University of Sheffield /AMRC Advanced Manufacturing Research Centre

Journal

Cultivating the future of agriculture
Transforming UK supply chain resilience
The digital thread: A force of modern manufacturing

ISSUE 18

Leading a new era of clean energy

A wave of change and optimism

A lot has happened since our last issue of the AMRC Journal. The country has continued to battle on various fronts with the cost-of-living crisis, rising inflation, energy security for the future and the journey to net zero. And we saw Labour achieve a landslide victory against the Conservatives – the first huge shift of its kind for 14 years.

Closer to home at the AMRC, we've also undergone change; refreshing our own strategy to make sure it's still fit to deliver on what we want to achieve by 2030. As figures from Make UK showed, the UK manufacturing sector has dropped out of the top ten world rankings for the first time – having a robust strategy is something we must get right if we are to help change the national outlook.

Labour's 'Change' manifesto showed some promise, and perhaps even small cause for optimism, for the manufacturing sector with pledges to make Britain a clean energy superpower; to accelerate net zero; and kickstart economic growth with a national wealth fund for things such as building supply chains, increasing carbon capture and supporting the manufacturing of green hydrogen. And in the King's Speech, prime minister Sir Keir Starmer committed to establishing an industrial strategy council.

It is this need for a long-term industrial strategy that has been called for by Verity Davidge, director of policy at Make UK, who said the UK's slip to twelfth place in the global rankings is not a reflection of any decline in UK industry but 'specific factors and trends which are redrawing the contours of the global economy' and it is these trends that 'reinforce the need for the UK to react with a long term industrial strategy to take competitive advantage of our undoubted strengths'.

To really help turn the tide, we don't just need technology and funding. We need the right people, with the right skills. The launch of Skills England, which will be aligned to industrial strategy, aims to meet the needs of the next decade and deliver highly-skilled workforces for the long-term. It's an area that the University of Sheffield AMRC Training Centre, which already plays a vital role in helping to close the skills gap, will no doubt be keeping a close eye on.

We may not see rapid change overnight but there are signs of intent which could provide the additional investment and productivity boost the country needs to reclaim its seat back at the table of the global top ten.

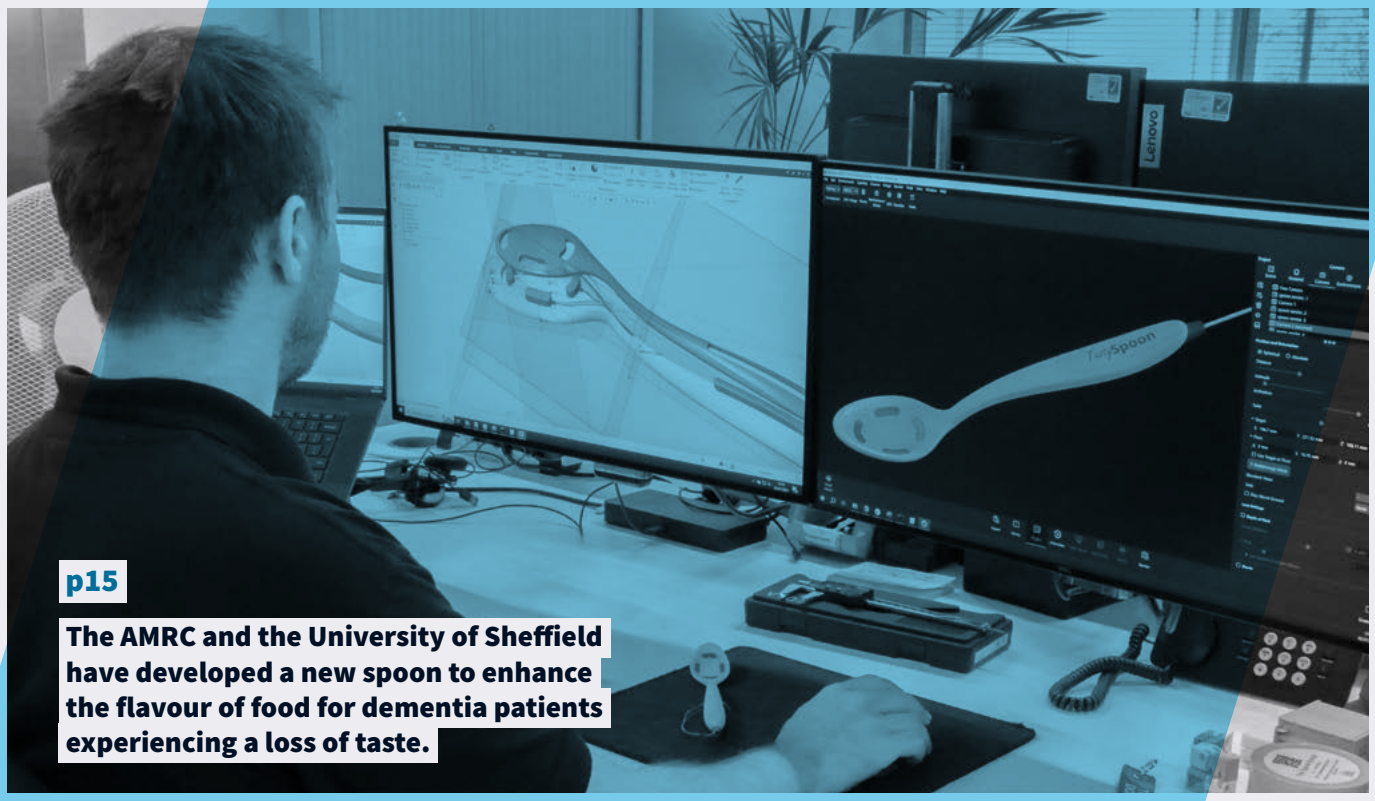
What is the AMRC doing to help?

In this issue our CEO Steve Foxley takes us through the refreshed AMRC strategy, outlining what's new and the importance of making these changes now; and you can read about the work we're doing with Rolls-Royce SMR, with some great insights from Alan Pardoe who heads up its manufacturing capability acquisition.

When it comes to skills, few do it better than the AMRC Training Centre. We raise a toast to some of its accomplished apprentices who have taken home a haul of awards this year. And not forgetting some of our favourite projects: a spoon developed to enhance food flavourings for people with dementia, and a fully autonomous tractor which is ploughing ahead with UK trials to help cultivate the future of agriculture.

I hope you enjoy this issue as much as I have in helping put it together with the team.

Chloé Rothenburg
Guest editor



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The AMRC and the University of Sheffield have developed a new spoon to enhance the flavour of food for dementia patients experiencing a loss of taste.


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Cover story: Rolls-Royce SMR and the blueprint for a clean energy solution. See pages 6–9 for more. Picture credit: Rolls-Royce SMR.

Reinvigorating our AMRC strategy

By Steve Foxley, CEO, AMRC

Our people and our culture is what underpins the AMRC strategy. We're already four years into our planned ten-year strategy which sets out our targets up until 2030. However, since we outlined this plan, the world has changed, our market has changed and we have changed.

In this issue, I would like to take you through our refreshed AMRC strategy, what this means and introduce to you our new vision and mission.

In September last year, we reviewed our strategy to see if the promises and targets we laid out in 2020 were still on track for 2030 – yes we are on track, doing exactly what we said we would do and are happy with the progress we have made.

However, the reality is that in the strategy we set out in 2020 to take us through to 2030, we found some gaps. Over the past few months, we've been reviewing the strategy and looking at what tweaks we can make.

Why does it make sense to do it now?

As we're closely reaching the mid-way point for this decade, we wanted to make sure the right adjustments are made for the next six years, to realise what we plan to achieve in this decade.

When looking at some of the strategic themes we set out in 2020, we asked: 'Are they still relevant or has the world changed?', 'Did we not quite understand what the industrial partners wanted?', and 'What adjustments do we need to make?'.

How are we going to do this?

Firstly, what we were finding with the group strategies is that they weren't quite connecting right and there were certain things where the strategy didn't quite fit with what the groups were focusing on.

We also identified gaps in the strategy and found the objectives needed a little work – we knew what the themes were, but we didn't fully iron out what we were aiming for up to 2030.

Our core strategy's focus was on the themes of: sustainability, digital, future propulsion and supply chain resilience.

As part of our review process, we looked at a number of factors, including stakeholder feedback, the High Value Manufacturing Catapult strategy – the national network of research centres we are proud to be a member of – those core themes and the national and regional manufacturing landscape.

What have been the outcomes of our strategy review?

At the top of it all, we asked 'Why are we here?', 'What is our purpose and why do we exist as an organisation?'

Right now, we are pretty happy with what we have defined. Our purpose is to: transform lives through innovation. Everything we're doing every day, all of the things we shout about and our achievements – the reason behind all of it is that we are trying to transform lives. Nothing has changed on our purpose – we've just underlined it.

However, where we did have a gap was our vision, and this is one of the new elements.

Our vision is to be the most impactful manufacturing research centre in the world by 2035.

This is all about where we are heading to as an organisation and that was something we weren't quite defining enough in 2020. We didn't have a clear idea, but now we do. Why this is important is that we are deliberate about using the word 'impact'. We do not want to be the biggest – we're not interested in size, we're interested in the impact we can make.

We want to be the most impactful research centre on the planet and that is something we can measure, compare ourselves with countries like the US or Asia – and we already have a good idea

“We’re much sharper about our objectives. We want to have a laser-like focus on our core themes, what each means and what we want to get out of them.”

Steve Foxley, CEO, AMRC.

of the impact we have made over the last 20-plus years at the AMRC. That is a new bit, the where we are heading and we want to make the most improvement out of all the research centres.

The mission?

This is about how we are going to get there – to the destination of being the most impactful manufacturing research centre globally by 2035. Our plan to achieve that is by:

- Driving UK manufacturing productivity improvements;
- Creating high value jobs, wealth and prestige by attracting investment;
- Promoting an environment which attracts and develops the best talent;
- Transforming landscapes and creating inspiring environments.

Just as we have done in Orgreave, and what we are trying to do in North Wales and the North West, all of that is feeding our vision and purpose and this is how we are going to deliver it.

Our values

These are the things that underpin our strategy – it’s about the importance of our culture and striving to be the best we can be:

- We strive for excellence
- We work collaboratively
- We champion inclusivity and diversity
- We act with integrity to deliver value

Where do we put our horsepower?

Coming back to our focus themes I mentioned earlier – we’ve got more refined on what we’re working on. Some remain the same, such as supply chain resilience, but others have been refreshed, such as sustainable manufacturing and industrial digitalisation – with the final one having a wider scope: future products and processes.

After speaking to our industrial members, we know the future products and processes theme is about more that just propulsion, which is where we narrowed our focus before – it’s about the future platforms they’re working on and even goes beyond that and is about the bigger picture.

We’re also adding in increasing technology transfer and our FerretWorks programme, which facilitates ambitious steps in manufacturing research by giving engineers the freedom, space and time to create and explore new ideas, to run adjacent to these themes.

Now, we are clearer with the messaging with our members and funders, we are clearer on the meshing of our groups, and how their own individual strategies feed into the overall AMRC strategy.

We’re much sharper about our objectives. We want to have a laser-like focus on our core themes, what each means and what we want to get out of them.

We have a more focused direction of where we want to go in the future, coupled with clearer objectives, and it’s these factors which are helping us to refine where we put our horsepower – not only to remain on track for 2030 and beyond, but to deliver what we set out to do, which is turning our world-leading research into practical improvements that make a difference for industry, our country and our communities.

Rolls-Royce SMR's vision for the clean energy solution

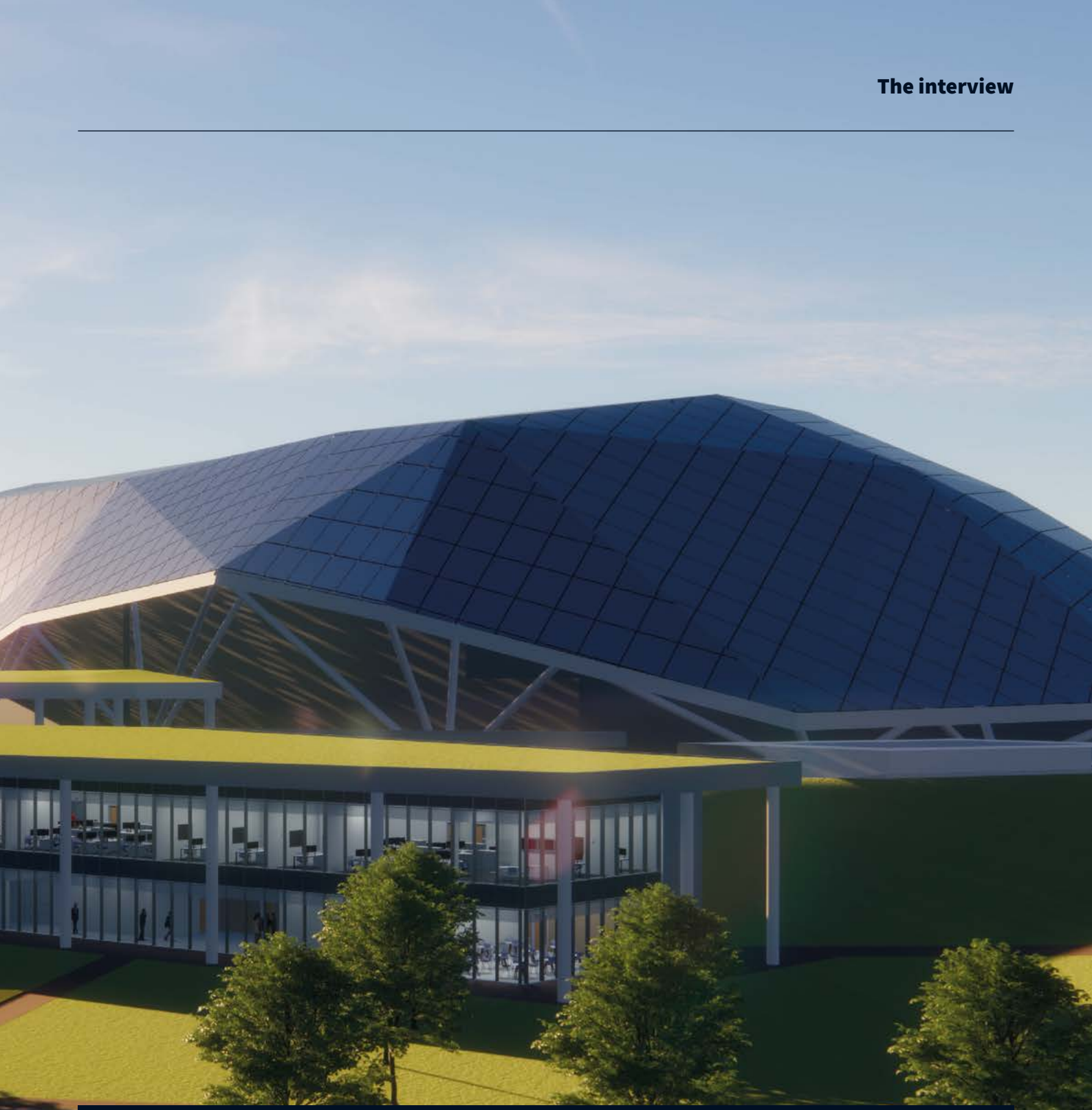
As global energy demands continue to skyrocket, Small Modular Reactors (SMRs) are emerging as a viable solution. **Mrudula Jadhav** sits down with **Alan Pardoe from Rolls-Royce SMR**, to understand the importance and global benefits of SMRs for the manufacturing industry; and the instrumental role the AMRC has to play.

"We cannot keep burning fossil fuels for power generation. With the demand for clean and affordable energy at an all-time high, there's a massive opportunity for clean energy solutions in the UK and globally. And this is what Rolls-Royce SMR is here for. We're creating a blueprint for a clean energy solution," says Alan Pardoe, who heads up manufacturing capability acquisition at Rolls-Royce SMR.

With an impressive 27 years at Rolls-Royce behind him, Alan began his career as a design engineer on the Trent 500 programme. Over the years, he has tackled diverse challenges across engineering, procurement and manufacturing; from Trent 900 and XWB engines to mechanical rigs and fuel cell systems. This background now serves him well as he manages the manufacturing capability delivery for Rolls-Royce SMR.

Alan Pardoe, manufacturing capability delivery manager, Rolls-Royce SMR.

Image: Rolls-Royce SMR.



Now, two years into the role, Alan is responsible for ensuring Rolls-Royce SMR develops the necessary manufacturing capabilities to seamlessly operate future factories, which will supply the parts to build these revolutionary nuclear power stations. This means having a clear plan for everything, from opening the factory to building the first nuclear power station, including processes, standards and compliance.

Alan is clear on Rolls-Royce SMR's bold vision: delivering clean, affordable energy for all. But how?

While the goal is clear, Alan believes achieving it requires a radical new approach to what and how it is being done. This is where Rolls-Royce SMR's approach becomes truly innovative.

"What we're doing radically different is factory-producing 95 per cent of a nuclear power station," Alan reveals. "We know that nuclear energy is carbon free at the point of generation, but affordability is still a challenge when compared with large nuclear power plants. Our SMR solution tackles this by factory-building and modularising everything – a game-changer to make our vision a reality."

Modularisation is Rolls-Royce SMR's unique selling point and a cornerstone of its strategy.

"Our SMRs will be built with factory-made modules, ensuring predictability, tight control over schedules and shipping, and guaranteed delivery times," says Alan.

"We're setting the standard for modular SMR design. It's a differentiator that sets us apart and the University of Sheffield Advanced Manufacturing Research Centre (AMRC) plays a key role in this journey, with their work being instrumental in establishing this revolutionary approach."

"This isn't just another project; it's a paradigm shift," Alan emphasises. "Different from traditional, civil nuclear projects, we're designing SMRs for fleet production – potentially hundreds deployed globally. This focus on deliverability requires a product-oriented approach from the outset, and not a one-off project mentality.

"Traditionally, Rolls-Royce projects have been built upon existing factories and product designs, but SMR is starting with a blank canvas.

"Although we can leverage our extensive experience in nuclear reactors from submarines, everything else is new. We've got no baseline. So, we've got this unique opportunity – both exciting and daunting – to establish the very foundation of the business from scratch."

This is where Experimental Module Assembly (Experi) comes in – it's the crucial first step on the path to making our vision a reality.

In 2017, the Rolls-Royce SMR team envisioned a dedicated assembly facility for its small modular reactors. With extensive work needed for module stacking, movement and heavy engineering, the initial target launch for this facility was 2025. This meant finding and retrofitting a building with specific capabilities.

"With the demand for clean and affordable energy at an all-time high, there's a massive opportunity for clean energy solutions in the UK and globally. And this is what Rolls-Royce SMR is here for.

Alan Pardoe, manufacturing capability delivery manager, Rolls-Royce SMR.

However, a desire to accelerate progress led Alan to the doorstep of the AMRC with just one question: "What can we do now?" This sparked the first phase of the Experi programme.

"Phase one focuses on utilising the AMRC's existing facilities and maximising what we could achieve with it." Alan explains.

"Now, Experi phase two is still under development, going through requirement capture and trying to understand what we really need to do next. We have a vision, but there's much to define and a lot of work to do. However, we are certainly on a route to maturity."

Alan paints the bigger picture.

"Imagine a factory on the horizon, where we'll build the first nuclear power station," he says. "We need to know how to operate things when we open its doors. So be it Experi phase one, phase two, pre-production, a centre of excellence – whatever the path, it's all part of the journey to that operational readiness."

Rolls-Royce SMR factories will produce hundreds of prefabricated and pre-tested modules ready for assembly on site into a complete nuclear power plant. Image: Rolls-Royce SMR.

Alan strongly believes that the urgency for SMR adoption cannot be ignored any longer.

"There are two things in play here," he explains. "The first is that there's a critical need to find a solution to the surging global energy needs. And secondly, because SMRs can be ready in a short term, they are a timely solution.

"Unlike traditional large-scale nuclear builds which can take upwards of 15 years to go on grid, SMRs offer a much faster turnaround. We're aiming to get them operational in the early to mid 2030s."

According to Alan, this swift deployment is crucial because in the next decade, the UK's existing base load nuclear capability will almost disappear – with all but one of the UK's existing nuclear plants reaching the end of their operational lives. While projects like Hinkley Point C are on the horizon, Alan says it's a long-term project that cannot bridge the demand gap alone.

He adds: "Without a fleet of SMRs, achieving net zero emissions is an incredibly difficult task. Although essential renewables like wind and solar lack the consistent base load power that nuclear offers to be enough to meet the growing energy demands. SMRs can provide a reliable, low-carbon foundation to make that happen."

Alan says that although SMRs are still expensive, they're affordable compared with large 'gigawatt-scale' nuclear plants, allowing companies to invest in clean energy directly. An SMR installed next to an industrial facility can reliably power the activities with clean energy.

So, what does that mean for the UK and the rest of the world?

"The initial deployment of the technology will likely be in the UK," says Alan. "This will create massive growth opportunities for the nation and the economy.

"The real impact lies in the supply chain, where SMRs will create thousands of high-

Modularisation is Rolls-Royce SMR's unique selling point which makes the solution affordable for all. Image: Rolls-Royce SMR.

skilled, long-term jobs for generations to come. We're talking high-calibre positions that will require significant training and expertise. And this won't be a temporary boom – the demand for these skills is here to stay."

When building SMRs in a specific country, sourcing components from that region reduces logistical challenges. So, while maximising UK capabilities for production is a priority, Alan notes that the global supply chain is equally important in this journey.

He says: "Every SMR, every power station relies on millions of components. Manufacturing all these components requires significant capacity. With maturity of the project, production will also scale up from one SMR per year to two to four and so on. Imagine needing 40 million components instead of ten million annually. Our existing capacity is bound to struggle.

"This is where the global solution comes in. We need to utilise manufacturing capabilities worldwide, while also mitigating risks of relying on single-sourcing of parts. This global deployment strategy creates a massive opportunity for the entire global supply chain."

Earlier this year, it was announced that a new testing facility for SMR prototype modules is being established within the AMRC's Factory 2050 facility in Sheffield. The Module Development Facility will produce working prototypes of the individual modules that will be assembled into Rolls-Royce SMR power plants.

"Our collaboration with the AMRC on SMRs goes back to 2017, even before I joined the Rolls-Royce SMR team," says Alan. "We knew we needed a digital backbone for our future factory, and the AMRC's expertise in both digital and assembly solutions made it the perfect fit.

"There's a long history of successful collaboration between Rolls-Royce and the AMRC, so it wasn't by accident that we ended up there.

"It's the perfect environment to experiment and develop methodologies. The AMRC's proven track record with Rolls-Royce in aerospace, combined with its unique skill set, made it our obvious choice."

The AMRC's work with Rolls-Royce SMR started with Module Demo One, after which the teams moved to something different – exploring digital instructions and data acquisition. This was followed by a cell demo which was building the first cubic module. According to Alan, each project was a stepping stone towards Experi.

He says: "From the first module project and now Experi, the AMRC has been a key partner in this process, helping us develop solutions that will become the foundation of our factory. Our partnership with the AMRC is built on trust, and there's a shared vision for the future.

"The entire AMRC team understands the bigger picture – how its work contributes not just to individual projects but to the creation of a factory and beyond. This focus on technology transfer to UK industry is what the AMRC does best."

It has been seven years since Rolls-Royce SMR sowed the seeds for a clean, affordable energy solution, and the journey has only begun. So, what keeps Alan and his team going?

"Developing these processes right now can feel like hard work," he says. "But we're laying the groundwork for the next 150 years.

"This isn't just about the here and now; it's about shaping the future for all those who come after us."

"The real impact lies in the supply chain, where SMRs will create thousands of high-skilled, long-term jobs for generations to come."

Alan Pardoe, manufacturing capability delivery manager, Rolls-Royce SMR.

Discover more

Cultivating the future of agriculture

By Lucy Hilton

AMRC Cymru is ploughing ahead with trials of the UK's first commercially available fully-autonomous tractor at Coleg Glynllifon to see how it fares in grassland farming.

The agriculture sector, a key part of supply chains for a range of industries, is under increasing pressure to produce high-quality, low-cost food for the population, whilst reducing environmental impacts. Amongst a host of challenges, two key aspects compounding the pressures the sector is feeling are labour shortages and consistency of operations.

The AgBot, funded through a £1.5m capital purchase grant AMRC Cymru secured from the Welsh Government, is designed to create a smaller, lighter and more efficient tractor unit, that can run non-stop and unsupervised for up to 23 hours and reach speeds up to 12 km per hour.

Currently, an AgBot is approximately two times more expensive than a conventional tractor, but could provide long-term savings when it comes to fuel consumption, labour costs and the capacity to switch out its diesel generator for the future potential of greener non-fossil fuels, such as hydrogen.

The AgBot is able to plot out the most efficient route on the field and because it has the standard three-point linkage, it means the tools and equipment hitched on to the front and back are compatible with those currently available in farming.

The trials at Coleg Glynllifon, part of Grŵp Llandrillo Menai, are new territory for the equipment, demonstrating applications that have not yet been trialled before, along with head-to-head comparisons with conventional tractor systems – both semi-autonomous and traditional. The purpose and application of these trials is to learn how the AgBot works with grassland farming, as opposed to its usual domain of arable farming.

Andrew Williams, ASC Autonomy Ltd AgXeed distributor for England and Wales, said: "It will be really interesting to see the results of the AgBot working alongside, and compared with conventional tools in a different application than usual."

Recent work by AMRC Cymru, which is part of the wider University of Sheffield

Advanced Manufacturing Research Centre (AMRC), has highlighted a lack of confidence within the agriculture sector to invest in automation technologies as, despite the increased and widespread use within manufacturing, the application to agriculture is still in its infancy.

The use of automation in the agricultural sector – whilst surrounded by some uncertainty – presents significant opportunities for efficiency and quality improvements with wide reaching benefits, which are already being demonstrated within manufacturing sectors that have engaged with these technologies.

As part of the High Value Manufacturing (HVM) Catapult, the AMRC is addressing major challenges in agri-tech and food by bringing new technologies to market that benefit the economy, public health and environment.

Dr Lynne O'Hare, chief portfolio officer at the HVM Catapult, said: "One of our four strategic priorities as a network is healthy living, which covers health tech, agri-tech, food and pharma. They are all challenged with the same pain-points: the lack of integrated solutions and a sizable labour gap.

"By leveraging the network's collective capabilities in cutting-edge technologies such as robotics, AI, digitalisation and engineering biology, we can develop innovative solutions to reduce emissions, secure sustainable supply chains and address the significant skills shortage."

By working directly with professional farmers alongside AMRC Cymru experts, it is hoped that the trials will build

"These trials have been the result of the AMRC embracing the farming community's views on technology use."

Andrew Martin, head of food, drink and agri-tech at AMRC Cymru.

the agriculture sector's confidence in emerging technologies.

Alex Lewis, manufacturing engineering lead at AMRC Cymru, said: "What an image to conjure, when advanced technology engineers are able to stand in a field with the beautiful Welsh landscape as a backdrop, alongside a team of professional farmers, all joining forces to conduct real-world trials for advanced, autonomous equipment.

"It is envisaged that the results of the project will provide some well-tested and objective guidance for farmers in Wales, and beyond, when considering the future for autonomy of this nature within agriculture."

To combat sector uncertainty, and in a UK-first, the AgBot's real-world field trials will assess efficiency gains, cost implications and the current and potential future energy systems that may be employed to affect autonomous farming operations. This will allow farmers to make informed decisions on the technology and help aid and de-risk future investments by the farming community.

The first trial, mowing grass for silage in Tyn Rhos, will be followed by cultivation in Tyddyn Gwian Uchaf. Both trials will see three vehicles tested: an autonomous tractor – AMRC Cymru's AgXeed AgBot; a semi-autonomous tractor – the Fendt 516 with autosteer; and a traditional tractor – the Fendt 516 with the autosteer functionality deactivated. The Fendt 516 was chosen as it has similar power to the AgBot, and was provided by Emyr Evans Tractors.

Laura Azais, senior manufacturing research engineer at AMRC Cymru, attended the first day of trials. She said it was interesting to observe how the same task of mowing could be performed by three vehicles with varying levels of technology.

"Initial observations reveal a clear set of pros and cons for each vehicle, which are heavily influenced by the landscape type, field shape and size," she said. "A significant benefit of the autonomous tractor is that it doesn't require a driver, which allows it to run 24/7, although it does necessitate some time and technical skills for setup."

Variables measured for analysis will include fuel consumption, locational variance, total distance travelled, total time, working speed, missing/overlapping strip, personnel resource, Power Take-Off (PTO) speed, active time, and quality.

Fuel consumption quantification was also considered, with each vehicle starting with a 100 per cent full fuel tank – any available data gathered during the trials will be utilised and verified with weighing scales to enable an accurate fuel volume for calculations.

Though the AMRC Cymru team is hoping the trials will demonstrate the AgBot's strengths, they're also welcoming the opportunity to learn more and improve. Looking ahead to prospective results, manufacturing lead, Alex, added: "We're seeking to understand the potential application of autonomous agricultural vehicles in real world environments.

"Without wishing to jump the gun, during the trials we have seen many potential benefits to autonomy, from outstanding accuracy in the field, to being able to see the 'hands-off' possibilities ahead.

"Conversely, some limitations in the autonomous system have been hinted

The AgBot on site at the Tyn Rhos trial.

The AgBot trials at Tyn Rhos were made possible with support from researchers and staff from the AMRC and Coleg Glynllifon. Pictured L-R: Alex Lewis, Wyn Davies, Laura Azais, Rhodri Owen, Harry Collins, Esmor Hughes.

at, which may show how the flexibility of conventional systems presents itself when certain situations arise.

"I expect we will see some trade-offs in the short term, but we anticipate an increase in further development and acceptance from farmers for this type of autonomy on the farm."

Work undertaken ahead of the trials in May 2024 looked at field mapping and preparation, and individual tractor testing and preparation. Each field to be used was divided into three blocks of approximately 1.4 hectares, centrally located within the fields to reduce the impact of any variability.

The Global Positioning System (GPS) equipment used during mapping utilises Global System for Mobile Communications (GSM) networks to improve the GPS accuracy and provide access to the mapping interface, as mobile network coverage is limited and signal stability is poor in the selected fields – an issue faced across the sector.

At Tyn Rhos, a three-metre buffer zone was left around each block to allow the AgBot to complete a final defining cut, giving more precision to the blocks than a contractor may be able to achieve, providing accurate coordinates and a defined area for each block via the AgBot mapping software.

Harry Collins, a senior manufacturing research engineer at AMRC Cymru, he shares a personal connection to the work – his family has a small holding with 120 acres of land, home to a flock of commercial sheep, as well as a group of pedigree sheep.

Harry said the first trial highlighted some important improvements that will be needed to further excel in a grassland environment, adding: "We've been able to learn how the AgBot works with grassland-farming, and consequently, we can work towards even better results and help de-risk future investments by the farming community."

Prior to each trial, all vehicles are tested to ensure everything is set up and working as required. For the AgBot, this was physical preparation and testing with all equipment attached and connected, as well as sensor fitting, assessment of extractable data and job creation, and path planning for the trial date.

In a similar manner to the mowing trials in Tyn Rhos, the cultivation trials in Tyddyn Gwian Uchaf will utilise the AgBot to cultivate all areas around the blocks used for the trials, providing a similar level of visibility of the three blocks.

Martin Jardine, director of agri food at Grŵp Llandrillo Menai, said it was fascinating to be part of the Tyn Rhos trial at Coleg Glynllifon. "Seeing the team put the AgBot through its paces, cutting silage on a working farm was great to see," he said. "I look forward to the findings of this unique research programme – it will be interesting to see how each compares in terms of speed, accuracy and efficiency.

"At Coleg Glynllifon we have the practical, hands-on knowledge of agriculture to complement AMRC Cymru's proficiency with emerging technologies. We are excited to continue our collaboration with AMRC Cymru as we look to discover potential productivity and sustainability gains for the Welsh agricultural economy."

Andrew Martin, head of food, drink and agri-tech at AMRC Cymru, is also committed to driving industrial transformation within farming. He said: "We want to de-risk technology so that informed decisions can be made by farmers in these challenging times.

"These trials have been the result of the AMRC embracing the farming community's views on technology use, looking at how we can get advanced manufacturing technology into farming, to the areas where it can really help, particularly land management and staffing.

"The partnership is a key aspect of how the AMRC can really look to deliver a transformational change through applied farming technology, which will develop long-term solutions."

AMRC Cymru serves up expertise for Oscar Mayer

By Lucy Hilton

AMRC Cymru has partnered with chilled food manufacturer Oscar Mayer to share its research and development expertise and help drive digital and sustainable innovations in the business to improve production efficiencies.

As part of AMRC Cymru's ambition to support the food manufacturing sector, the centre will work with Oscar Mayer to increase its capability and capacity in advanced food manufacturing, working collaboratively to support knowledge and transfer technologies.

The collaboration aims to provide whole supply chain solutions to revolutionise operations and propel Oscar Mayer into a new era of digital transformation and sustainability. A knowledge transfer partnership will also be explored, involving centralised data management, digital twin technology and long-term expertise.

One of the flagship projects of the collaboration is the digital factory footprint, which aims to transform the existing factory layout into a sophisticated digital simulation, allowing for the benchmarking of the simulation against actual production data to ensure accuracy and reliability.

The digital model will then help enhance production efficiency by simulating production scenarios, allowing for the identification of eliminations of bottlenecks to streamline layout. It will also allow the team to test new ideas and changes in a virtual environment without disrupting real-world operations, whilst making it easier to understand the impact of proposed modifications.

Another critical focus of the partnership will be energy efficiency, as the project aims to install advanced energy monitoring sensors across Oscar Mayer's facilities, allowing the collection and analysis of data to reduce energy consumption and minimise its carbon footprint.

Andrew Martin, head of food, drink and agri-tech at AMRC Cyrmru, is proud to be supporting a key local business that shows the strength of adopting change required in advanced manufacturing.

The Oscar Mayer team visit AMRC Cymru's facilities.

He said: "Oscar Mayer is a strategic business within the Welsh economy, who have embraced the development of new digital transformation in a drive through its environmental, social and governance work.

"The partnership we have embarked upon will not only develop Oscar Mayer's strategic goals, but drive forward new areas of digital engagement that will impact both new productivity within the business and on the wider, overall food supply chain.

"We are proud to be a strategic partner in the endeavour and welcome other food businesses to join us on this transformational journey."

Oscar Mayer, which specialises in developing and producing chilled prepared foods and has more than 90 years' experience in the UK grocery market, has sites in Wrexham, Flint and Erith.

The AMRC, which is part of the national High Value Manufacturing Catapult network of research centres, has world-class capacity to replicate an entire supply chain to make changes that have real impact for businesses and for the planet. It is ideally positioned to work with Oscar Mayer and help support its commitments of using resources wisely and responsibly, using less energy and creating less waste.

Ian Toal, chief executive officer of Oscar Mayer, said: "Our partnership with the AMRC is an exciting step forward for Oscar Mayer. We are thrilled to collaborate and drive innovation together, paving the way for a sustainable and efficient future in food manufacturing."

‘Tasty Spoon’ aims to boost flavours for people with dementia

By Chloé Rothenburg

A new spoon to enhance the flavour of food for dementia patients experiencing a loss of taste is being developed by researchers at the University of Sheffield and the AMRC.

The Tasty Spoon™ is a breakthrough technological aid looking to use electrostimulation to help people with taste loss, a symptom of the neurological condition, with the hope to maintain a level of healthy nutrition.

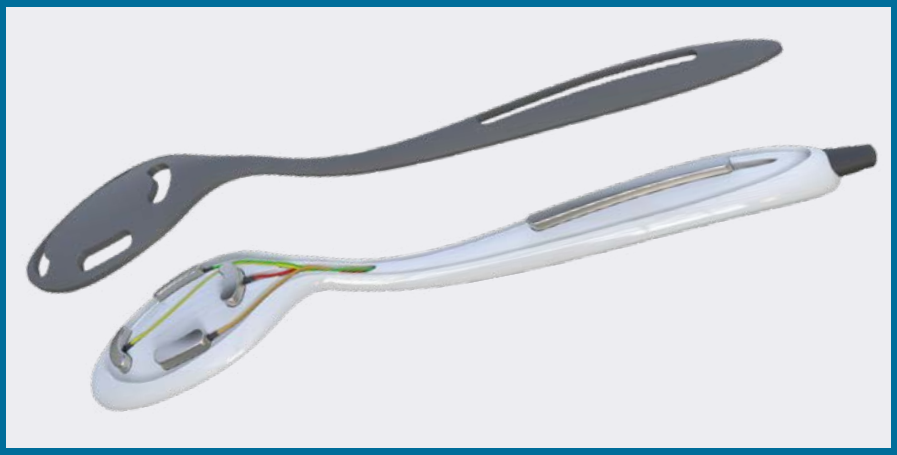
It is being developed by the University of Sheffield, drawing on the design and prototyping expertise of AMRC engineers to create the spoon.

Dr Christian Morgner, of the University of Sheffield’s Management School and Healthy Lifespan Institute, said: “A loss of taste can remove the enjoyment of food which impacts patient wellbeing as food plays such a significant role in our lives. This is especially prevalent in patients who live alone or in public care homes with more generalised nutrition.

“The development of a technological aid like the Tasty Spoon™ has the potential to rekindle the pleasure of eating for those facing taste-related challenges and therefore contributes to better health as well as mitigating the expense of treating the side-effects of poor nutrition for the NHS.”

The rechargeable device, resembling a traditional spoon, is set to be easy to use unassisted and be simple to clean. It aims to help patients differentiate between different types of food and restore an enriching meal experience and aims to use established distribution channels for patients and carers.

The AMRC is bringing its design and prototyping knowledge to the project by developing a proof-of-concept prototype spoon that will incorporate the electronics needed to deliver the subtle electrostimulation to the user – alongside considering environmentally-friendly materials and production methods.



A CAD model of the first ‘tethered’ proof-of-concept prototype of the Tasty Spoon™.

It will also work with user groups to evaluate waveforms and frequencies to see if users can determine enhanced flavour through the Tasty Spoon™ – as well as determining the optimum positioning of the electrodes that will be embedded in the spoon.

Marcus Crossley, senior project manager in the AMRC’s design and prototyping group, said its engineers are very excited to be working in collaboration with the Alzheimer’s Society and Management School to develop the initial Tasty Spoon™ prototype devices.

He added: “Working closely with people living with dementia will enable us to evaluate and refine functional and inclusivity aspects of the aid, with the goal of enhancing people’s quality of life.”

The project has been funded by the Alzheimer’s Society’s Accelerator Programme – designed to support people to boost new dementia products and innovations to market – to work on the commercialisation of the Tasty Spoon™, making it accessible and affordable for people living with dementia.

Simon Lord, head of innovation at the Alzheimer’s Society, said: “A healthy, balanced diet can help improve a person’s quality of life. However, common symptoms of dementia, such as memory loss and difficulties with thinking and problem-solving, can make it more difficult to eat and drink well.

“That’s why we’re excited about the possibility Tasty Spoon™ presents in improving the taste and enjoyment of food and improving the health and nutrition of people living with dementia.”

South Yorkshire clean-tech zone powering green future

Abdul Gheit, experiemental officer, adjusting site controls at the University of Sheffield's Translational Energy Research Centre (TERC) facility.

The conversation around energy transition is shifting. While environmental concerns remain paramount, a new focus is emerging: the economic opportunities this transition presents for UK manufacturers. **Experts from the University of Sheffield's Advanced Manufacturing Research Centre (AMRC) and Energy Innovation Centre (EIC) explore this interesting shift**, highlighting how South Yorkshire is positioning itself as a national leader in the UK's clean-tech sector.

"In recent years, government leaders and lawmakers have been changing their narrative about energy transition," says Stuart Dawson, the University of Sheffield AMRC's chief engineer for hydrogen.

"The discussion is moving away from ecological consequences of inaction and towards highlighting the economic opportunities."

Stuart cites Graham Cooley, former chief executive officer at ITM Power, who says that manufacturers must realise that 'energy transition is also an economic transition'. This aligns with the views of Chris Skidmore, author of Mission Zero: An Independent Review of Net Zero[1], who states that 'net zero is the economic opportunity of the 21st century'.

This increasing emphasis on explicitly seizing the economic potential of energy transition is being welcomed with open arms in the UK. Stuart explains why.

"In the past, the UK has often failed to fully capitalise on such opportunities. For example, the UK's off-shore wind programme. Over the past 20 years, the UK has deployed some of the largest off-shore wind farms in the world – the largest off-shore wind capacity in Europe and second only to China in installed capacity.

"This huge deployment of off-shore wind turbines has massively contributed to the decarbonisation of the UK's electricity production.

"So, a great success story then? Well, environmentally – yes, but for the first two decades the programme featured less than 20 per cent of UK-manufactured content. That is, despite the UK's hugely successful deployment of off-shore wind, we only captured 20 per cent of the manufacturing opportunity.

"As the energy transition ramps up we need to maximise UK-manufactured content in clean technologies rather than importing it from abroad."

The energy transition will open multiple doors. But what is the scope and scale on offer?

"It is mind boggling," says Stuart. "The 2019 UK Climate Change Act commits the government, by law, to reduce greenhouse gas emissions by at least 100 per cent by 2050, compared with 1990 levels.

"Despite the UK's impressive 73 per cent reduction in emissions from electricity production as compared with 1990 levels, 75 per cent of the UK's energy still comes from fossil fuels.

"But largely, even now – petrol, diesel and aviation fuel power transport and natural gas provides heat for buildings and industrial processes. If we are to hit

net zero by 2050 then all these fossil fuels will need to be substituted or decarbonised within the next 26 years."

So, if achieving the UK's energy transition requires a 'level of deployment that is unprecedented and eye-watering'[2], then what is the size of the economic prize?

Stuart explains: "If we consider just the potential scale of the future hydrogen economy: in April, the Hydrogen Innovation Initiative[3] published its 'UK Hydrogen Innovation Opportunity', which estimated the global hydrogen technologies' market to be worth $1tn annually by 2050. The UK's share of this global market could be worth £46bn per annum by 2050 and create 410,000 jobs.

"For context, according to the ADS 2024 Aerospace Sector Outlook, in 2023 the value-add of the UK's aerospace sector was £19.9 billion and it directly employed 104,000 people[4]. Technologies that support hydrogen production, propulsion and industrial decarbonisation are highlighted in the report as three of the UK's biggest opportunities."

So, how is the South Yorkshire clean-tech cluster coming to life?

"At both national and international levels, there is an imperative to transition to greener processes for the sake of the wellbeing of our planet and the people on it, as well as an economic boost," says Professor Mohamed Pourkashanian, managing director of the Energy Innovation Centre (EIC) at the University of Sheffield. "And South Yorkshire has become a major hub to serve this purpose, leading the way to make aviation more sustainable, in the last decade.

"Decarbonising aviation by making the fuel it uses more sustainable is a vital part of the puzzle for making flying a more environmentally-friendly mode of transport. The EIC brings together TERC and Sustainable Aviation Fuels Innovation Centre (SAF-IC) to support first-hand the crucial work being done to decarbonise industry in the aviation sector and beyond.

"Whilst some modes of transport can be made electric through batteries or adapted to run on hydrogen, this isn't yet possible for jet engines. Instead, developing sustainable aviation fuels (SAFs) – which can be used as fuel straight away with no changes needed to engines or the fuelling infrastructure we already have – is what will help us to remove up to 80 per cent of the emissions from flying."

> **"Clean-tech manufacturers need innovation, and innovation is what we do best at the AMRC."**
>
> **Stuart Dawson**, chief engineer for hydrogen, University of Sheffield AMRC.

The EIC's two research facilities are the only places in the world where you can capture carbon, produce green and blue hydrogen, store them or convert them into sustainable aviation fuels and analyse their performance and technical suitability. The EIC is also home to the UK's only Sustainable Aviation Fuels Clearing House, which provides cross-industry support for the development, testing, qualification and production of sustainable aviation fuels.

"We're building South Yorkshire as the place to be for sustainable aviation and industrial decarbonisation."

The AMRC is helping to push things further

"Clean-tech manufacturers need innovation, and innovation is what we do best at the

Ihab Ahmed, researcher, setting up an auxiliary power unit testing rig at the TERC facility.

AMRC," says Stuart, who has been leading the AMRC's research into hydrogen since 2020.

"We recognise the huge, time-critical opportunity to create a solid support system for clean-tech manufacturers, and this is reflected in the AMRC's core technology theme of future products and processes.

"Our capabilities help clean-tech manufacturers to innovate and scale-up at all stages of the product lifecycle. We're working on innovation projects with partners like ZeroAvia, Toyota, Chesterfield Special Cylinders and EON Power."

But that's not all.

Earlier this year, Rolls-Royce SMR announced the set up of a new testing facility within the AMRC's flagship Factory 2050 facility in Sheffield. This new multi-million pound Module Development Facility will manufacture and test working prototypes of individual modules that will be assembled into the Rolls-Royce SMR power plants.

Rolls-Royce SMR is the first UK reactor design to be submitted for regulatory justification by the UK Government and is also currently progressing through the Generic Design Assessment (GDA) process by the nuclear industry's independent regulators.

Professor Harry Burroughes, who heads up the AMRC's Factory 2050 facility, says SMRs could be a significant technology supporting the UK's climate change targets, and explained that the AMRC has been research partners with Rolls-Royce SMR on modular builds since 2017.

He adds: "We are now supporting Rolls-Royce SMR in developing a manufacturing process for the Mechanical Electrical Pipework (MEP) modules, containing as much innovation and advanced Industry 4.0 techniques as possible before the production ramp-up phases start – thus, scaling-up years of fundamental research to full-scale products and processes.

"The key to having SMRs available to support the UK's climate-change targets is pace, and the pace at which we are moving is incredible. In the last two years, we have moved from a small tabletop to a now 14-metre demonstrator, which is absolutely world-class – and we don't plan on slowing down.

The AMRC is using filament winding technology to manufacture lower cost and lightweight composite pressure vessels that can store hydrogen to be used as a clean energy source.

"This new opportunity is a brilliant way to showcase how innovation can have a real-world manufacturing impact, and we are proud to be playing our part in this crucial technology for the world's future sustainable energy needs."

In July 2023, South Yorkshire was named the UK's first Investment Zone – further accelerating its continuous drive for innovation, job opportunities and fostering sustainable development and economic growth.

"The UK's first Investment Zone, world-class research capabilities of the AMRC, TERC and SAF-IC, and the presence of major clean-tech companies such as ITM Power, Lhyfe, Suiso, Hybrid Air Vehicles and CPH2 form a powerful trident – helping establish South Yorkshire as one of the UK's leading clean-tech manufacturing and innovation clusters," says Stuart.

Professor Pourkashanian adds: "There's also the fact that Boeing – with its first European factory in Sheffield – is a major partner to both the AMRC and the EIC, and has several major projects to make the manufacturing of aviation components more sustainable, supporting clean-tech energy transition."

Composites at Speed and Scale (COMPASS) is one of them – a major boost to aerostructure manufacturing in the UK, with a new research facility in South Yorkshire with Boeing as its first major research partner. It will help solve composites manufacturing challenges needed to meet future demand for lighter commercial aircraft, and help the aviation industry reach net zero.

Stuart says the scale and breadth of the energy transition puts huge economic opportunities on the horizon for UK manufacturers.

He adds: "A combination of the expertise and cutting-edge technology that lies in the region, the work that the AMRC is doing in the field, along with a strong industry network and support, inevitably puts South Yorkshire on the map as a major clean-tech hub and a rapidly growing leader in the sector – and in the process helping the UK capture the economic opportunities of the energy transition."

References

1 MISSION ZERO – Independent Review of Net Zero (publishing.service.gov.uk).

2 An Efficient Energy Transition: Lessons From the UK's Offshore Wind Rollout (institute.global).

3 The HII report was commissioned to provide a common understanding of the opportunity that the emergent global hydrogen economy presents for the UK and highlights the steps needed to build the UK industrial capability and capacity to position the UK as a market leader.

4 Value of aerospace, defence, security and space sectors to UK up 50 per cent over 10 years – ADS Advance.

Developing viable zero carbon emissions flight

By Chloé Rothenburg

Engineers from the AMRC are part of a new £17.5 million project to evolve next generation fuel cell technology that is set to soar and provide a viable solution for zero carbon emissions flight.

Working in collaboration with ZeroAvia, a global leader in the development of hydrogen-electric propulsion systems for aircraft, the Advanced Fuel Cells for Aviation Decarbonisation (AFCAD) project will develop and define high temperature fuel cell systems to enable zero carbon emissions flight for regional aircraft, providing a significant contribution to tackling the world's climate emergency.

The project team secured £10.5m of UK government funding through the Aerospace Technology Institute (ATI) strategic programme – with the rest of the funding coming from industrial partners. It is being delivered in partnership with the Department for Business and Trade, Innovate UK, and industry.

The consortium, made up of the AMRC, ZeroAvia and the University of Kent, alongside Coventry University, will work together to advance this crucial technology towards commercialisation. The research will centre on developing components and the full high temperature PEM (HTPEM) fuel cell stacks, demonstrating previously unmatched levels of specific power and durability.

Due to a heavy reliance on fossil-based fuels, the transport sector currently contributes approximately 25 per cent of global greenhouse gas emissions.

ZeroAvia's fuel cell stack that will be used to develop rate capable assemblies for, with the completed stacks aimed to go into its 2000 powertrain aircraft. Image: ZeroAvia.

James Hunt, future propulsion lead at the AMRC, said that the aerospace sector is particularly difficult to decarbonise, due to the high energy density requirements needed to power an aircraft over long distances.

He added: "Various studies in the sector have identified that hydrogen fuel cell electric propulsion could be a viable zero carbon emission technology for aircraft, ranging from small size air taxis and eVTOLs, through to regional aircraft flying up to 90 passengers over distances greater than 500 miles.

"A hydrogen-electric propulsion system consists of a number of key sub-systems onboard the aircraft. Very simplistically, this starts with hydrogen storage which can be gaseous or cryogenic liquid, a fuel delivery system comprising of a multitude

The consortium, which includes the AMRC, is further developing fuel cell technology to enable the completed fuel cell stacks to be able to go into ZeroAvia's 2000 powertrain aircraft (pictured above). Image: ZeroAvia.

of pipes, valves, pumps and fittings, the fuel cell system which generates electrical power via an electro-chemical process – and the propulsion system which, in itself, can comprise of an electric motor, gearbox and a propeller.

"To get the power density required for longer distance flight, the fuel cell system can be the limiting factor, where scaling up results in additional weight and aerodynamic drag. Within the AFCAD project, ZeroAvia is developing its next generation system based upon high temperature proton exchange membrane (HTPEM) technology, which many in the industry believe to be key to unlocking hydrogen-electric propulsion for regional jets and beyond."

The AMRC is supporting ZeroAvia by addressing the manufacturing challenges for some of the key components in the fuel cell, such as the bi-polar plates, as well as researching the best way to assemble the stack. Each fuel cell can have upwards of 1,200 individual components, which all need to be accurately positioned sequentially to ensure efficient operation of the stack.

Lee Wheeler, future mobility lead who will be overseeing the AFCAD activity at AMRC Cymru, explained: "In designing an optimised production process and pilot line, we will de-risk the industrialisation of the ZeroAvia system to ensure that the HTPEM stack module can be assembled with zero defects at the rate and scale required by the aerospace sector, helping anchor manufacturing in the UK and deliver zero emission flight."

Val Miftakhov, chief executive officer for ZeroAvia, said: "The award of this project recognises that ZeroAvia is best placed to develop this technology and that the UK can garner strong industrial advantage from establishing leadership in high temperature PEM fuel cells for aviation and beyond."

Jonathan Reynolds, UK Government Business and Trade Secretary, said: "Our world-class aerospace sector added almost £40 billion to the economy last year, and by backing it to pioneer cutting-edge new technologies we're delivering economic growth and supporting high-skilled jobs in every part of the UK.

"It's fitting that I launched this new support at Farnborough Airshow, where the best of British innovation is showcased on the global stage, reinforcing our commitment to placing innovation and manufacturing at the heart of our industrial strategy."

The project, expected to run for three years, will develop the Technology Readiness Level (TRL) from TRL 3, which involves analytical and experimental critical function or characteristic proof-of-concept, to TRL 5, that looks at technology basic validation in a relevant environment – with planned entry into service for the HTPEM fuel cell by 2027.

"Studies in the sector have identified that hydrogen fuel cell electric propulsion could be a viable zero carbon emission technology for aircraft."

James Hunt, future propulsion lead at the AMRC.

The digital thread: A force of modern manufacturing

The AMRC's expertise across multiple capabilities puts us at the forefront of understanding and untangling the digital thread. But what is it, why does it matter and what is the AMRC's vision in this space? **Gavin Hill, senior theme lead for digital at the University of Sheffield AMRC, writes.**

Gavin Hill, senior theme lead for digital at the AMRC.

The AMRC's expertise across multiple capabilities puts us at the forefront of understanding and untangling the digital thread. But what is it, why does it matter and what is the AMRC's vision in this space? Gavin Hill, senior theme lead for digital at the University of Sheffield AMRC, writes.

'Data is the new oil.' Most of us have heard this phrase, coined by British mathematician, University of Sheffield alumni and entrepreneur Clive Humby, emphasising the immense value of data in today's world. Humby didn't stop there though: '...Like oil, data is valuable, but if unrefined, it cannot really be used.'

This insight pushes us to go beyond collecting data and focus on refining it into actionable information. This is where the digital thread starts to play a part in the analogy.

Just as oil gains value through refining, supplementing and being transported closer to where it's needed, the digital thread enhances data value. By creating a continuous data pipeline for a process, service, or product, throughout its lifecycle, we enable its potential future value.

At different stages, we add context to the data, allowing us to use information such as material characteristics, machinability and in-use performance to make better informed decisions. This might result in adjusting supply chains or altering product usage guidance. Essentially, the digital thread allows us to extract more value from our data.

The digital thread of a product is the flow of data throughout the lifecycle of the product, which provides a single, accessible data source. It can encompass all relevant data about a product, from its design and manufacturing, to its performance in the field and disassembly or second life.

The existing digital thread of most products isn't perfect, but the effort of research in the space is about making it easier to adopt, and clearing the way for us to have a more valuable digital thread.

As an example, consider a clicky pen. The ideal, yet vastly over-engineered digital thread for this pen would include materials data, design specifications, manufacturing processes and even how often it has been clicked, through to disposal and recycling possibilities. This comprehensive data integration allows for continuous improvement of the design of the pen and the processes used to make it.

While here we take the example of using such an all encompassing digital thread for a pen, its true potential is realised in complex products like ships, smart buildings, planes or uncrewed aerial vehicles (UAVs).

Imagine a world where we can disassemble a vehicle at the end of its life, knowing exactly which parts can be reused, based on their history. We could know which parts can be recycled using emergent technologies and identify exactly how many tonnes of carbon dioxide were used to create and operate the vehicle. That is what a complete digital thread enables.

Interoperability can be difficult when adopting burgeoning technologies like Internet of Things (IoT), artificial intelligence (AI), and cyber-physical systems into a manufacturing environment. The digital thread acts as a conduit, supporting the seamless integration of these technologies to enhance manufacturing processes – without it, fully realising the benefits of Industry 4.0 would be challenging, if not impossible. This is the driver behind the AMRC's research investment in this space.

As with an oil pipeline, there are different ways to approach the implementation of the digital thread in manufacturing. Many large manufacturers rely on established manufacturing execution systems (MES) and product lifecycle management (PLM) systems from industry giants, like Dassault Systèmes, PTC and Siemens, to enable their digital thread. These systems are akin to the well-established, existing, oil pipelines. While reliable, they require significant investment and maintenance, which can slow down innovation and adaptation.

For many small and medium-sized enterprises, the cost of traditional MES and PLM systems is prohibitive. This has led to the emergence of new players offering Software-as-a-Service (SaaS) models with cloud-native functionalities for enabling the digital thread. These solutions are more cost-effective and adaptable, similar to buying a new, modern, plastic pipeline to transport your oil, that is easier to maintain and upgrade than the traditional pipe.

> **"It will support productivity, efficiency and adaptability improvements that give manufacturers the potential to set themselves apart from their competitors."**
>
> **Gavin Hill,** senior theme lead for digital at the AMRC.

The most radical approach involves questioning the very data models and foundations upon which current MES and PLM systems are built, down to their fundamental building blocks. This is like questioning the foundational aspects of our oil pipeline – if we should alter the pipe's profile, use a new pipe, or even transfer the oil as a gas instead.

At the AMRC, which is part of the national network of High Value Manufacturing (HVM) Catapult research centres, we've been exploring the digital thread concept for years – even before we knew what it was. Our research spans various aspects of the manufacturing lifecycle, providing valuable insights and advancements in this field.

We've taken efforts to enact research that views the digital thread problem from all three of the angles described above, because we know we need to support all types of manufacturers and understand how different the landscape may be in the not too distant future. Our activities include:

- **Automating the transition from computer-aided design (CAD) to optimised computer-aided manufacturing (CAM) programs for machine tools.** This key research focus requires a robust digital thread to provide the necessary data for creating precise CAM programs and enable feedback from machining centres.
- **Working with companies, including Rolls-Royce and BAE Systems, to optimise data transfer within supply chains through the connected model-based engineering environment programme.** The AMRC is working with BAE Systems, Rolls-Royce, Siemens, National Physical Laboratory and HVM Catapult partner the National Composites Centre. This ensures data, such as geometric dimensioning and tolerancing annotations within CAD models, can be transferred accurately, regardless of the PLM or CAD system used. This confirms the integrity of a digital thread between suppliers.
- **Our Factory+ project, using a Unified Namespace (UNS) approach built on open-source components to enable seamless data exchange within a manufacturing facility.** This project is a blueprint for future factory connectivity and a critical enabler of the digital thread.
- **Partnering with Siemens to deploy MES and PLM systems, providing a robust foundation for our digital thread research.** Additionally, we're expanding our collaborations with Dassault Systèmes and PTC to allow us to utilise their tools in this space and support a wider set of industrial demands.
- **Investigating data structures and representation, leveraging concepts and technologies like ontologies, 4D modelling and SysML V2.** This foundational research aims to influence future software offerings to meet the holistic needs of the manufacturing community.
- **The AMRC's UAV project, which serves as a practical application of the digital thread concept.** By focusing on design elements and incorporating tools like hardware in the loop (HIL) and interactive simulation analysis, we are gaining valuable insights into the effort required to implement a comprehensive digital thread in complex systems.

The AMRC took its UAV demonstrator to the MACH 2024 exhibition to serve as a visual and tangible focal point for our digital thread work. It has allowed us to understand the difficulties, opportunities and positives that come with implementing a digital thread for a product and the software stacks that stand behind it.

An uncrewed aerial vehicle (UAV), the AMRC's learning vehicle for the digital thread.

"Just as oil gains value through refining, supplementing and being transported closer to where it's needed, the digital thread enhances data value."

Gavin Hill, senior theme lead for digital at the AMRC.

The UAV will continue to act as a platform for our core research for years to come. We will be using the next two years to build a digital thread from requirements capture, through to the manufacturing stage – with the addition of specialised views into applying it in areas like machining, composites and additive manufacturing.

The key is that the UAV is in the public domain, meaning manufacturers, academics and anyone else can learn from it and engage with us to help guide the future direction of that research to make sure it is as beneficial as possible for UK manufacturers.

Looking ahead, our goal is to have all the necessary data available at the right time to enable optimal decision-making for a manufacturer, automating many of those decisions. This requires interoperable and modular software that can adapt to changing needs and preferences.

Over the next 12 months, we will focus on building a broad-based understanding of the digital thread within the AMRC and the wider manufacturing community – educating stakeholders and addressing knowledge gaps. We will work closely with industry partners to understand their pain points and align our research efforts with their needs. This collaborative approach will ensure our research is relevant and impactful.

We will enhance our technical capabilities by recruiting experts and investing in key areas of research, including deepening our understanding of digital requirements and manufacturing processes. We will continue to develop the UAV project by concentrating on specific sub-systems and the transition of their digital requirements through to the end of the design phase. This focused approach will provide valuable insights and practical applications for the digital thread.

In the long run, we aim to create a comprehensive digital data flow from raw materials to end-of-life for products. This involves integrating various digital systems and understanding the implications of any technical debt that comes along with them. By doing so, we will pave the way for a more efficient and sustainable manufacturing ecosystem.

The digital thread is not just a concept, but a transformative force in modern manufacturing. We are at the forefront of this transformation, exploring new technologies, rethinking data foundations and working closely with industry partners.

Discover more

Smart factory adoption transforms aerospace production line

By Chloé Rothenburg

Research engineers at the University of Sheffield AMRC have helped a global aerospace company to revolutionise its production line with smart factory adoption, enabling its only UK facility to reach new heights with record turnover figures.

LISI AEROSPACE, part of the French-owned LISI Group, is a leader in high-technology aerospace components and in collaboration with the AMRC, has successfully delivered the smart factory production line at its facility in Rugby to secure increased productivity gains in the aerospace fastener industry.

Mark Capell, general manager of the Rugby site, highlighted some of the outcomes and impacts of the work.

He said: "The project has resulted in some big impacts for our company, the new machines have demonstrated a huge improvement in performance by over 100 per cent, enabling us to hit record turnover figures at our Rugby site.

"We've also won additional work contracts worth over £2m and provisionally secured additional funding to implement a further two production lines by 2027 – alongside helping us to raise the profile of the business in the local area, helping to combat the national shortage of jobs in the area, enabling us to create 12 job opportunities in the new production line."

Taahir Patel, process development manager at Rugby, said the partnership had grown between LISI AEROSPACE and the AMRC over the course of the project, adding: "Collaborating with the AMRC team over the past four years has been immensely rewarding for the LISI Group.

Smart Factory production team working together to deliver a innovative production line. Image: LISI AEROSPACE.

"Together, we have successfully developed a new smart factory production line, which has also enhanced the skillsets within the process development department. This partnership has transformed our approach to project management, providing us with the fundamentals of running projects in an agile way."

Discussing the innovation delivered as part of the smart factory production line project, Mark said that it had pushed beyond the current global state-of-the-art in fastener production processes with key changes including the prediction of component quality from sensor data and data analytics.

The new generation of machines in the PoC production line at LISI Rugby. Image: LISI AEROSPACE.

He added: "It has also provided a basis of sustainable competitiveness and positions LISI AEROSPACE Rugby for success in the AIRBUS 2026 contract."

James Moore, AMRC project lead, said: "The deliverables for this project were wide-ranging and technically complex. This was compounded by significant delays in the delivery of the new machines due to the effects still being felt from Covid-19 and other recent global events in the supply chain.

"However, the close-working relationship built between the AMRC and LISI AEROSPACE engineers allowed us to work in an agile manner and quickly make changes to our plans and machine trials to react to the constantly changing situation.

"I'm very proud to have been part of this project and to have been able to deliver under such challenging circumstances. Additionally, I believe engineers on both sides have managed to learn a great deal from each other over the four years."

Other project partners, who are all suppliers of specialist machinery used in fastener manufacturing, included Earlsdon Technology (E-Tech) based in Coventry, SMART machinery in Italy and Danobat based in Spain.

Challenges overcome by the teams during the four-year project included the development of the smart factory production line; getting the team at LISI AEROSPACE to adopt the new technology; and creating a data-driven culture at the manufacturing site, which heavily relied on manual processes previously.

There was also the added task of developing a proof-of-concept for the prediction of component quality that could demonstrate a correlation between part quality and signal data, as well as the installation and adoption of the production line.

The innovation provided by the AMRC not only captured data from the new machines, but also analysed the data captured. The analysis identified key indicators within the five processes conducted by the smart factory machines that could be used to predict a reduction in the quality of the parts produced.

James added: "Our AMRC engineers developed a prototype monitoring architecture and data model for each of the machines that reaches technology readiness level (TRL) six, which requires a technology model or prototype demonstration in a relevant environment. These prototypes are now ready for further roll-out into production."

"The project has resulted in some big impacts for our company, the new machines have demonstrated a huge improvement in performance by over 100 per cent, enabling us to hit record turnover figures at our Rugby site."

Mark Capell, general manager of the Rugby LISI AEROSPACE site.

Aerospace fasteners manufactured at LISI AEROSPACE Rugby. Image: LISI AEROSPACE.

Taahir added that the project has enabled the introduction of an agile way of project managing, something they were unfamiliar with previously.

"The work has also facilitated a shift for us in terms of going from traditional engineering, to the creation of a process development team with exciting new roles," said Taahir.

"The job roles as a result of the new smart factory have been completely redefined, including a new and attractive approach to training and development. It has also enabled an expansion to our apprenticeship programme, to include roles such as software developers and data analysts to support the project."

In house development of LISI AEROSPACE's machine monitoring system has facilitated a pathway to upskill engineers with software development skills, and allowed further development of applications, such as the smart app developed to introduce gamification on the shopfloor, enabling the company to incentivise the workforce through engagement.

The project work has helped to enhance the knowledge of the LISI Group sites on the various types of sensors and machine learning, which is now being adopted, alongside creating a significant improvement in output to be gained by moving towards Industry 4.0.

Looking ahead, the LISI team at the Rugby facility is now looking at new opportunities for continued improvement of the new production line through the standardisation of processes, improved rejection windows and tooling cost savings through ongoing use of the models.

James said: "This project is an excellent example of aerospace manufacturing actively adopting Industry 4.0 technologies and reaping the benefits of such an adoption. LISI AEROSPACE, being one of the only fastener manufacturers to make this adoption, and being first, will undoubtedly give them an edge over their competitors in the future. Taking the project as a 'further proof-of-concept' for Industry 4.0 should provide further impetus for the manufacturing industry as a whole to begin their own journeys."

Mark added that for LISI AEROSPACE, the project has become a big showpiece case study within the LISI Group and will now be used as a template for future projects.

"The project has not only impacted the business, but also the UK economy with three of the machines being manufactured in the UK," said Mark.

"It now has the potential to be rolled out to the LISI Group globally, and using the smart factory technology has allowed us to increase its capacity and double production since 2021. Further plans will also double production capacity with the implementation of two further smart production lines."

"This project is an excellent example of aerospace manufacturing actively adopting industry 4.0 technologies and reaping the benefits of such an adoption. LISI AEROSPACE, being one of the only fastener manufacturers to make this adoption, and being first, will undoubtedly give them an edge over their competitors in the future."

James Moore, project lead for the University of Sheffield AMRC.

Making 5G Open RAN affordable and accessible for manufacturing

By Lucy Hilton

AMRC North West and a consortium of leading industrial partners have begun to test flexible Open RAN deployment options for the manufacturing sector, as part of the £4.6 million Factory of the Future Open RAN (FoFoRAN) project.

Alongside BAE Systems, Dassault Systèmes, aql, Productive Machines and SafeNetics, research engineers at AMRC North West, which is part of the University of Sheffield Advanced Manufacturing Research Centre (AMRC), are leading trials of new mobile tech, designed to increase the resilience of the UK mobile network and alter the current inflexible and unaffordable choice of manufacturing industries for 5G deployment.

FoFoRAN is one of 19 projects backed by an £88 million investment through the government's Department of Science, Innovation and Technology Open Networks Research and Development Fund trialling new mobile technologies.

The ambition is to increase the resilience of the UK mobile network, enhancing competition and innovation within the 5G telecoms supply chain and ensuring the country is not overly reliant on any one form of technology.

Dr Aparajithan Sivanathan, head of digital technology at AMRC North West, highlighted a big demand for manufacturers of all sizes to have greater connectivity, a higher bandwidth and near-zero latency of 5G to function effectively – alongside the need to help open up the telecoms supply chain so different companies can provide different parts of the 5G infrastructure.

"The current choice of manufacturing industries for 5G deployment is single vendor solutions, but it's an option that, in some ways, is inflexible and does not address all the unique requirements of advanced use cases of connected manufacturing and is unaffordable for smaller manufacturing businesses," he said. "Individual manufacturers need the freedom to choose components that are fit for purpose, have network vendor options, equipment suppliers and services at varying costs.

A human, robot and AI shared space enabled by 5G.

"Open RAN has the potential to be more affordable, interoperable, secure, reliable and provide the capabilities needed in industry. We are excited to build on our research in Open RAN in the hope of creating further innovative solutions in these areas."

Since beginning in October 2023, the project use cases are progressing well. Equipment has also arrived at the AMRC North West facility at the Samlesbury Enterprise Zone in Lancashire, with installation and deployment due later this year.

Abhul Qurashi, theme lead for connectivity at AMRC North West, said FoFoRAN's consortium of partners ensures a high level of collaboration throughout the project.

"There is a combined activity for the exciting High Density Data (HDD) testing later in the project, whereby all the partners will collaborate to test data throughput," he said. "We will simultaneously stress the bandwidth capacity of 5G and similar networking infrastructures to their limits for a combination of use cases and from multiple locations."

The project focus areas will help to determine how it compares with the current commercial off-the-shelf single vendor network deployment, and assess technical characteristics, performance and any potential deployment challenges – as well as helping to identify if it's possible to standardise network services for digital manufacturing use cases.

AMRC marks a decade of reconfigurable manufacturing

As the AMRC marks more than a decade supporting UK manufacturers in reconfigurable manufacturing, **Dr Lloyd Tinkler, senior technical fellow for electrical machines,** speaks to **Chloé Rothenburg** about the impact it has made.

Dr Lloyd Tinkler, senior technical fellow for electrical machines at the AMRC.

A government study published in 2013 on 'The factory of the future' sparked the idea for the AMRC to begin exploring reconfigurable manufacturing.

The report, which examined the trends to shape and influence the future of manufacturing, included a recommendation from AMRC founder Keith Ridgway for 'a design of agile, reconfigurable factories and extended enterprises'.

But what actually is reconfigurable manufacturing? It can be defined as a system designed for rapid change in its structure, as well as its hardware and software components, to enable quick adjustments to production capacity and functionality in response to sudden market or system changes.

Lloyd said the reconfigurable manufacturing theme of research is intimately connected with the AMRC's flagship Factory 2050 facility, and is one of the main drivers behind why it was built and why it is home to the suite of technologies that are the focus of engineers' research.

"The motivation behind this research area is to help UK manufacturers to be more agile and adjust what they produce and how much of it – and can allow them to be more competitive on the global marketplace," Lloyd adds.

Discussing why reconfigurable manufacturing is important to the AMRC, Lloyd explained: "In high-value manufacture, the production volumes are typically low, and therefore manufacturers cannot necessarily use the same automation as in mass production to remain globally competitive. For example, solutions to manufacture a car can't be applied to making an aircraft.

"Reconfigurable manufacturing systems mean that we can bring some of the benefits of automation, such as improvements in quality, throughput and increased traceability to this lower volume production.

"As we're a high-wage economy, we can't compete by throwing more people at it, we need to be smarter about how we produce things – and being more agile in what we produce and how much of it.

"This has run through from the very opening of Factory 2050; through all of the projects, including the use of digital work instructions, providing people with the support so they can produce more products of different variants."

The concept of a reconfigurable cell is extremely powerful for sustainability targets. The cell could initially be configured to perform some manufacturing

"The motivation behind this research area is to help UK manufacturers to be more agile and adjust what they produce and how much of it – and can allow them to be more competitive on the global marketplace."

Dr Lloyd Tinkler, senior technical fellow for electrical machines at the AMRC.

process then be reconfigured to do the disassembly of the product, and even reconfigured again to inspect and sort the raw materials. This enables the realisation of a truly circular economy, but all done in a singular cell without the need for commissioning expensive individual cells.

Over the past decade, the AMRC, which is part of the High Value Manufacturing (HVM) Catapult network of research centres, has developed reconfigurable manufacturing from an initial literature review on key technologies. These included robotics, autonomous mobile robots, smart tools and digital technologies to provide instructions to operators, and digital architecture to connect all these devices and allow data to flow around the factory – alongside development of a small scale demonstration funded by AMRC membership.

This demonstrated pivotal ideas and key concepts such as modularity and scalability to aid reconfiguration, and integrability through the use of message queuing transport telemetry (MQTT) communication protocol to connect legacy hardware into an internet of things (IoT) system.

What followed, with funding from the HVM Catapult, was that the AMRC developed the full-sized reconfigurable factory demonstrator cell (RECON) currently in use at the AMRC's Factory 2050 facility.

Since then the RECON cell has been used for shorter turnaround projects for a number of small and medium-sized enterprises (SMEs), automating the handling of parts in galvanisation processes, construction of modular housing, and the assembly of large magnets for wind power generators – helping to make this work faster and cheaper.

In the latter project for Sheffield SME Magnomatics, AMRC engineers demonstrated the reduction in installation time from 55 minutes to 55 seconds for each of the 204 magnet cassettes which make up the rotor; addressing a key bottleneck in scaling-up production.

"For me, this project showed a clear use for our RECON cell that was used for its intended purpose. We were able to demonstrate something and take it apart in a timely manner – which took just a couple of weeks," said Lloyd. "It was a perfect example of showing the benefit of having that reconfigurable flexibility."

In terms of what the future holds for reconfigurable manufacturing at the AMRC,

Pictured is the AMRC's reconfigurable manufacturing cell.

Lloyd said: "Our aim is to try to address one of the big challenges we grapple with at the moment: that although things are reconfigurable, like Lego bricks that all click together, there then remains significant work to reprogram it to get things to run properly.

"This is exactly the challenge we are addressing through the EPSRC-funded R3M (Reconfigurable Robots for Responsive Manufacture) project, which started in September 2021 and will finish in early 2025."

The consortium for R3M, led by Cranfield University, alongside support by Loughborough University and colleagues at the University of Sheffield and the AMRC, has been created to develop software tools which can accelerate the reconfiguration process to make this concept viable in real world manufacturing.

The project aims to develop a tool which automatically generates robot code using robot operating system (ROS2) from human readable instructions in automation markup language (AML), develop robust control strategies which ensure these programs can be deployed into the real world, and then automatically assess the risks associated with the reconfigured system to ensure this can be safely deployed.

Lloyd said that the goal over the next few years is to have more intelligent systems that can avoid a human going in and correcting the programs that can be created to produce particular components – reprogramming robots, reprogramming machine tools – reducing the time and effort to switch between different processes and products, and unlocking the benefits of reconfigurable manufacturing

He added: "We are on a journey that's not yet reached its end. There's more work still to do and it's looking to be an exciting time ahead."

Novel disassembly system unlocks sustainable solutions

By Chloé Rothenburg

A first-of-its-kind automated disassembly system that can inspect, dismantle and sort sub-components of legacy electric devices to reuse and recycle has been developed in a collaborative project between the AMRC and Siemens.

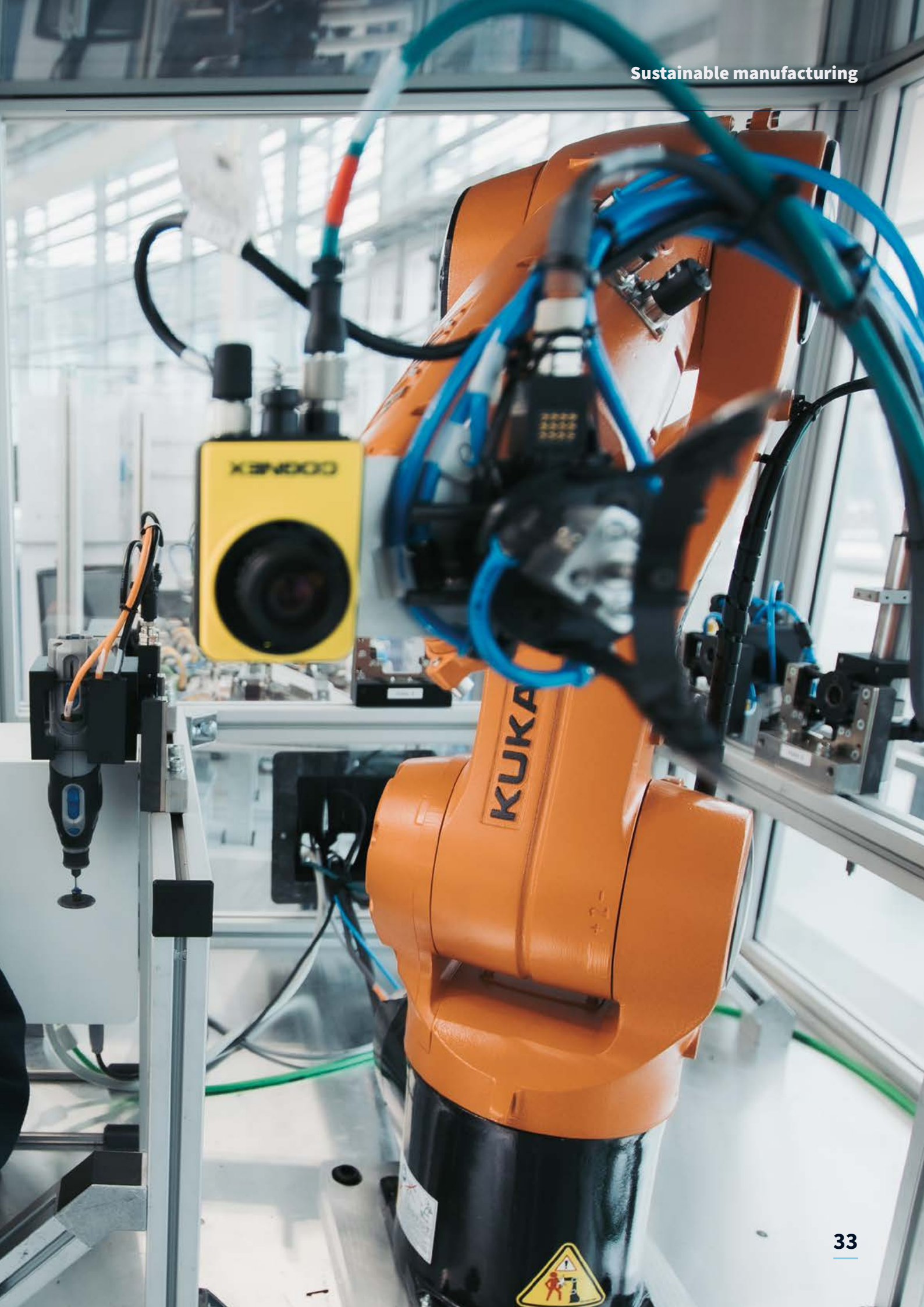
The project, which explored the feasibility of creating the disassembly system, was undertaken to drive forward Siemens' sustainability goals for its digital industries motion control products.

A spokesperson from Siemens said circularity and waste reduction are key pillars of its strategic framework for decarbonisation, ethics, governance, resource efficiency, equity, and employability (DEGREE). Through DEGREE, Siemens aims to achieve sustainable outcomes by optimising its own processes, and collaborating with research partners, the supply chain and customers on services such as predictive maintenance, repairs and servicing, reuse and recycling and collection systems.

"As a global technology company and innovation leader in electrification, automation, and digitalisation, Siemens supports the development of sustainable industrialisation," added the spokesperson.

"Through the development of software, electrification and automation technologies including AI, the business plays a crucial role in helping society achieve its global environmental goals, by providing systems that support the transition to a low-carbon economy.

"The partnership with the AMRC on the disassembly system is an example of where innovation can help Siemens,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as well as its wider customers, reduce procurement costs for input materials, energy supply and reduce waste volumes."

Following the success of the project, engineers at the AMRC are expanding their research to explore new ways to create a cell that has the scope to identify the product it needs to disassemble and the steps to disassemble it, alongside the tools it needs to use and the order to do it – creating a system that could automatically disassemble any component by itself.

Andreas Mertzios, research engineer at the AMRC, which is part of the High Value Manufacturing Catapult, explains how the scope of work will now be expanded.

He said: "Our work with Siemens was very successful – we've learnt so much about the challenges of the disassembly process and it's now got us wondering where we can go next.

"We have begun to work on a new project that aims to start the development of a cell that can identify what the product is that needs disassembling – and also work out 'on its own' what the steps are to disassemble it, what tools it should use, and in what order it should do it.

"The partnership with the AMRC on the disassembly system is an example of where innovation can help Siemens, as well as its wider customers, reduce procurement costs for input materials, energy supply and reduce waste volumes."

Siemens spokesperson.

Effectively, we are trying to create a cell in the future that can automatically disassemble anything by itself."

The initial collaborative project identified opportunities to recover and sort legacy components during their product lifecycles, where they hold a greater value for repair, reuse and recycling.

It included an additional need for the demonstrator to accommodate a range of Siemens products, meaning it had to be flexible in its products' fixturing solutions, as well as common tooling and operations to perform the automated disassembly.

In order for the team at the AMRC to develop an innovative disassembly solution, it analysed Siemens' existing product range under its drive technology motor inverters to understand the feasible orders and methods of disassembly to component level.

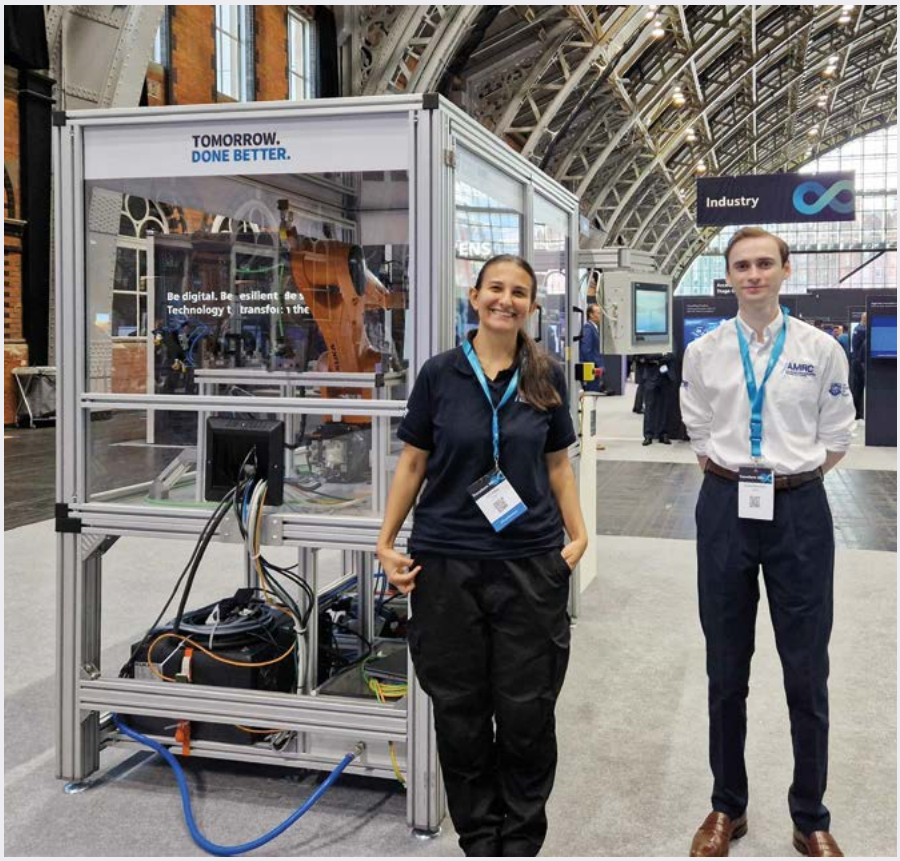
The exact product, a Sinamic G120C frame of a Sinamic drive, was used for the automated disassembly demonstrator, and included tooling and fixturing solutions for multiple product families.

The practical tests were complemented by research on automated disassembly techniques and tooling used in industry to make sure we achieved an efficient disassembly process which aligned with Siemens products.

A visit to Siemens to observe its assembly production line helped AMRC's mechanical design, and provided opportunities to assess whether assembly tooling and its methods could be re-used for the disassembly. Siemens NX, an advanced high-end CAD and CAM software was used to design the tooling, fixturing and the disassembly cell itself.

The solution was then developed further and implemented to create a reconfigurable, automated disassembly cell that could disassemble different product families. The team followed a design process that promotes agile manufacturing by completing fixturing and disassembly experiments ahead of the design being finalised.

A flexible fixturing system, which can secure multiple products using a single fixture with independently actuated pneumatic clamps, was designed to secure the different products – alongside a range of robot end-effector tooling



Lucy Mello, research engineer at the University of Sheffield AMRC, pictured with Daniel Newbold, senior software engineer at the AMRC.

Andreas Mertzios and Lucy Mello, research engineers at the University of Sheffield AMRC.

was designed to conduct the dexterous disassembly tasks.

The AMRC team used as many components from previous projects as possible. Most of the components in the final cell were sourced this way – and the approach kept final costs for the cell in budget and gave a second lease of life for the re-use of products that didn't have an allocated project.

Andreas said that the demonstrator successfully proved out the feasibility of an automated disassembly system, adding: "The system is able to inspect, dismantle and sort the sub-components of electronic devices for reuse and recycling – which has helped to close the loop of circular manufacturing."

As a result, using a combination of the AMRC's innovative methods and Siemens' technologies and know-how, engineers delivered the first connected disassembly demonstrator like this for Siemens' motion control products.

"The project has been fundamental for the AMRC and, by extension, the University of Sheffield's vision and strategic plan to support sustainable manufacturing, improve relationships with industry and innovate," added Andreas.

Following the success of the Siemens disassembly project, the work has been showcased at major events this year, including MACH at the NEC in Birmingham and Siemens Transform at Manchester Central.

AMRC engineers are now looking at expanding their research and are undertaking a project, funded by the High Value Manufacturing Catapult, on perception driven disassembly. Engineers are looking into technologies that already exist that would be helpful on expanding the AMRC's journey in this area further.

"We have begun to work on a new project that aims to start the development of a cell that can identify what the product is that needs disassembling. Effectively, we are trying to create a cell in the future that can automatically disassemble anything by itself."

Andreas Mertzios, research engineer at the University of Sheffield AMRC.

Empowering manufacturers with sustainable process tools

By Mrudula Jadhav

The University of Sheffield Advanced Manufacturing Research Centre (AMRC) has collaborated with an industry-led consortium of partners to deliver Project Butterfly – a direct response to the urgent need to decarbonise the manufacturing industry.

Project Butterly drives forward the innovation of digital technologies at the heart of manufacturing processes – with an aim of reducing any environmental impact and accelerating the industry's journey to net zero. The project explores scalable digital solutions for factory processes to lower CO_2 emissions by reducing material consumption and energy use.

Funded by Innovate UK under the Made Smarter innovation challenge, the project consortium comprises a wide array of partners, including the AMRC, BAE Systems, Leonardo, Nissan, Accenture, Intellium, GKN Aerospace, Moy Park and University of Lincoln. The consortium represents a cross-sector interest in developing solutions for decarbonising industry and manufacturing, bringing together research, innovation, demonstration and growth.

As part of the project, the AMRC, a member of the High Value Manufacturing (HVM) Catapult network of research centres, is equipping manufacturers with innovative digital tools to assess and improve process sustainability with ease.

Tace Morgan, senior engineer at the AMRC, said: "In order to meet sustainability goals, we need to make significant changes to UK manufacturing. However, this can seem like an insurmountable task given the ever-changing, fast-paced nature of the manufacturing industry.

"This is what Project Butterfly aims to tackle. It offers manufacturers an easy, yet effective opportunity to take small steps at the grassroots level to improve sustainability in their businesses."

At the start of the project, the AMRC carried out an extensive literature review around the topic of Resource Efficiency and Energy Efficiency (REEE) in manufacturing, where no consistent approach was found for quantifying and evaluating the REEE of a process at the manufacturing engineer level.

Although some tools and procedures that could aid in assessing REEE were identified, no guidance was found to help engineers walk through the evaluation of a production route and highlight the areas that could be targeted for improvements.

Recognising the lack of a standardised approach for evaluating process sustainability at the manufacturing engineer level, Project Butterfly set out to establish a comprehensive framework that can be used by manufacturing engineers to assess and prioritise areas of their processes for improvement.

This framework centres on two key AMRC tools: the process sustainability calculator and the guidance for process decarbonisation. Tace explains: "The development of these tools is aimed at helping manufacturing engineers to take their first steps towards improving the sustainability of their manufacturing processes, answering the question, 'where do I begin?'."

Tace Morgan, AMRC senior engineer, explaining how data for different processes was collected using the AMRC's Factory+ framework.

The AMRC's process sustainability calculator is a tool that will enable manufacturing organisations to identify high-carbon intensity processes qualitatively. The tool helps manufacturers compare several processes (up to five) with the associated resources to identify areas of focus to improve process CO_2 equivalent (carbon dioxide equivalent) emissions and prioritise decarbonisation efforts, based on existing sources of data.

The tool can also fill the gap between carbon accounting and lifecycle analysis, and will encourage questions about how processes are set up and what can be done to make them more efficient in the short and long-run. It also accounts for the changeability factor, and taking into consideration the ease or difficulty of changing a process, leading to the identification of quick wins in industrial decarbonisation.

The tool is a comprehensive agnostic method for assessing the sustainability of manufacturing processes in any sector. The assessment enables flexibility and allows companies to choose which metrics are a priority to them.

Tace adds: "As sustainability becomes a key driver for businesses, the AMRC aims to provide UK manufacturers with the tools to become more sustainable and make the transition as simple and achievable as possible. This is why Project Butterfly advocates for small changes in manufacturing processes. If more businesses make even the tiniest of improvements in their processes, the overall impact created on the UK's decarbonisation goals will be enormous."

Building on the calculator, AMRC engineers have created guidance for process decarbonisation which explains how to use the calculator with ease.

It also provides guidance on how to capture and leverage data sources to increase REEE, including using the calculator for further sustainability assessments in an organisation.

"If more businesses make even the tiniest of improvements in their processes, the overall impact created on the UK's decarbonisation goals will be enormous."

Tace Morgan, senior engineer at the AMRC.

How does it work?

Engineers demonstrated the use of the AMRC's process sustainability calculator via three sample tasks, by evaluating the different manufacturing processes deployed to achieve the tasks to support the aim of Project Butterfly.

The tool, along with the guidance developed by the AMRC, were used to assess the opportunity for improvements in sustainability for different processes, determining which processes should be given the highest priority.

Sample tasks

1 3D printing
The processes chosen are two 3D printing processes – a Fused Deposition Modelling (FDM) process, and a Stereolithography (SLA) process. These processes are frequently used in the AMRC to print prototypes and complex parts used in projects. It was chosen to print the same part on the two 3D printers and collect data from the full process, including post processing.

2 Metal additive manufacturing
AMRC engineers chose two selective laser melting processes used for 3D printing of metal on two different generations of machine. The processes are frequently used at the AMRC to print prototypes and complex parts for use in projects as well as to conduct research on metal 3D printing and metallurgy.

3 Composite material manufacturing
The tool was also demonstrated on two processes often used to conduct valuable research into different composite materials and manufacturing methods. The first process involved the use of an autoclave in a pre-processing step for carbon fibre material laced with a thermoplastic powder that required curing. The second process was a compression moulding cycle carried out on a small press machine.

The clever bit
For every sample, both selected processes were mapped out with the start and end of the processes being defined. The resources used as part of the processes were identified and for each resource that was measured, a value for the CO_2 equivalent (CO_2e) was retrieved from an existing database. This allowed for the environmental impact of gathering, processing, manufacturing and using a particular resource to be equated to an amount of CO_2 in kilograms, enabling it to be compared with one another using a common unit.

The routine use of all sample machines was observed and data was collected from a singular job for both selected processes on each machine using the AMRC's Factory+ framework and with the help of machine operators. In addition, operators of all of the machines completed a questionnaire on the ability for both processes to be changed and/or adapted.

Process and resource efficiency were calculated using historical data. This, combined with the changeability scores and the data collected for individual processes, was entered into the process sustainability calculator to ascertain a priority score for both processes, which were then analysed to recognise opportunity to improve process sustainability.

Figure 1: Process sustainability calculator for 3D printing task

	Process 1 (FDM)	Process 2 (SLA)
CO_2e	0	0
Changeability (Process)	9	1
Changeability (Resource)	6	4
Efficiency (Process)	1	9
Efficiency (Resource)	5	3

Key

1 – 3	Low priority
4 – 6	Medium priority
7 – 9	High priority

Results

3D printing

It was seen from the results of the prioritisation calculator that overall, process two (SLA) scored a higher priority and offered the greatest opportunity for improvements in sustainability. This higher score was significantly influenced by the process efficiency and CO_2e scores for process two.

For this case study, process efficiency was calculated by analysing the number of failed prints for the month of February 2024. The SLA process had a much higher tendency for the build failing, giving it a lower efficiency score and presenting an area where this process can improve. With regards to CO2e, it was discovered that nitrile gloves and IPA wipes were much larger contributors in comparison to model/support material and energy usage, resulting in process two receiving a higher score.

Overall, process one (FDM) scored higher in terms of both process and resource changeability, but both processes were reasonably similar in terms of their ability to change, meaning this did not have a big sway on the final scores.

Metal additive manufacturing

Overall, the prioritisation calculator results revealed that process two scored a higher priority and offered the greatest opportunity for improvements in sustainability. However, both processes scored very similarly due to them being different generations of the same machine.

Both processes scored similarly for most factors except for CO_2e and process changeability. The lower score that process two received for process changeability was due to the machine being an older model that is in the process of being phased out, offering a limited ability to update the process. Process two scored higher for CO_2e, again due to it being an older model featuring a less efficient use of resources.

Both processes scored identically for resource changeability and process efficiency, as both used the same types of resources and both had the same tendency to fail. Process two scored higher for resource efficiency due to it using electricity in a less efficient way.

Composite material manufacturing

It was seen in the prioritisation calculator results that overall, process one scored a higher priority and offers the greatest opportunity for improvements in sustainability. This higher score was mainly caused by process changeability and CO_2e. Process two was used to produce a large batch of products whereas process one was used to produce a single product.

For both processes, the raw carbon fibre material was the largest contributor to the overall CO_2e. The autoclave was using double the amount of electricity per unit of carbon fibre and also featured significant contributions to the CO_2e score, because of the bagging consumables required in the process. Both processes scored the same for process efficiency, as both were identified to have a similar tendency to fail. Additionally, both processes scored identically in terms of resource changeability. For all three samples, it was considered that some of the priority scores may have been exaggerated, as there were only two processes included in the case study, providing less context for calculating the priority scores.

Transforming resilience of UK manufacturing supply chains

Supply chain resilience is a core focus in the AMRC's strategic vision. **Victor Shi, supply chain resilience theme lead at the University of Sheffield AMRC**, explores what it means, why it's important for the AMRC and what is to come.

Victor Shi, supply chain resilience theme lead at the AMRC.

What is supply chain resilience? It consists of a combination of flows, relationships, adaptability and the capacity to transform in the face of change.

Flow: Materials flow from suppliers to customers in the form of raw materials for finished goods, and reverse material flows, from customers to the manufacturer, driving sustainability and resource efficiency. Additionally, there is information and financial flows between customers and suppliers, which are intertwined within the complex network of businesses.

Relationships: Visualise this through a graph, where nodes represent firms and edges show the relationships between them. In collaborative relationships, partners openly share knowledge and technical roadmaps to improve the overall productivity of the entire supply chain. In adversarial relationships, supply chain companies compete, disrupt and decouple to access market resources.

Adaptability: Supply chain resilience focuses on the breakdowns within the supply chain network – but it can also evolve, adapt and overcome such challenges, including major world-changing events such as Covid-19, shipment blockages at the Suez Canal and disruptions in the Red Sea.

The severity of these supply chain constraints can range from increased costs in developing new supply bases, delays in manufacturing processes, inventory build-ups, and difficulties in downstream production ramp-ups. All these factors can lead to order backlogs and place stress on the supply base, impacting both quality and safety.

But, as the frequency of supply chain disruptions increases, can the supply base adapt and meet delivery targets? Anticipating, observing and acting against supply chain disruptions both upstream and downstream can help manufacturing firms become more agile.

Supply chain resilience at the AMRC is one of our core focus areas, and our approach looks at both preventing supply chain risks, such as from world conflicts, and recovering from supply chain disruptions made through the continuous development of a supply chain community of practice. This helps enhance our skillsets, improve resource capabilities across the organisation and

to work jointly with our partners to better understand leading tools and techniques.

The vision of the AMRC's supply chain research theme is to become a leader in the transformation of UK industries' resilient supply chains: by recognising the potential of manufacturing supply chain opportunities where UK businesses are well-positioned – alongside developing tools and techniques to provide unbiased and reliable supply chain support to the UK manufacturing industry.

The strategic objectives of the AMRC supply chain resiliency strategy are to help businesses untangle the complexities in supply chain networks by achieving the following goals:

- Exploiting supply chain opportunities in rapidly growing sectors;
- Developing measures and assessments for manufacturing supply chain resilience;
- Creating holistic analysis tools to prioritise cross-sector supply chain opportunities;
- Transforming into a digital supply chain to utilise technology for increased visibility and growth opportunities.

Recent projects of note worked on by the AMRC, connected to the supply chain include:

Supply chain complexity

Engaging with supply chains is an essential step in building trust. Marco Franchino, technical lead for cost modelling, and technical fellow Dr Cansu Kandemir, both working in the Integrated Manufacturing Group at the AMRC, collaborated with University of Sheffield management school scholar, Dr Diego Ruiz Hernandez, to develop a methodology for measuring supply chain complexity in the manufacturing context.

This methodology was then applied in the £10 million Zero Carbon Humber project, funded by the UK government.

The Zero Carbon Humber project partnered with Avanade, Microsoft and Accenture, to develop a digital Minimum Viable Product (MVP) for industrial decarbonisation supply chains.

AMRC research engineer Christopher Haynes, who investigated the Zero Carbon Humber supply base, suggests that increased complexity in critical materials and components could add value by providing alternative sources and flexibility to cover potential uncertainties in hydrogen production and carbon capture infrastructure.

The project's output demonstrates the potential of digital models in solving complex supply chain problems. The product-level digital twin showcases the benefits of connectivity between hydrogen producers, industrial emitters and various cross-sector actors in industrial decarbonisation clusters. It also includes embedded financial modelling of different supply and demand scenarios, providing investors with visibility of potential order volume and related return on investment.

The supply chain model visualises the level of speciality and value across more than 700 products/commodities and more than 300 potential manufacturing suppliers in the UK.

A systematic methodology

Identifying critical products and processes in UK manufacturing was developed by the AMRC, in partnership with fellow High Value Manufacturing Catapult research centres WMG (the University of Warwick), CPI, National Manufacturing Institute Scotland (NMIS) and the Manufacturing Technology Centre (MTC).

The results of this project included a strong methodology and toolkit for evaluating products, processes and cross-sector capabilities in the UK manufacturing industry, providing a macro-level perspective that is crucial for informing governmental policies and private investment decisions.

Additionally, an integrated supply chain assessment framework was created within the HVM Catapult to facilitate comprehensive assessments and inform strategic supply chain decision-making.

Supply chain demonstrator

Collectively across our South Yorkshire, Lancashire and North Wales facilities, a team from each site created its own supply chain demonstrator.

The models at each centre, all created using different methods, help to observe the magnitude of financial, sustainability and operational key performance indicators (KPIs) in a virtual environment – which can help manufacturers gain confidence in their actions during supply chain disruptions.

The team in South Yorkshire has developed a demonstrator wall to exhibit simulation and modelling capabilities, supporting businesses in making informed decisions.

One model focuses on forecasting economic and operational performance based on users' choices regarding the number and geographical distribution of global suppliers for a UK-based company, while factoring in potential disruption. A second model simulates a hypothetical UK semiconductor supply chain, optimising the location of key network points and exploring the viability of a UK-based supply chain.

At AMRC Cymru, the team utilised an existing piece of technology by Industrial Vision Systems (IVS) in the form of a smart workstation, which set out to showcase a supply chain with a physical element of

"The supply chain demonstrators approach enabled a diverse range of digital and modelling capabilities benefiting supply chain visibility, quality and efficiency, while reducing costs, waste and carbon footprint, thereby paving the way for a more sustainable manufacturing future."

Victor Shi, supply chain resilience theme lead at the AMRC.

assembling components, showing three companies feeding into one another.

The team showcased the logistics and tracking of the logistics system, assembly time and data collection in terms of in process inspection, goods receipt inspection, and final inspection prior to dispatch to the final end customer. All of which was carried out on the IVS work station and further development of gathering data was completed in the form of utilising the Siemens mindsphere digital connectivity application.

The supply chain digital thread demonstrator at AMRC North West explores and showcases the potential of digitally enabled, interconnected supply chains. By using the printed circuit board assembly process as a case study. The demonstrator highlighted the integration of various physical components in manufacturing, and facilitated seamless data exchange across the supply chain.

Through the use of advanced manufacturing execution systems, the project captured and embedded quality control data within the digital thread, enabling traceability down to the individual component level and the specific processes and personnel involved.

Ultimately, the demonstrators for the connected supply chain ecosystem enhanced resilience against single points of failure, managed logistics disruptions, and provided the agility to respond to demand fluctuations.

The supply chain demonstrators approach enabled a diverse range of digital and modelling capabilities, benefiting supply chain visibility, quality and efficiency, while reducing costs, waste and carbon footprint, thereby paving the way for a more sustainable manufacturing future.

Supply chain transformation playbook

With this project, the AMRC is focusing on capturing comprehensive information about supply chains across various industries to identify the challenges faced by manufacturing sectors in the UK.

This initiative involves mapping these identified challenges to the demonstrators at the AMRC to showcase viable solutions for enhancing supply chain efficiency and resilience. By addressing the needs of both large industries and SMEs, the project aims to provide tailored strategies that improve supply chain operations, support regional economic growth and foster innovation in manufacturing practices.

An automated logistics warehouse system at AMRC Cymru.

Our future aims in this focus theme will look to explore the development of a digital test bed to enable supply chain mapping, develop and deploy technology to help increase connectivity, competitiveness, capacity and capability – to help support innovation driven enterprises to develop – as well as create supply chain programmes; Fit 4 Aerospace and Fit 4 Defence.

The UK manufacturing sector provides more than 2.5million jobs, stimulates economic growth, attracts inward investment, and captures supply chain opportunities. These are key drivers in strengthening the resilience of the UK's manufacturing supply base.

Post-Covid 19, we observed increased financial instability in lower tier manufacturing supply chains; even good companies are depleting reserves. With downstream sectors picking up demand, suppliers are struggling to access finances and resources to meet these sudden increases in demand.

Helping UK manufacturing supply chains to win orders, meet demand and produce high quality product and services are pivotal roles of the AMRC's supply chain resilience mission. We are listening to our partners' needs to develop innovations that drive their operational efficiencies and resources effectiveness to make the same product with less waste and without compromise on quality.

We are demonstrating leading tools and techniques to help supply chains transform from manual to automation.

We are demonstrating leading tools and techniques to help supply chains transform from manual to automation.

We invest our resources and skills towards understanding the mutual dependencies in the supply chain, to help our industrial partners to visualise supply chain relationships, who are critical sole source suppliers and what the hidden and forgotten capabilities are.

Therefore, we can minimise the impacts of disruptive supply chain events, remove uncertainties in supply chain data sharing and increase confidence for companies to invest in manufacturing supply chain capabilities in the UK.

Flintshire manufacturers adapt to digital tech solutions

By Lucy Hilton

Flintshire manufacturers are being supported with the adoption of digital technologies to boost their productivity, skills, training and decarbonisation knowledge, and sharpen their competitive edge to improve success in the marketplace.

AMRC Cymru's Accelerating Decarbonisation and Productivity through Technology and Skills (ADAPTS) programme was selected by Flintshire County Council to receive funding support from the UK Government Shared Prosperity Fund (UKSPF). It provides direct, fully-funded support for local manufacturers, giving them unparalleled access to advanced manufacturing technology, knowledge transfer, training and upskilling in digital and decarbonisation strategies.

Dylunio Solutions, a design consultancy based in Flintshire, North Wales, specialises in product design and development. It wanted help finding a solution to reduce communication delays when sharing its design manufacturing processes for approval with external manufacturers.

Through the ADAPTS programme, AMRC Cymru tested the feasibility of utilising a smart workbench to display digital work instructions for a product developed by Dylunio Solutions. This focused on developing a systematic and methodological approach for facilitating the transfer of work instructions across a number of smart workbenches.

Matt Groves, manufacturing research engineer at AMRC Cymru, said: "The project grew an understanding of smart workbenches' capabilities to assist in training and manufacturing. With its capabilities for gated processes, it also raised a conversation on the potential of developing audited processes that can be duplicated across workbenches."

Engineers successfully created smart instructions through the diverse functionalities of a smart workbench, confirming the feasibility of transferring assembly instructions from one smart workbench to another of the same brand, with minimal setup time.

It provided the company with fundamental knowledge of smart workbenches, increasing its confidence to invest in a smart solution, which would free up engineering time to rethink its designs and processes, and potentially mitigate any miscommunication. Knowledge transfer using Industry 4.0 technologies also created opportunities to increase the business's potential for job creation.

Granada Cranes also benefited from the ADAPTS programme. The company specialises in the design, manufacture, installation, and servicing of cranes and lifting equipment, both onshore and offshore.

Most processes at Granada Cranes rely on paper copies of documents, making it difficult to standardise and control document versions. AMRC Cymru explored how the business could adopt and implement technology to move towards a paperless working environment.

Researchers at AMRC Cymru ran various tasks with Granada Cranes to answer questions that would help validate the need for new digital technologies and form the basis for a technology roadmap.

Lucy Morley, manufacturing research engineer at AMRC Cymru, said: "When running roadmap-type projects, we encourage input from all levels of the business to ensure the roadmap is relevant to the day-to-day operations of the company.

"Input from Granada Crane's employees, paired with our technical knowledge, meant a progressive path towards a paperless working environment could be achieved with technology that is right for them."

A thorough technology roadmap was created, highlighting potential improvements to internal processes, and where new technology could support these improvements. This prepared Granada Cranes to be able to adopt new digital ways of working. It also supports a knowledge transfer partnership (KTP) between AMRC Cymru and Granada Cranes that began earlier this year.

Matt Groves, manufacturing research engineer at AMRC Cymru, with the Train AR workbench.

Lightweight aircraft seat design takes off

By Chloé Rothenburg

Composites experts at the University of Sheffield AMRC worked with Norfolk-based Mirus Aircraft Seating to develop and manufacture methods for a new seat back design to be used in short-haul budget flight aircraft.

Mirus Aircraft Seating, a global leader in the manufacture of aircraft seating with operations in the UK, Malaysia and China, approached the AMRC with a new seat back design, building on previous seat design research projects undertaken together.

The company's aim was to have one of the lightest seat backs available on the market, as lightweight seats reduce the overall weight of an aircraft, which contributes to reduced fuel consumption.

The AMRC worked on tool design and pressing trials, including intensive development work being carried out on the preforming methodology due to the layup of the seat back being a thin monolithic layup. This thickness presented a challenge in producing good quality preforms due to it being more difficult than it would be for layups with more plies.

The tool design and manufacturing methodology developed by the AMRC helped Mirus Aircraft Seating bring a new product to market.

This seat is light, but also able to be produced at a relatively high rate, meaning costs can be kept down. The impact of having a lighter seat back brought into the market is that it can contribute to reducing the overall weight of a plane. Lighter aircraft use less fuel, helping to reduce emissions and contribute towards more sustainable aviation travel.

The seat backs have now been aerospace certified and Mirus have begun making them. They are made from a carbon fibre reinforced pre-preg composite, which is low density, provides sufficient stiffness and passes the flammability requirements.

A render of the new, lighter weight seat design developed by AMRC engineers. Image: Mirus Aircraft Seating.

Callum Warnes, a technical lead in the composites group at the AMRC who managed the project, said: "This project was a great opportunity for the AMRC to collaborate directly with a UK manufacturer. Developing lightweight aerospace components is a vital step in the industry's push towards decarbonisation and net-zero, and composite materials are already playing a large role in this."

The seat backs produced by the AMRC were shipped to Mirus Aircraft Seating, where they were tested using the company's dynamic testing rig.

Composites experts at the AMRC modified the manufacturing techniques to ensure the seat backs met the test criteria, and assisted the company in producing preforms at a rate of between 15 to 20 minutes – the time taken for the press program – meaning one operator can keep up with the press.

Adam Challenor, technical director for Mirus, said: "The collaborative work done between both parties and utilising the expertise of AMRC, enabled a right-first-time approach to the seatback tooling and allowed us to achieve our challenging development timelines."

Awards haul for AMRC Training Centre apprentices

Apprentices at the University of Sheffield AMRC Training Centre have proved their worth to industry this year, taking home a haul of awards that recognise the impact they are making in their companies. Mrudula Jadhav reports on some of the success stories of the centre's star apprentices.

The University of Sheffield AMRC Training Centre equips the next generation of engineers with the skills and knowledge needed to succeed in the industry, while working with employers to provide apprenticeship programmes that are laser-focused on industry needs.

By combining classroom learning with hands-on experience, the AMRC Training Centre is a key part of the skills puzzle, helping close the gap between what employers need, and the skills available in the workforce. Launched earlier this year and backed by the Department for Education, the AMRC Training Centre is also part of the South Yorkshire Institute of Technology (SYIoT).

The AMRC Training Centre offers apprenticeships at every level, from level three advanced through to degree – covering a wide range of specialties, from machinist technician to nuclear manufacturing. It also provides continuing professional development (CPD) programmes to upskill, reskill and multi-skill existing workforces, ensuring everyone is equipped for the future of manufacturing.

And the AMRC Training Centre's success is evident – it has recruited more than 2,000 apprentices, while collaborating with more than 300 companies from a diverse range of sectors, including McLaren Formula 1, Boeing, ITM Power, AESSEAL and Forgemasters, alongside smaller businesses like Tribosonics, Agemaspark and Penny Engineering that are the backbone of UK manufacturing and supply chains.

Now in its tenth year of delivering apprenticeships, the AMRC Training Centre has had a spectacular year celebrating an impressive number of success stories of apprentices who have been recipients of major accolades. From wins in the North, South and West Yorkshire Apprenticeship Awards, to bagging laurels across Sheffield, Rotherham and Harrogate, these victories not only demonstrate the powerful impact the apprentices are having on their companies within the industry, but also how the AMRC Training Centre is helping nurture and develop the skilled engineers of tomorrow who will take the manufacturing sector to new heights.

Alice Lees, 21
Manufacturing engineering degree apprentice

Employer: Rolls-Royce
Studying: Manufacturing technology degree apprenticeship

South Yorkshire Apprenticeship Awards
Winner of the Engineering/Manufacturing Apprentice of the Year award

"I'm very thankful to both the AMRC Training Centre and Rolls-Royce for being supportive and encouraging me to embrace various opportunities. Their support has opened doors to a wide range of opportunities that I would never have had if I'd have taken the typical university route."

Maddie Bissett, 23
Warehouse focused technician

Employer: Unilever
Studying: Mechanical manufacture degree apprenticeship

Harrogate Business Excellence Awards 2024
Winner of the Apprentice/Trainee of the Year award

Unilever Apprentice of the Year 2024
Winner

West Yorkshire Apprentice Awards
Highly commended, Engineering/Manufacturing Apprentice of the Year

"Receiving the award is such a proud moment in my career. It's great to see recognition for all the hard work that is put in throughout my apprenticeship years and it certainly is also great motivation to keep going and see where I can take myself."

Daniel Ferrow, 25
Manufacturing engineer – Industry 4.0

Employer: Stanley Black & Decker
Studying: Engineering technician degree apprenticeship

Made in Sheffield Awards
Winner of the Apprentice of the Year award

"Winning any award is always a great moment, winning the Made in Sheffield award is no different. As a young apprentice who has been identified as the best in engineering it makes me feel so proud of all the hard work I've done. And I know it made my parents and colleagues proud as well. It's given me the confidence to pursue hard goals within my business, to advance the ladder to where I can start coaching the next generation of apprentices at Stanley Black & Decker.

Lucy Austin, 20
Apprentice maintenance planner

Employer: HEINEKEN UK
Studying: Maintenance engineering degree apprenticeship

North Yorkshire Apprentice Awards
Highly commended, Engineering/Manufacturing Apprentice of the Year award

"To be recognised for my apprenticeship achievements so far was really rewarding and has given me encouragement to keep learning within my workplace and at the AMRC Training Centre. My people manager and I attended an exciting awards evening where the achievements of many apprentices across the city of York were celebrated. I feel proud of the work I have done and hope that there are more celebrations to come in the future."

Niamh Brodigan, 21
Structural engineer apprentice

Employer: Portakabin
Studying: Manufacturing technology degree apprenticeship

Rotherham Apprentice of the Year Awards
Winner of the Higher/Degree Apprentice of the Year award

"I'm honoured and amazed to have won the award, especially being up against some other amazing apprentices. It just shows if you push for your voice to be heard and put ideas out there, you will be acknowledged and given the opportunity to show your abilities."

Will Keelan, 24
Junior project engineer

Employer: Cobra Sport Exhausts UK
Studying: Metal fabricator advanced apprenticeship

Made in Sheffield Awards
Winner of the Apprentice of the Year award

The Joint Awards Scheme
Winner of the Engineering and Design award

"Winning these awards would not have been possible without the support of my team at Cobra Sport Exhausts. As a fabricator welder, finding higher education opportunities was tough, but with the AMRC Training Centre's support network, I will begin my manufacturing technology degree apprenticeship in September 2024. It will provide me with critical industrial knowledge and skills to support my career moving forward and towards my dream of becoming a chief engineer at Cobra Sport Exhausts."

AMRC Training Centre joins springboard for innovation

By Lucy Hilton

The University of Sheffield AMRC Training Centre is part of the new South Yorkshire Institute of Technology, a powerful collaboration of educators and employers from across the region, delivering higher-level technical education to help close skills gaps in key areas.

Backed by more than £12 million in funding from the Department for Education (DfE), the South Yorkshire Institute of Technology (SYIoT) – one of only 21 nationally – marks a significant milestone for the region, and is recognition of the investment being made by education providers from across South Yorkshire in high-quality, higher-level technical education and training.

Made up of the University of Sheffield AMRC Training Centre, DN Colleges Group, Sheffield Hallam University, Barnsley College, the Sheffield College and RNN Group, SYIoT is supported by core employers that include HLM Architects, AESSEAL and Pendo, providing high-quality training and qualifications in engineering and manufacturing, construction, digital, healthcare sciences, science and media.

Nikki Jones, director of the University of Sheffield AMRC Training Centre, said: "With the launch of the DfE-backed South Yorkshire Institute of Technology, we are unlocking a future brimming with potential.

"These institutions are not mere places of learning; they are engines of progress. They bridge the gap between theoretical knowledge and real-world application.

"The South Yorkshire IoT is a springboard for innovation. It is a platform for creativity, for collaboration, and for shaping a future that is not only prosperous, but also sustainable and equitable."

SYIoT education partners already work with more than 5,000 employers in the region, but a key focus will be extending that reach, particularly to small and medium-sized businesses. With the pace of change and emerging and changing technologies, the IoT investment in South Yorkshire ensures that education providers have access to facilities and equipment that can support them to prepare and develop individuals with the skills that meet employers' needs.

Qualifications and courses are designed and delivered with local and national employers. This gives students – of all ages and backgrounds – the practical skills and technical knowledge they need to stand out in the job market, and provides employers with the reassurance that the training staff receive can be applied to their business.

For the AMRC Training Centre, these courses span level four higher apprenticeships and level six degree apprenticeships. The higher apprenticeships courses are:

- Automation and Controls Engineering Technician
- Engineering Manufacturing Technician
- HNC in General Engineering (commercial)
- HNC in Manufacturing Operations (commercial)

The degree apprenticeship courses are:

- Control Technical Support Engineer
- Nuclear Scientist and Nuclear Engineer
- Manufacturing Engineer
- Product Design and Development
- Tool Process Design Engineer

The AMRC Training Centre is a core member of the South Yorkshire Institute of Technology.

Nikki added: "For industry leaders, the South Yorkshire IoT is a bridge to the future workforce. By investing in these students, you're investing in the future of your businesses and the entire region.

"Together, within the collaboration of this IoT, we can weave a new narrative for South Yorkshire. We can transform it into a hub of innovation, a magnet for cutting-edge companies, and a place where skilled workers and groundbreaking ideas converge."

Discover more

AMRC Cymru to grow graduate talent

By Lucy Hilton

AMRC Cymru is launching a graduate development programme to support talent development and acquisition, securing a pipeline of skills to fill gaps in the workforce.

Four graduates with specific capabilities will be recruited in the first cohort to fill entry-level engineering positions, assigned to different technology pathways within the research centre.

The talent scheme provides successful candidates with an ideal transition from university to a professional engineering environment, joining the state-of-the-art facility in Wales, which focuses on advanced manufacturing sectors including aerospace, automotive and food and drink in the key research areas of future propulsion, sustainability and digital manufacturing.

Over two years, the graduates will participate in four, four-month placements in these different theme areas, with the final eight months in a self-selected area of focus or graduate group project, allowing the opportunity to learn from experts and make a direct impact on real-world projects, working closely with industry to help it access advanced technologies that will drive improvements in productivity, performance and quality.

Zara-Lea Field, engineering apprentice at AMRC Cymru, knows first-hand how rewarding a career kickstart at the AMRC can be and said when she applied for her role she was aspiring to start a new career path with a company she could trust.

She said: "I came across an opportunity which led to my interest in the AMRC. I applied for various roles and had the lucky opportunity to become their apprentice.

> **"It is a gateway to a world of innovation and hands-on experience."**
>
> **Graham Howe,** head of operations at AMRC Cymru.

"It's great working for a company that cares about your personal well-being as well as the environment. And meeting lots of different people that seem to carry similar values of good will, healthy work ethic and altruism."

The AMRC Cymru team will be visiting local universities in late 2024 to attend graduate events and speak to students about the opportunities available to them. With 2024/25 being the very beginning of the programme, the team is also looking to improve its outreach and application process year-on-year.

The selection process will begin in April 2025, followed by applicants being invited to produce an online presentation and take part in a two-day assessment centre in June, ready to start their position in July.

The in-person assessment centre will involve visiting manufacturing process lines and taking part in team challenges, with a strong emphasis on relationship-building with small and medium-sized enterprises (SMEs).

Successful graduates will work across automation, design, manufacturing intelligence, and project management and operations. With automation, they will be immersed in the world of automated systems and learn how to develop and deploy them in manufacturing environments. Through design, they'll explore the art of product design and learn how to create products that are both functional and aesthetically pleasing. Whilst learning about manufacturing intelligence, graduates will harness the power of data-driven manufacturing and learn how to use data to improve decision-making. During project management and operations, they will master the art of efficient project management and learn how to optimise manufacturing processes.

An ideal candidate will have a 2:1 degree in a relevant discipline such as manufacturing engineering, production engineering, robotics, automation, mechanical engineering, aerospace / aeronautical engineering, electronic engineering, software engineering cybersecurity, mathematics or physics. They will also be skilled in creative problem-solving, and have excellent communication,

Zara-Lea Field, engineering apprentice at AMRC Cymru.

self-motivation and teamwork abilities, alongside the willingness to learn and demonstrate adaptability. They will also have eligibility to live and work in the UK.

Successful completion of the programme could lead to a role within AMRC Cymru or a similar organisation.

Graham Howe, head of operations at AMRC Cymru, described the programme as a 'gateway to a world of innovation and hands-on experience' and said it is designed to meet the aspirations of the best graduates and help AMRC Cymru shape the future of manufacturing engineering, research and development in Wales.

Graham is keen for applicants to be as ardent a supporter of manufacturing and Welsh industry as the team they will be joining. He said: "At AMRC Cymru, we're constantly looking at how we can help local manufacturing organisations.

"With our graduate programme, whilst we want applicants who will bring something new to our breadth of knowledge and perspective, we also want to take this opportunity to examine how we're working with our local education and academic centres.

"We're looking for spirited applicants, with an existing interest in automation, design or manufacturing intelligence, who want to start their engineering careers, and help shape the future of Welsh manufacturing.

"If our current graduate programme specifications don't cover where you're up to in your manufacturing journey so far, get in touch. We want to develop our opportunities, and there might be something else you'd be the perfect fit for."

The graduate programme team will also soon begin further education outreach in the local area, with apprenticeships and continuing professional development (CPD) courses also planned. Twilight sessions at local schools will look to show design and technology teachers the technology used by AMRC Cymru on a day-to-day basis.

After the opening of HVM Catapult Baglan, which is a partnership between HVM Catapult funded by UK government and the Welsh Government, graduates will have access to multiple AMRC facilities, with work that can even involve national and international travel.

"We want applicants who will bring something new to our breadth of knowledge and perspective."

Graham Howe, head of operations at AMRC Cymru.

New members at the AMRC

Certas Lubricant Solutions is the UK's leading independent supplier of high-performance lubricants across sectors including automotive, aerospace, manufacturing and construction. Focusing on innovation, quality and sustainability, Certas Lubricant Solutions deliver tailor-made solutions to enhance operational performance, safety and efficiency.

INSPHERE creates the technology to capture, analyse and utilise data to drive advanced, automated production. Its purpose is to create unique, game changing manufacturing technology that enables smart factories and facilities to create a more sustainable future.

Productive Machines enables the machining industry to reach the best part faster, right-first-time via its milling process optimisation. It's a Software as a Service (SaaS) solution that takes cutting forces and machine tool dynamics into account and applies unique spindle speeds and feed rates across the toolpath.

Events at the AMRC

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

September 26, 2024
National Manufacturing Day
AMRC-wide

October 1, 2024
Workshop: Data-Driven Design in Manufacturing
AMRC Factory 2050

October 8-9, 2024
Annual ATI Conference
ICC Wales

November 6, 2024
ADAPTS
AMRC Cymru

November 9, 2024
Lord's Mayor Parade
London

November 14, 2024
Unleashing the potential of sports engineering in Wales
AMRC Cymru

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.

Discover more

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

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