of the study.

The research has therefore demonstrated that aircraft seat recycling is both feasible, and economically viable, marking a significant shift in how the aerospace industry approaches sustainability and waste management currently.

The results also suggest that establishing a centralised seat recycling centre in regions like Western Europe could streamline the supply chain and increase the feasibility of circular practices within the aerospace industry.

While this kind of simulation is often used in other sectors where recycling and circularity practices are well established, like automotive, it is still novel for the aerospace industry. The International Civil Aviation Organisation has said that the circular economy is still an emerging concept for the sector, and its application is not widespread, so there is scarce availability of reliable data. By providing a data-driven decision-making tool, this study can



An illustration of a recycling centre shopfloor represented through discrete event simulation.



The model integrates key process elements such as automated conveyor systems and robotic arms to demonstrate material flow, machine utilisation and process interactions.

give the aviation sector the confidence to challenge traditional linear supply chain models, and support the transition to a circular economy in aerospace.

Global dissemination

The AMRC is now presenting its findings to its partner companies, including aerospace giants Airbus and Boeing and various seat manufacturers, as well as disseminating its findings at global conferences. The model is also on display on the AMRC Factory 2050 supply chain demonstrator wall, showcasing these insights to a wider audience, with an aim to change the way the sector plans and designs its future cabin interiors, ensuring that recycling and whole-life circularity is built into the process.

Marco Franchino, lead engineer for manufacturing intelligence at the AMRC's integrated manufacturing group, highlighted the project's potential for widespread applications. He said: "Working on this project has shown how

simulation can turn complex sustainability challenges into practical insights.

"Our model highlights not only the environmental benefits of reducing emissions through recycling, but also demonstrates a viable business case for circularity, laying the groundwork for scalable solutions within aerospace and beyond."

While this study was focused on aircraft seats, the methodology used is adaptable to other components, both in the aerospace sector and beyond. The ultimate goal is to extend the use of this model in real-world case studies, fostering collaboration across industries to promote sustainable practices and quantify the benefits.

Future AMRC HVM Catapult projects, scoped in collaboration with Victor Guang Shi, supply chain resilience lead at the AMRC, will build upon the knowledge gained during this project. As part of the HVM Catapult, the AMRC will look

at investigating the traceability aspects of the digital thread and the use of intelligent artificial intelligence (AI) and machine learning (ML) towards future supply chain mapping and assessment, to mitigate risks and enhance networks.

Although, by its nature, the simulation includes a number of assumptions, it is a valuable tool to stimulate discussion about the potential business case for changing the way seats are made for aeroplanes. For all the industry's work on lightweighting and fuel composition to deliver on its mission to be more sustainable, perhaps part of the solution was sitting underneath us the whole time.



**Find out how
we can help your
sustainability**

By providing a data-driven decision-making tool, this study can give the aviation sector the confidence to challenge traditional linear supply chain models.

How weather forecasts can support sustainable manufacturing

By Mrudula Jadhav

In a significant step towards sustainable manufacturing, engineers from the University of Sheffield AMRC have found a way of using weather forecasts to reduce the environmental impact of manufacturing processes – without hindering productivity.

In the UK, energy production is split between renewable sources like wind and solar, and fossil fuels such as coal and gas. However, the power output of renewable energy sources fluctuates based on weather conditions, directly affecting the carbon intensity of the electricity grid; less favourable weather means greater reliance on fossil fuels, which increases carbon emissions.

This variability makes it crucial to understand when the grid is running on more renewables making it 'more sustainable', versus when it's 'less sustainable' due to greater reliance on fossil fuels, to make informed energy choices.

Recognising this, the University of Sheffield Advanced Manufacturing Research Centre (AMRC) has developed a system to strategically schedule energy-intensive manufacturing tasks for periods when the grid's carbon footprint is lowest – directly addressing the challenge of reducing the carbon dioxide equivalent (CO₂E) of manufacturing processes.

Tace Morgan, sustainability theme lead at the University of Sheffield AMRC, said: "A key challenge in improving manufacturing sustainability is reducing its carbon footprint. While using renewable

"Our research leverages the predictable link between carbon intensity and weather patterns."

Tace Morgan, sustainability theme lead, University of Sheffield AMRC.

energy offers a lower carbon intensity, its availability varies, making it an inconsistent source.

"Our research directly addresses this by leveraging the predictable link between carbon intensity and weather patterns. This allows us to intelligently schedule energy-intensive tasks for greener times, significantly lowering environmental impact without hindering productivity."

The AMRC has also developed a web interface tool that showcases how manufacturers can utilise the technology to inform their scheduling decisions, providing a clear understanding of the trade-offs between production timelines and environmental impact.

With these promising initial findings, further research is needed to seamlessly integrate such a system into complex,

real-world manufacturing environments and incorporate data from entire production facilities, where multiple factors influence schedules.

This groundbreaking work builds upon the AMRC's previous research under Project Butterfly, which established the link between weather patterns and predictable energy carbon intensity. Funded by the national High Value Manufacturing Catapult network, of which the AMRC is a member, the current research further refines this concept, directly supporting the UK's journey towards its net zero goals.

As part of the project, the AMRC developed a machine learning model capable of forecasting energy carbon intensity over 48 hours. Trained on historical weather data and additional insights, such as the observed increase



AMRC North West's real-world manufacturing data helped validate the project's innovative approach to sustainable scheduling.

in renewable energy capacity and the periodicity of carbon intensity over days, weeks and annually, the model analyses publicly available weather forecast data alongside energy production trends to identify optimal times for running machinery with the lowest associated CO₂E emissions.

The effectiveness of this innovative approach has been validated through discrete event simulations (DES) using real-world manufacturing process data from AMRC North West. These simulations,

which were applied to use cases involving melting, cutting and machining processes, compared traditional production schedules optimised for speed with those prioritising minimal carbon emissions.

Notably, one simulation demonstrated that accepting a modest increase in production time could lead to a significant reduction in overall emissions, specifically, a reduction of 4.74 kilograms of CO₂E was achieved by extending production time by just 2.8 hours – highlighting a tangible pathway to greener operations.

Dr Jon Hall, technical lead for connected factories at the AMRC, said: "The model's ability to accurately predict the maxima and minima in carbon intensity as a function of time is particularly valuable, as it helps identify the most and least sustainable periods for machine operation, and can also calculate the potential CO₂E reduction if sustainable scheduling was prioritised.

"At the end of the day, it's all about making smarter choices when we use energy."

"At the end of the day, it's all about making smarter choices when we use energy."

Dr Jon Hall, technical lead for connected factories, University of Sheffield AMRC.

Recycling traceability technology: optimising the packaging circular economy

A three-year partnership between AMRC Cymru and Polytag to develop traceability for manufacturing production lines using cutting-edge digital technologies is a brilliant demonstration of the real-world impact industrial collaborations can deliver for Wales. **Lucy Hilton writes.**

Polytag works to provide traceability data to retailers and organisations using plastic packaging of what, and how much, gets recycled.

To do this, the company works alongside a wide range of partners across the supply chain and oversees the application of invisible tags onto product labels, using special invisible ink that can only be detected under UV light.

When the packaging, such as milk or drink bottles, get recycled in a waste management facility, the camera on Polytag's plastic detection units (PDU) detects the product barcode and other data embedded in the tag as it goes through a UV light-only environment, allowing Polytag to report on how much volume of product packaging is recycled.

This, in turn, enables brands and organisations to use that data to make improvements to their packaging to boost recycling rates, and ultimately improve their sustainability credentials, contribute to the circular economy and respond accurately to packaging legislation.

The technology also facilitates the implementation of digital deposit return schemes (DDRSs), a model that Wales has recently become the first country to commit to as part of its broader deposit return scheme (DRS) plans. Additionally, it supports businesses in the upcoming extended producer responsibility (EPR) regulation, providing barcode level data to organisations to help track and prove the correct disposal of and recycling rates of packaging. The technology provides an integrated solution, including an intuitive data-sharing platform, unique packaging identification, and end-to-end supply chain visibility.

For Bobby Manesh, AMRC Cymru's head of research, the collaboration with Polytag exemplifies the kind of innovative, purpose-driven partnership that the team aim to foster.

He said: "Working together to explore cutting-edge digital technologies for greater traceability and sustainability of single use plastics has not only advanced our shared research goals, but also demonstrated the real-world impact of industrial collaboration in Wales."

Starting in 2022, AMRC Cymru engineers were tasked with constructing a prototype system to pave the way for Polytag's technology to take its next step in technological maturity, and optimise its solution.

AMRC investigations looked at how GS1 – a global system of standards – data matrix codes are constructed to meet global standards and then printed, carrying out a broad range of tests to give insight into their ability to withstand various supply chain conditions through the lifecycle of the packaging whilst maintaining their integrity and readability via the Polytag detection hardware.

Printing system development demonstrated the ability to successfully print readable tags, whilst also highlighting improved clarity on a range of packaging substrates, sufficient for proving the concept of UV tagging items of packaging.

Bobby said this early stage of work with Polytag was essential in proving the core principles behind the technology.

He added: "Developing and testing the prototype gave confidence in the

engineering approach and provided a solid platform for further refinement of packaging traceability solutions.”

Cobots and conveyors

Using a simulated material recovery facility (MRF) setting, engineers successfully installed, configured and integrated a robot picker to detect and select tagged packaging by receiving coordinates from a vision system for each item detected, achieving a 100 per cent pick success rate for detected items. This collaborative robot (cobot) was proven to be successful in acting on the detection of invisible UV tags and can be used alongside humans, or as a stand alone solution in recycling centres.

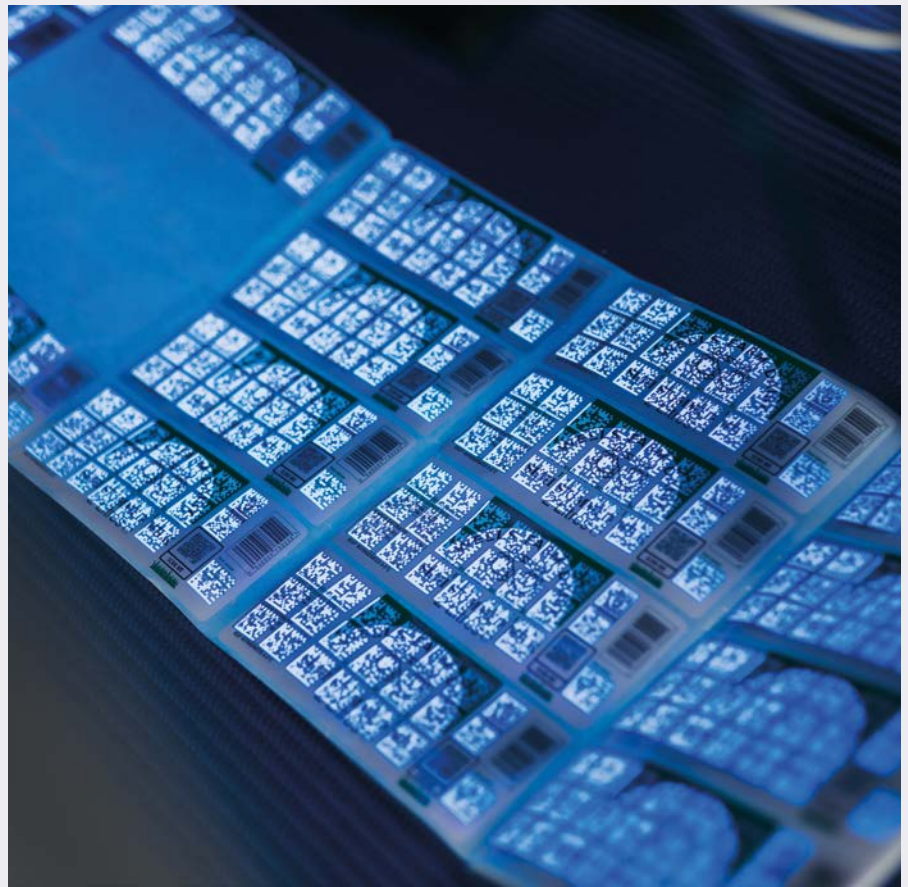
The system developed and demonstrated at the AMRC Cymru facility, from print to pick, indicated that the Polytag aim towards industry adoption was feasible and enabled the Polytag team to continue to develop their vision system solution further through to technology readiness level nine (TRL9).

Expanding to multiple packaging types

Following this project, AMRC Cymru was asked to test a similar system to the first project, in a real environment, but instead of looking at codes printed on ‘clean’ labels, focusing on codes printed on packaging in a variety of conditions.

AMRC Cymru designed experiments to look at the detection rates of different printing patterns and ink colours, as well as analysing a system developed and commissioned by a third-party integrator. Experiments were run in the recycling facility with ‘clean labels’, and a second run of experiments looked at running the bottles from an earlier stage, seeing how they are detected after being compressed, heat treated or distorted.

The tests carried out provided baseline data on the system as a whole, and also proved that the Polytag system was capable of detecting tagged items under ‘real-world’ supply chain conditions.



Test samples of Polytag’s UV packaging.

Additionally, it showed great potential for excellent detection rates for multiple codes, across multiple packaging types within various facilities.

Alice Rackley, chief executive officer of Polytag commented: “Collaborating with AMRC Cymru has been transformative for Polytag.

“Their technical expertise and rigorous testing environments have helped us refine and validate our technology, ultimately supporting us to the large-scale industry adoption we have achieved today, through work such as The Ecotrace Programme and collaborations with national packaging compliance agencies such as Citeo in France.

“This partnership is proof of what’s possible when innovation meets purposeful collaboration, and we’ve only just begun.

“The insights gained during this partnership to date are laying the groundwork for smarter packaging systems, with the potential to drive change not just in Wales, but across the global recycling and manufacturing sectors.”

Bobby added: “We are proud to support Polytag’s mission and look forward to building on this relationship in the future.”

“The insights gained during this partnership to date are laying the groundwork for smarter packaging systems, with the potential to drive change not just in Wales, but across the global recycling and manufacturing sectors.”

Alice Rackley, chief executive officer, Polytag.

Strengthening UK supply chains

With global supply chains shifting and changing, how does the UK remain world-class in advanced manufacturing? That is the question posed by **Melissa Conlon, commercial director of AMRC North West**, who heads up a specialist team helping to develop stronger and more efficient supply chains.



Melissa Conlon,
commercial director
of AMRC North West.



The current challenges in the UK manufacturing supply chain are multifaceted and complex, reflecting both domestic issues and international pressures. Ongoing disruption from geopolitical tensions, pandemic aftershocks and global trade instability cause fluctuating prices, delayed deliveries and inventory shortages.

This creates uncertainty and operational risk for manufacturers trying to meet customer demand and plan long term. Additionally, manufacturers are facing challenges in rising operational costs when it comes to energy, raw materials, labour and compliance.

The shortage of skilled labour is a critical barrier to growth, whilst technology adoption and digital transformation are seen as tools for addressing inefficiencies and visibility. However adoption requires investment, a skilled workforce and integration.

As a result, UK manufacturing finds itself trying to navigate 'a perfect storm' of overlapping challenges where recovery – and more importantly growth – are dependent on strategic adaptations.

At the University of Sheffield AMRC, we have made a significant investment in our newly-established supply chain team, who conduct applied research focused on developing innovative materials, processes and technologies that improve supply chain efficiency, resilience and sustainability. This can include, but is not limited to, advancements in automation, artificial intelligence (AI) and predictive analytics.

Kevin Shepherd, Kevin Ross and Andy Hinton make up the new team and work under my guidance and closely with our AMRC supply chain resilience theme lead, Dr Victor Shi. It is based at AMRC North West in Lancashire, but works across the entirety of the AMRC and has both a national and international reach.

The team, which has many years of experience in supply chains and comes from a background in nuclear supply chain development, is now working across all sectors of manufacturing, from defence and aerospace, to food and drink. In addition to academic research, it applies practical solutions to supply chain challenges, often working with our partners on their shop floors.

Bridging the divide

Team lead Kevin Shepherd has found the cross-sector nature of his work to be one of its most compelling elements. He began his career aged 16 in the automotive industry, later transitioning into the food and drink sector, followed by a role at the Manufacturing Advisory Service (MAS). Eventually, his journey led him into the nuclear industry as an industrial advisor.

“I wanted to use my industrial experience to support other businesses – and that’s exactly what brought me to the AMRC,” Kevin explains. “For me, it’s all about translating academic knowledge into practical application, bridging the divide between academia and the shop floor. That means getting innovation into operations – whether it’s business strategy, production enhancements, or design improvements.

“Our team thrives on the industrial side of manufacturing – process optimisation, automation, digital innovation – it’s the kind of work I’m passionate about.

“In my opinion, that’s what manufacturing is all about. At the AMRC I bring a hands-on, shop floor mindset to engineering, working alongside our academic partners to create meaningful change in the industry. We are strategic about strengthening supply chains, building resilience and reducing risk.

“This practical, boots-on-the-ground approach is what fuels our new team. Take our recent collaboration with a company that needed vacuum vessels and initially knew of only two UK suppliers. Through our network and research expertise, we identified 36 potential manufacturers. Narrowing that to eight gave the company

a 300 per cent increase in viable options – dramatically expanding its supply base beyond what they had imagined possible.”

What are we here to do?

The supply chain team’s objectives are based primarily around:

- 1. Collaboration and networking:** Facilitating collaboration between manufacturers, suppliers and research institutions to share knowledge, best practices and resources.
- 2. Research and development:** Conducting applied research with a problem solving focus based on the specific challenges of a single manufacturer or an entire sector.
- 3. Supply chain analysis:** Using our digital manufacturing capability to develop tools and methodologies for better data collection and analysis, enabling manufacturers to gain insights into their supply chains.
- 4. Sustainability solutions:** Delivering solutions that promote sustainable practices and materials that minimise environmental impact. This may involve creating frameworks for circular supply chains, waste reduction and energy efficiency, aligning with regulatory requirements and consumer expectations.
- 5. Risk management frameworks:** Developing guidelines and frameworks for manufacturers to assess and manage risks associated with supply chain disruptions. This can include strategies for diversification, contingency planning, scenario modelling and pivoting into new supply chains.
- 6. Prototype and pilot programs:** Supporting manufacturers in testing new technologies and practices through pilot programmes.
- 7. Digital transformation support:** Encouraging and assisting manufacturers in adopting digital tools and technologies that enhance supply chain visibility and responsiveness. This includes promoting Industry 4.0 practices involving internet of things (IoT), automation and data analytics.
- 8. Cross-industry insights:** Sharing knowledge and experiences from different sectors, enabling manufacturers to learn from successful practices in other industries.

“Many UK manufacturers are leading in research and development, particularly in sustainable practices and green technologies

Kevin Ross, theme lead for supply chain, University of Sheffield AMRC.



Automation and robotics remains an emerging field in manufacturing. The AMRC helps businesses improve the way things are made, reused and recycled – improving efficiency, time and costs.

“The UK is brimming with potential, determined to innovate and prove that it remains a critical player in the global manufacturing arena.”

Melissa Conlon, commercial director, AMRC North West.

And while it is not a current activity, the team would also welcome the opportunity to engage with policymakers to shape regulations that support supply chain resilience. The team, through its current projects, can contribute data and insights to inform better decisions regarding trade policies, tariffs and support for manufacturing sectors.

By delivering the above interventions, we can significantly contribute to overcoming supply chain challenges, enhancing efficiency and resilience whilst fostering sustainability and innovation within the UK manufacturing sector.

Kevin says one of the comments he least likes to hear is ‘we don’t make anything in the UK anymore’.

“Actually, the UK still boasts a vibrant manufacturing sector with companies innovating in defence and aerospace, pharmaceuticals, and automotive industries. These sectors are thriving and contributing significantly to the economy,” he said.

“While traditional manufacturing may have declined, the UK has pivoted towards advanced manufacturing and technology-driven production. This shift emphasises high-value goods and innovative processes, which are very much alive.”

Kevin Ross agrees. He said: “Manufacturing today is global, and many UK-based companies operate within international supply chains. This approach allows them to leverage global resources while maintaining production capabilities at home.

“Many UK manufacturers are leading in research and development, particularly in sustainable practices and green technologies. This focus on innovation is reshaping the UK manufacturing landscape.

“Manufacturing in the UK continues to create jobs, particularly in emerging fields such as robotics and automation. These sectors provide skilled employment opportunities and are integral to the economy.”

Reskilling presents a significant opportunity across transferable skills,

but it’s far from a new challenge. For years, engineers have been retiring faster than the next generation can be trained. In response, companies are increasingly investing in apprenticeship programmes and developing their own training schemes, recognising the potential for experienced staff to pass on critical knowledge and expertise.

Kevin says: “This makes employee retention more crucial than ever – without seasoned professionals, there’s no one left to train and mentor incoming talent.”

Andy shares this concern, viewing the skills gap as a risk that could exacerbate capacity issues. He said: “We need to spark interest as early as primary school. While AI may one day operate machinery, true engineering lies in understanding how things work – physically and conceptually – and having the curiosity to explore how they fit together.”

Industrial placements offer invaluable, hands-on learning experiences. But as Andy emphasises, that legacy knowledge from those still in industry must also be captured and transferred. The generational divide calls for deliberate succession planning. How do we ensure that standard operating procedures and processes aren’t locked away in someone’s head, but shared across the organisation?

Sector startups

To partially negate the need for succession planning, a wave of innovative startups in the UK manufacturing sector is challenging the narrative of decline. These companies are leveraging technology and creativity to deliver cutting-edge products and solutions.

These new players are transforming traditional industrial models by adopting advanced technologies like AI, robotics and additive manufacturing (3D printing) to streamline production and customise goods. They are pioneering the utilisation of sustainable practices such as circular design, low-waste operations and biodegradable materials to meet environmental goals, and are fostering collaboration between sectors.

In conclusion, the future of advanced manufacturing in the UK is contingent upon the ability to adapt and innovate amidst the complexities of a shifting global landscape.

While challenges such as geopolitical tensions, rising costs and skilled labour shortages pose significant hurdles, they also present opportunities for growth and transformation within the sector.

The establishment of dedicated supply chain teams like the one we have here at the AMRC underscores a proactive approach to tackle these challenges through applied research, collaboration and the promotion of sustainable practices.

As exemplified by the efforts of Kevin Shepherd, Kevin Ross and Andy Hinton, bridging the gap between academia and industry is vital to fostering a resilient manufacturing ecosystem. By leveraging cross-industry insights, developing risk management frameworks and facilitating digital transformation, the AMRC is positioned to empower manufacturers to navigate these tumultuous times effectively.

Furthermore, the commitment to training and reskilling the workforce indicates a recognition of the essential human element in manufacturing. The University of Sheffield AMRC Training Centre focuses on providing high-quality training and education in advanced manufacturing and was established to address the ongoing skills gaps in the sector.

The potential for innovation from new startups, and the ongoing evolution of established companies demonstrate that the UK remains a hub of manufacturing prowess, constantly redefining its capabilities.

Ultimately, by embracing change, prioritising collaboration and investing in sustainable solutions, the UK can not only sustain its manufacturing legacy, but also emerge as a global leader in advanced manufacturing practices.

The narrative of decline is outdated; instead, the UK is brimming with potential, determined to innovate and prove that it remains a critical player in the global manufacturing arena.

Delivering enduring impact for Welsh manufacturers

AMRC Cymru is changing the future of manufacturing in Wales, one business at a time. **Lucy Hilton reports.**

Following the inaugural Accelerating Decarbonisation and Productivity through Technology and Skills (ADAPTS) programme in Flintshire, and last year's Powys programme, the team at AMRC Cymru has now been tasked with extending its offering, opening their doors to even more businesses in Flintshire and Wrexham.

Funded by the UK Shared Prosperity Fund (UKSPF), a significant component of UK government's support for places across the country, the ADAPTS programme supports manufacturers with unparalleled access to advanced manufacturing technology, knowledge transfer, training and upskilling in digital and decarbonisation strategies.

In 2024, AMRC Cymru supported 32 companies in Flintshire as part of ADAPTS, with all beneficiary companies receiving an initial visit and guidance on opportunities to improve their manufacturing process.

The work was a collaborative effort between AMRC Cymru, Small World Consulting and Coleg Cambria, involving 48 months of engineering support from 23 staff from AMRC Cymru.

Initial work focused on capturing critical manufacturing aspects like technology status, opportunities for decarbonisation, productivity assessments and opportunities for training.

Full-scale support consisted of tailored support from an AMRC Cymru engineering team, focusing on advanced technology adoption, access to bespoke training through Coleg Cambria on technology skills, and foundational training in sustainability for businesses from Small World Consulting.

Of the 32 Flintshire companies, 16 received follow-on support in the form of a project, ranging from two to six months of engineering time. All 16 companies involved in projects saw an improvement in productivity and adopted new

technologies or processes, as well as new or improved products or services. Sixty-four people also received training, with all 64 attending green skills courses, and 21 jobs were safeguarded in Flintshire.

Councillor Chris Dolphin, Flintshire County Council cabinet member for economy, environment, and climate, celebrated ADAPTS' success, saying: "With UK manufacturers investing around £38.8bn into the economy annually, seeing the ADAPTS scheme prepare Flintshire businesses for growth is wonderful.

"I truly believe this investment into Flintshire's firms will help increase their resilience and, in the long-term, draw and retain talent into the county."

Last year, the team also delivered a knowledge and skills-based ADAPTS programme in Powys, which supported individuals from across 13 organisations with developing Industry 4.0, design and digital skills.

AMRC Cymru supported

32 companies in Flintshire

as part of ADAPTS.

All 16 companies involved in projects saw an

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21 jobs

were safeguarded in Flintshire.

This year, AMRC Cymru has won funding to support a further eight projects in Flintshire and 16 projects in Wrexham. The Wrexham funding will be the Broughton-based centre's first major programme in Wrexham, and follows the work of its former research director Andy Silcox – who is now interim chief technology officer for the University of Sheffield AMRC – on the Wrexham and Flintshire Investment Zone's shadow board.

ADAPTS Flintshire, which received £811,083 from Flintshire's allocation of the UK Government's Shared Prosperity Fund, saw successes including a collaboration with Dylunio Solutions to launch life-saving equipment for military dogs, a world-first product. The team at AMRC Cymru developed a smart workbench to streamline the design and development phases for Dylunio's respiratory system to protect service dogs from toxic fumes while on active duty. Sensors flagged any incorrect actions, ensuring users could not progress to the next stage of the production process, significantly reducing wasted time and resources.

Crucially, the smart workbench's capabilities allowed for enhanced quality control, which played a critical role in the product reaching the testing phase, with it now undergoing testing in the United States with the end customer who commissioned the project.

Graham Wilson, design director at Dylunio Solutions, said AMRC Cymru was 'fantastic' at tailoring its support to the challenges small businesses face. He said: "We are passionate about developing products that make a positive impact, and this respiratory device has the potential to save the lives of military dogs.

"The real-time learnings provided by the smart workbench were invaluable and played a key role in the team meeting the required quality standards. The workbench has sped up the entire process; to send the device to America for testing is an amazing achievement, and we are excited to see how it performs."



James Allum, design lead at AMRC Cymru and technical lead for the ADAPTS programme, at the ADAPTS celebration event.

Work also included a partnership with Biofortuna to develop two automated solutions for the quality inspection of lyophilised beads. This collaboration aimed to increase the speed and accuracy of Biofortuna's quality inspection process by identifying cost-effective and scalable automated solutions to replace manual methods – research crucial for Biofortuna to expand its manufacturing capacity and mitigate risks associated with future investments in automation and technology.

By addressing a critical bottleneck in its production line, the project enabled Biofortuna to streamline operations and enhance overall efficiency. Chris McCarthy, development and manufacturing manager at Biofortuna, praised the AMRC for giving the company a new perspective. He said: "If we hadn't partnered with AMRC Cymru, I feel we would have had to invest a lot of time and resource into researching the potential options, but ultimately, I think we would have been limited to ready-made off-the-shelf solutions.

"ADAPTS provided us with the opportunity to look at it from a different angle and they came up with tailor-made, bespoke solutions to our niche problem."

For James Allum, design lead at AMRC Cymru and technical lead for the ADAPTS programme, the project's growth is a testament to the hard work of the team. He said: "It's amazing that we've been able to win further funding to deliver ADAPTS further into Flintshire, and across Wrexham, in 2025 and 2026. Our aim is to take the learnings and redouble our efforts to once again deliver an enduring impact.

"One of the most positive experiences for me has been getting out and seeing the diversity of manufacturing sectors which are supported in our own backyard. We've been able to work with everybody, from startups developing pioneering new scientific instruments, to supporting incremental innovations on the production lines of multinational household names.

"We look forward to applying our expertise to yet more diverse and exciting challenges in the months to come."

"ADAPTS provided us with the opportunity to look at it from a different angle and they came up with tailor-made, bespoke solutions to our niche problem."

Chris McCarthy, development and manufacturing manager, Biofortuna.

Apprentices fuel F1 dreams with hard work and determination

By Mrudula Jadhav

Meet Charlotte and Sophie, two University of Sheffield AMRC Training Centre apprentices whose drive has taken them straight to the pit lanes of Formula 1 with McLaren Racing – a journey built on skill, ambition and friendship in the high-stakes world of motorsport.

For machining apprentices Charlotte Carrington, 20, and Sophie Hulse, 19, walking into the McLaren Technology Centre in Woking is a powerful reminder of the unparalleled opportunity they've seized. These young women aren't just learning a trade; they're forging careers with one of Formula 1's most iconic teams.

For both Charlotte and Sophie, the spark of motorsport engineering ignited early.

Charlotte, from an all-girls school, honed her skills through practical projects like racing electric cars and participating in educational programmes such as STEM Racing (formerly F1 in Schools). These experiences led to mentorship and involvement with Girls on Track, a joint initiative between the Fédération Internationale de l'Automobile (FIA) and Motorsport UK to empower women in motorsport.





Sophie's fascination with Formula 1, on the other hand, began at home. Supported by her school's design and technology department, she was determined to pursue a practical career and proactively reached out to many teams.

"I wrote letters, like physical letters to every single UK-based team," she says. "When they didn't reply, I sent emails asking for feedback, and then another email nudging for more feedback."

This tenacity landed her crucial work experience, proving her drive for a hands-on path.

When it came to further education, an apprenticeship offered the practical experience they both desired. Sophie, whose parents both completed apprenticeships, knew it was the right option for her. "University was never really

the route I wanted to go down," explains Sophie. "My dad in particular was very keen on the apprenticeship route."

In September last year, Charlotte and Sophie both joined the AMRC Training Centre, based on the former site of the Orgreave coking works in South Yorkshire, to pursue a machining apprenticeship.

Every week, they spend three days in the training centre's state-of-the-art workshops, immersing themselves in complex machining processes and mastering the precise skills required for advanced manufacturing. The remaining days are dedicated to core knowledge development, ensuring they have a deep theoretical understanding to complement their practical skills.

The AMRC Training Centre's industry-rooted environment has been pivotal for Charlotte, who appreciates the

centre's engineering facilities, where the apprentices work with equipment mirroring what they'll find in industry. For Sophie, it is the 'unique connection' with instructors that matter to her.

"The trainers are all from within industry," says Sophie "It feels like you're talking to a colleague rather than a teacher or an authority figure. This collaborative atmosphere fosters genuine learning and gives a taste of the professional world."

Beyond technical skills, the apprentices also received practical support, including accommodation from the University of Sheffield for the first year – helping ease the transition into their new lives hundreds of miles away from home.

Sophie says: "That was a really big help because it was very stressful trying to find a flat, especially when you're 18 and you don't really know what you're doing."

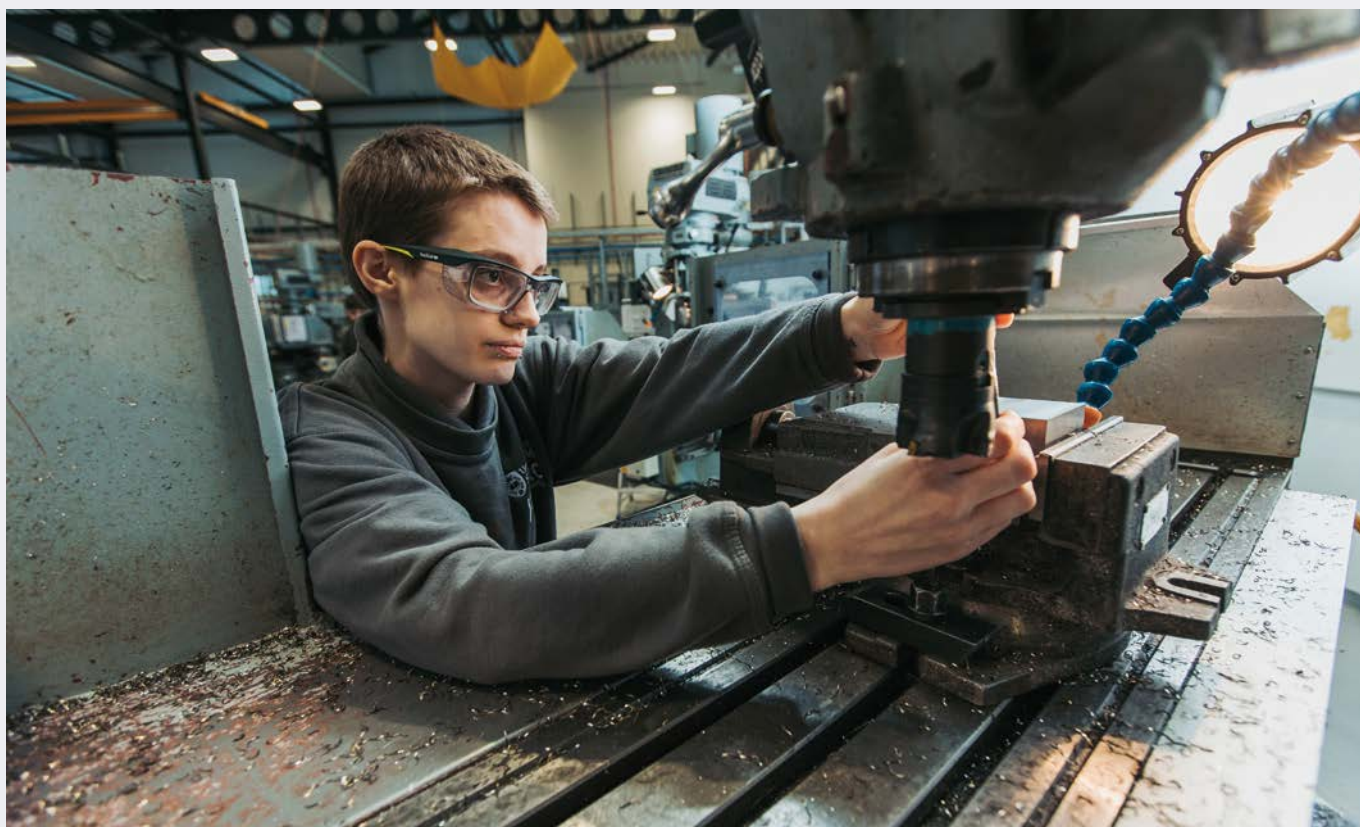
Once a month, the two friends travel to Surrey to visit the McLaren Technology Centre in Woking. This allows them to shadow experienced team members, observe projects and integrate into the high-performance culture; seeing first-hand how their training translates to real-world F1 applications.

"This collaborative atmosphere fosters genuine learning and gives a taste of the professional world."

Sophie Hulse, machining apprentice.



Machining apprentices Charlotte Carrington (left) and Sophie Hulse, in instruction with Darren Laycock, engineering trainer at the AMRC Training Centre.



Sophie Hulse, machining apprentice, on the shop floor at the AMRC Training Centre.

“I feel like I’m pinching myself every time I walk onto the boulevard,” Sophie says, referring to McLaren’s iconic walkway adorned with historical racing cars. Charlotte echoes the sentiment, describing the experience as ‘almost so out of this world that you don’t really believe you’re there.’

However, the most special and heartwarming aspect of their apprenticeship journey so far has been the friendship that has blossomed between the two of them, having discovered early on that they would be sharing a twin room for three weeks during their induction period.

“We were literally just thrown in,” says Charlotte, laughing as she recalls sharing pot noodles and bonding over TV shows and late-night talks.

Now living next door to each other in the University of Sheffield accommodation, their bond is a lifeline. “We just knock on the wall,” says Sophie, describing their easy collaboration for coursework and mutual support, while navigating challenges in a traditionally male-dominated field. It’s invaluable, she says, having someone ‘just to rant at’ or talking about things that were difficult or challenging.

“Most times, we’re both in the same boat,” said Sophie.

Drawing notes from her journey, Sophie offers direct advice to other aspiring young apprentices: “Don’t be shy. Pester people.” She encourages individuals to speak up and not let others ‘speak over what you’re trying to say.’ Charlotte, in turn, emphasises the importance of self-worth, saying: “Know why you’ve done a good job, and know when you’ve earned it.”

McLaren Racing are committed in paving the way for early careers and apprentices who are keen in joining the motorsport industry, and have now employed both Charlotte and Sophie after their time at the AMRC Training Centre completing an apprenticeship.

Both Charlotte and Sophie’s impact is already being felt. Charlotte, for instance, experienced a full-circle moment when she returned to a Girls on Track event, this time fielding questions as a McLaren Racing employee, rather than as an attendee. Similarly, Sophie

connected with a younger student seeking advice, realising she had become a role model.

Reflecting on years of dedication, Charlotte challenges any kind of notion that their success is down to luck. “When people go, ‘oh, yeah, you’re so lucky,’ I think ‘but I’ve just spent ten years building myself up,’” she says. Sophie added: “It’s not luck. Anybody can do it. You just have to put in the effort.”

And what lays ahead? Their core aspirations are clear: to thrive within the engineering space, and to inspire all the little Charlottes and Sophies to make their mark in the world of STEM.

Through their inspiring journey, nurtured by the AMRC Training Centre and accelerated at McLaren Racing, Charlotte and Sophie are proving that hard work, determination and the unwavering support of a friend are the true engines of success in the high-stakes world of Formula 1.

“Know why you’ve done a good job, and know when you’ve earned it.”

Charlotte Carrington, machining apprentice.

Future-proofing York Minster's conservation with 3D scanning technology

Look up at York Minster and you're likely to see somewhere a medieval grotesque staring right back at you. Hundreds of these ornate decorations adorn the cathedral's walls and are painstaking for stonemasons to restore or replace, each one often taking months. But the cathedral is looking for new ways to help them conserve these much-loved masterpieces, harnessing modern technologies to maintain them for future generations. **Katia Harston reports.**

York Minster has partnered with the University of Sheffield AMRC to help integrate cutting-edge 3D scanning technology into its conservation efforts, significantly enhancing the efficiency and cost-effectiveness of repairing and replacing its historic stone grotesques.

As one of the finest Gothic cathedrals in Europe, if not the world, York Minster faces increasing challenges in preserving its ancient stone carvings, due to centuries of exposure to the elements. The traditional process of repairing and replacing these intricate grotesques – many of which are hundreds of years old and positioned at significant heights – is time-consuming and costly.

Seeking a modern solution, York Minster approached the AMRC to identify the most suitable 3D scanning technology to streamline its critical conservation work to repair and restore its weather-beaten grotesque statues.

"Our stonemasons are highly skilled artisans, and their work is vital to preserving



York Minster.

the Minster for future generations," said Laura Cotter, research and innovation manager for York Minster Fund.

"We recognised the potential of 3D scanning to revolutionise our processes, allowing us to capture detailed digital records and facilitate more efficient repairs.

"The AMRC's expertise was instrumental in navigating the complex market of scanning technologies and ensuring we made the best investment."

The successful collaboration, funded through the High Value Manufacturing Catapult, underscores the AMRC's



Luke Snell, digital surveyor, at work on the South Quire Aisle at York Minster.

“The AMRC’s expertise was instrumental in navigating the complex market of scanning technologies and ensuring we made the best investment.”

Laura Cotter, research and innovation manager, York Minster Fund.

commitment to driving the adoption of digital technologies, supporting traditional British craftsmanship and fostering a sustainable future for vital heritage sites.

AMRC engineers conducted a comprehensive analysis of four different 3D scanning systems in the challenging environment of the Minster, evaluating their performance on moss-covered grotesques from scaffolding at significant heights. This rigorous testing and detailed comparison revealed that cost does not always correlate with quality, with the lowest-priced scanner demonstrating comparable capabilities to the most expensive. The AMRC’s thorough analysis provided crucial insights into data quality, even at the smallest details.

“This project perfectly exemplifies how advanced manufacturing technologies can be applied to diverse sectors, including

heritage conservation,” said Phil Yates, a technical fellow at the AMRC who led on the project. “We were able to provide independent, expert analysis, enabling York Minster to select a 3D scanner that offers both exceptional quality and value.

“This collaborative effort highlights the AMRC’s dedication to empowering industries with the tools and knowledge to embrace digital transformation, ensuring the longevity of essential skills and the preservation of national treasures.”

Based on the AMRC’s recommendations, considering cost, scan quality and ease of use, York Minster acquired the scanner that delivered the highest quality results. This technology is now actively being used to create accurate scans of individual stone blocks, enabling them to be 3D printed or cut on a Computer Numerical Control (CNC) saw for precise

repairs. The scanner also provides an invaluable method for recording the Minster’s historically significant features for posterity.

The successful implementation of this technology has not only significantly reduced the cost of repair work, but has also positioned York Minster as a leader in heritage conservation, supporting its ambition to become a European Centre of Excellence for heritage crafts, particularly in stonemasonry.

Furthermore, the enhanced efficiency and effectiveness of their new process could open up opportunities for the Minster to undertake repair work for other historical monuments, creating a potential new revenue stream.

New members at the AMRC



Master Fluid Solutions has been a global leader in the metalworking fluids industry for 74 years. Its innovative products and services are designed to improve manufacturing processes, reduce costs and enhance the sustainability of operations across various industries. It's committed to providing solutions that meet the needs of customers, while maintaining high standards of quality and performance.



QualiChem, Inc. manufactures some of the most advanced metalworking fluids available in the world. As a global supplier, its fluids meet all the relevant health and safety regulations, including GHS and REACH. Its products include water-dilutable coolants, straight oils, metal forming fluids and rust and corrosion inhibitors. QualiChem is a quality-focused ISO 9001:2015 company and a zero-discharge facility.



Visual Components is one of the pioneers of the 3D manufacturing simulation industry. The organisation is a trusted technology partner to a number of leading brands, offering machine builders, system integrators and manufacturers a simple, quick and cost-effective solution to design and simulate production processes for fast, accurate and optimised workflow.

Events at the AMRC

Go to amrc.co.uk/events for the most up-to-date AMRC events information.

September 9 – 12, 2025

DSEI

Excel, London

September 11 – 12, 2025

Clean Energy Summit

Magna, Rotherham

September 16, 2025

Aerospace Innovation Showcase:

High-rate composite manufacture

AMRC Factory 2050

September 17, 2025

Subtractive manufacturing showcase

AMRC Knowledge Transfer Centre

October 29 – 30, 2025

Advanced Engineering

NEC, Birmingham

November 4 – 6, 2025

World Nuclear Exhibition

UK Pavilion, Paris

CPD courses at the AMRC Training Centre

As specialists in the advanced manufacturing and engineering training sectors, our highly experienced trainers can offer a variety of bespoke, accredited and non-accredited continuing professional development (CPD) programmes, which can be tailored to meet your individual organisational needs. Delivery can take place both in person and online.



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To discuss your requirements, email cpd@amrctraining.co.uk or call 0114 222 9958

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