

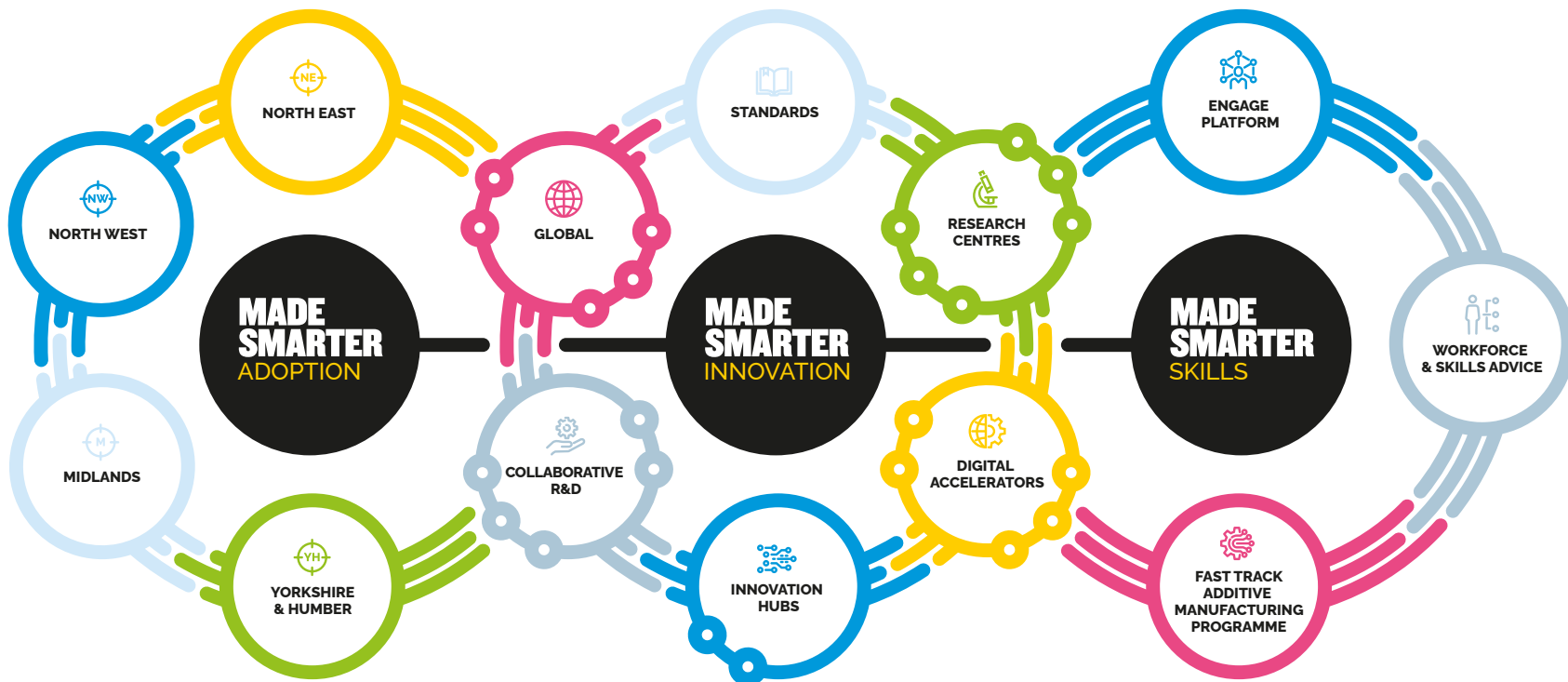
MADE SMARTER

INNOVATION



Delivered by
Innovate UK,
EPSRC and ESRC

Challenge Brochure



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Foreword



Chris Courtney
Challenge Director



There are hundreds of companies engaged across the programme, with the plans to many more even before we launch future investments.

The future of manufacturing will be profoundly transformed through the drive for net zero and advanced digitalisation, enabled by world leading teams across manufacturing, technology developers and academia delivering systemic transformation. Manufacturing will play a massive part in delivering a net zero future. It is a significant contribution to emissions and yet within the industry, has the power to deliver the solutions we all need. Not only do we have the opportunity to make products in a 'net zero' way, but we can also make the future products and services that we all need.

When the Made Smart Innovation Challenge launched in September 2020, we targeted improved productivity, sustainability and jobs across the sector. Building on the platform of the 2017 Made Smarter Review lead by Juergen Maier we constructed a £300 million national innovation programme, to enable acceleration of digital innovation to deliver smart factories and connected supply chains.

Working closely with the Department of Business, Energy and Industrial

Strategy and the wider Made Smarter programme, we built an innovation programme that creates a connected ecosystem, delivers the future of manufacturing we want and puts people at the heart of the transformation. The programme we have built ranging from the applied research in our research centres, boosting startups through our accelerator programme, scaling those in our innovation hubs – digital supply chain hub and the smart manufacturing data hub and industrialising them in the collaborative R&D programme.

There are hundreds of companies engaged across the programme, with the plans to many more even before we launch future investments.

Launching all the major building blocks of our programme in the midst of the pandemic and other geopolitical uncertainty is a testimony to the relentless efforts of the sector, who have risen to the occasion and in the most challenging circumstances any of us have seen, have generated and delivered significant digital innovations with the foundations laid for many more.

There is much more to do to really harness the full power of digitalisation in UK manufacturing. In the next decade the most achievable CO2 reduction will come through resource and energy efficiencies which digitalisation can best help deliver. We have engaged significant parts of manufacturing, but will continue to engage further, particularly with SMEs through the Smart Manufacturing Data Hub. There is significant capability for AI in the UK, which offers huge potential to optimise manufacturing and global supply chains.

And I would hope in the future to see significant investments in the areas of design optimisation, increased circularity and traceability of supply chains enabled by advanced digitalisation.

I'm proud to have led the team who have built this programme and I'm delighted to share that the research centres, the two innovation hubs and new accelerator opportunities are all operational and keen to support and engage whether you're a start-up or a multinational, in food or pharmaceuticals, aerospace or automotive.

Working together for the people-led digital manufacturing future we want.

With our partners we're investing £300m to develop digital ideas more quickly.

MADE SMARTER INNOVATION



STANDARDS & INTEROPERABILITY

Building a common open standards environment for manufacturing digital technologies through workshops, guides and helpful tools to address interoperability challenges through standardisation.



RESEARCH

Made Smarter Innovation has invested in 5 research centres to identify early stage, transformative innovation ideas, covering both technological and societal aspects.

Our InterAct project is a call to arms for academics from the social sciences to support the innovation and diffusion of digital technologies that will result in a stronger, more resilient UK manufacturing industry.



COLLABORATIVE R&D

So far over 320 participants and over 80 projects have been supported over multiple themes:

- Fast Start
- Digital Supply Chain
- Sustainable Smart Factory
- Robotics & Automaton Industrialisation (open early 2023)



INNOVATION HUBS

Together, the Smart Manufacturing Data Hub and the Digital Supply Chain Hub are a national network of facilities available to the manufacturing industry collaboratively developing novel digital solutions for key manufacturing challenges through a network of test beds. Their purpose is to drive innovation by enabling the testing of digital solutions.



DIGITAL ACCELERATORS

Connecting leading UK manufacturers and pioneering technology start-ups to develop innovative technology solutions to many of the UK's manufacturing challenges.



GLOBAL

Supporting UK companies, working with leading industrial nations, to develop global innovation bridges and global collaborative research & development to increase exports and inward investment opportunities.



MADE SMARTER

Innovation Challenge

Overview

Mission

We have a mission: to build a digital innovation ecosystem that funds and supports UK innovators and manufacturers. It's our hope that this empowers them to validate, develop and launch their ideas.

By partnering with experts along the way, makers and digital solution companies alike can completely transform the face of manufacturing.

Through the national Made Smarter Innovation programme, we're making it easier for these individuals to innovate using emerging technologies.

Manufacturers will be able to create better, more competitive and sustainable products and processes, while digital companies can get the opportunity to develop & deploy their game-changing concepts in an exciting market.

Objectives

We aim to transform the UK's manufacturing capabilities through the development and adoption of industrial digital technologies (IDT). We aim to harness the transformative power of this ecosystem to deliver a modern, connected, resilient and flexible, significantly more productive, and environmentally sustainable UK manufacturing sector and a vibrant technology sector that enables that transformation. By increasing the sustainability of the UK Manufacturing industry, this will create an increase of reusable resources and reduction in waste and carbon emissions.

This investment will:

- increase in GVA by £2.3 billion
- create thousands of highly skilled jobs
- raise productivity by 30%
- create a 4.5% decrease in carbon emissions
- create a 25% decrease in manufacturing waste
- allow the UK to shape the future of manufacturing.

2017 Made Smarter UK review goals



Faster Innovation and Adoption of IDTs for the UK
£455bm



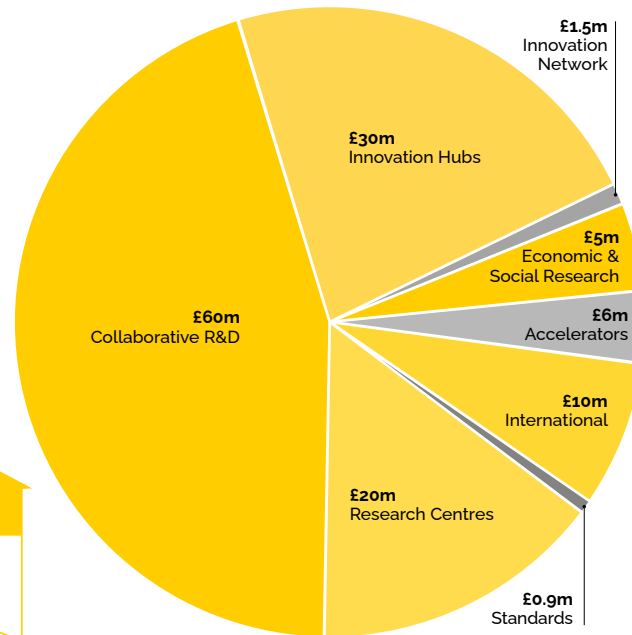
Increase manufacturing sector growth between
1.5 & 3% p.a.



Increase in jobs of
175,000

Made Smarter Innovation, as one of the Government's Industrial Strategy Fund (ISCF) programmes, is investing £147m into creating a fully connected, dynamic manufacturing ecosystem inspiring innovation across academia, technology providers and manufacturers.

Made Smarter Innovation Targets by 2034



The numbers



64
Collaborative research and development projects



10
Competitions



6
Direct awards



75 and growing
Total number of funded interventions



240+
Business, organisations, and universities



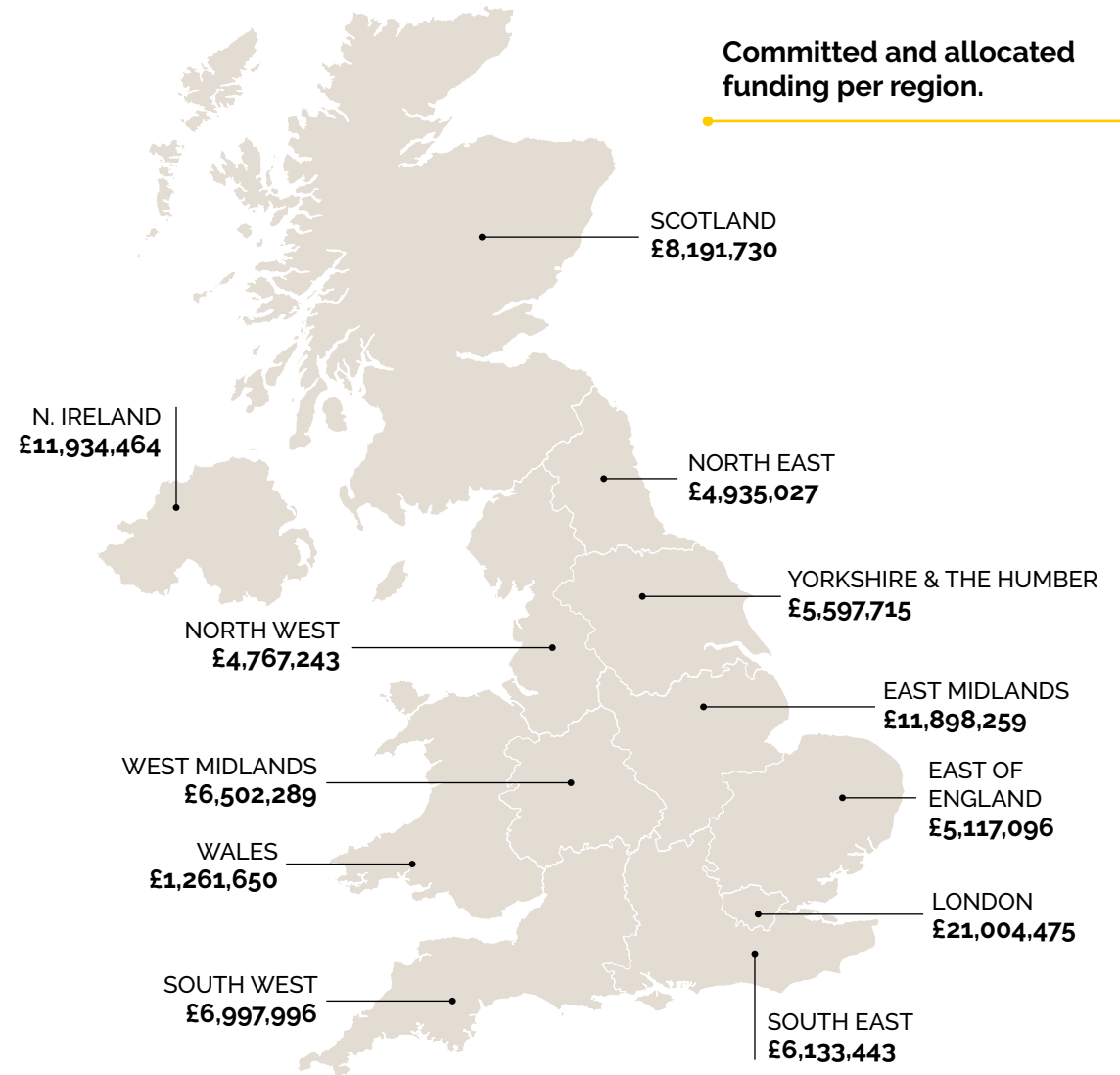
£52.5m
Co-investment committed



£115m
Committed to date



£27.7m
Co-investment realised



Industrial Digital Technologies (IDTs)

The Made Smarter review published in 2017 set the goal that 'by 2030, the UK will be a global industrial leader in creating, adopting and exporting advanced digital technologies, shaping how the world does business.

The review outlined the significant impact digital technologies could have on improving productivity and competitiveness of the entire UK manufacturing sector whilst growing the technology sector that enables the improvement.

The review highlighted the critical digital technologies we can harness to deliver the improvement as:

- Artificial intelligence, machine learning and data analytics
- Additive manufacturing
- Robotics and automation
- Virtual reality and augmented reality
- Industrial Internet of Things (IIoT) and connectivity (5G, LPWAN, etc.)

The Made Smarter Innovation challenge held a review of technology strategy to complement the challenge-led approach. We reviewed three horizons and sought to understand the intersection between industry demands.

The summary points are:

1. **artificial intelligence:** orientate the globally competitive capability in the UK towards apparent demand from manufacturing. Currently heavily clustered in the London area

2. **robotics:** build on significant public investment to increase mature industrial applications

3. **additive manufacturing:** key to aerospace and defence but lacks full cross-sectoral advocacy

4. **net zero:** a primary catalyst for change with profound impacts on how we make and deliver—a critical role for digitalisation

5. **design:** a critical enabler for future products in all sectors, including design for future manufacturing capabilities

6. **integration:** identified as a strategic technology element in all IDTs, but it is not clear how we can bring this to product-level

7. **platforms:** can we challenge the notion that it is too late for the UK to become a platform player?

It is essential to recognise that some significant technology areas were not specifically addressed by the Made Smarter Review, in particular:

- **synthetic environments/digital twin:** a key strategic area for further review
- **blockchain:** there's a strong pull seen

within the competitions and a very active UK space.

These insights have led Made Smarter Innovations to invest in targeted areas, such as:

- the use of data in driving improved processes and factory operations
- the orientation of early-stage artificial intelligence companies in addressing manufacturing net zero challenges via an accelerator programme.

The importance of diversity and inclusion

It is important not to consider technology in isolation to people, and one particular area of focus is equality, diversity and inclusion.

In the UK, neither manufacturing nor the associated technologies areas are sufficiently diverse or inclusive. The benefits of these perspectives are being missed.

Made Smarter Innovation programme is set to change the future of the manufacturing sector in the UK. Left unchecked, and without due consideration and action, the programme could exacerbate existing diversity and inclusion challenges.

Conversely, there is a tangible opportunity, given the position of influence, to effect real and lasting positive change.

How we intend to create change

Programme support:

- there is an opportunity to ensure that a more diverse range of people benefit directly from the Made Smarter Innovation programme support
- care is required to ensure that diverse audiences are understood, engaged, and enabled rather than following standard practice.

Inclusive technology:

- we have a responsibility to ensure technology developed through the programme is inclusive
- there is an opportunity to stimulate systems-level change by calling for new approaches and technologies from more inclusive manufacturing processes and manufactured product development.

Future technology:

- as a critical influencer in the future of technology in manufacturing, the Made Smarter Innovation Programme can unify and synchronise ED&I efforts across the manufacturing landscape by raising awareness,
- we can utilise this to inspire change and normalise proactive ED&I action.

Skills:

- although delivery of skills is not in the scope of the Made Smarter Innovation, the challenge recognises the part that the programme has in the broader skills landscape
- improved, and new skills will be a direct result of the challenge interventions
- the MSI innovation activities will play a significant role in determining what technologies will feature in future manufacturing activities and the skills required to engage with these technologies.

Digital is our opportunity to lead the world in sustainable manufacturing

In March 2021, the UK Government Department for Business, Energy and Industrial Strategy published an Industrial Decarbonisation Strategy. Of the approximately 370 megatonnes (Mt) CO₂e ('e' suffix indicating CO₂ equivalence) produced by the UK, about 70 Mt CO₂e, or about 1/5th, is a result of industrial activity. By 2030, these emissions need to reduce to 40 Mt CO₂e and by 2040 to 10 Mt CO₂e.

There's no doubt, these figures pose issues. However, our work within the Made Smarter Innovation challenge points to the UK as ideally positioned to succeed. Here's how.

Resource Efficiency and Energy Efficiency (REEE)

Resource Efficiency and Energy Efficiency (REEE) must deliver two-thirds of the industrial CO₂e reduction required by 2030.

The key to REEE's solution is digital, and knowing where to start needs data. Once data is available, efficiencies can sometimes be immediately apparent. If not, the Made Smarter Innovation challenge has identified a common digitalisation pathway to optimise existing linear operations.

Reducing emissions

The sooner emissions are reduced the greater the warming mitigation. Digital delivers CO₂ reductions and does so quickly. Research conducted with the Made Smarter Innovation Advisory Group has shown that:

- artificial intelligence (AI) is the only industrial digital technology strategically crucial to all

manufacturing sectors

- the UK has the most significant investment in early-stage AI companies anywhere in Europe
- when compared to the size of the economy, the UK is ahead of North America and Asia. This places start-up and scale-up companies ideally placed to move fast.

Creating value

Digitally enabled REEE represents better value and less risk than other abatement contributions.

The necessary digital capabilities already exist. Our research reveals that very little of the globally competitive UK AI capability is currently orientated towards manufacturing.

The critical question is why manufacturing doesn't already use this capability. The answer is complicated and still emerging. However, interventions such as fast start collaborative research and development and the Made Smarter Technology Accelerator facilitate new-to-manufacturing digital companies to do just that.

Resilience and productivity

Digitally enabled REEE also delivers resilience and productivity, allowing more to be done less through:

- digitally enabled transparent and provenanced supply chains
- reduced material and energy resource usage
- reduced sensitivities to variable material availability and price.

By facilitating the shift to circularity, digitally enabled REEE can go further than currently planned. AI, blockchain, digital twin and digital design are critical to industrial symbiosis and scalable circular manufacturing, further reducing industrial resource and energy use, thereby mitigating other costly and risky CO₂e abatement technologies.

Digital manufacturing also facilitates reduced use phase emissions. Technologies, such as robotics and additive manufacturing, allow:

- designers greater freedoms to create products that emit less CO₂ during their use (and re-use)
- more value creation across the whole value chain, including UK-wide based manufacturers.



However, 89% of the emissions associated with the UK's demand for manufactured products occur outside the UK. Once developed, Industrial Digital Technologies can be exported at scale. Industrial Digital Technologies, where the UK is strong, are relevant to the economies of other industrial nations with industries such as chemicals, pharmaceuticals, food and drink, aerospace and automotive.

Our strategy

We have identified a universal, challenge-orientated (technology-agnostic) digitalisation pathway consisting of two halves:

1. the optimisation of linear processes and supply chains, which is the focus of the Made Smarter Innovation challenge
2. the digital facilitation of industrial symbiosis and large-scale circularity.

Throughout, we will build on the UK's leading capabilities in ethics and human adoption.

Strategy in action

The £1m Made Smarter Technology Accelerator (MSTA), delivered by the Digital Catapult through 2021, attracted over ninety technology start-up and scale-up company applicants.

They were competing for one of fourteen places to address the Industrial Challenges posed by seven companies from a wide range of sectors.

Each start-up and scale-up company, many of which hadn't previously worked with manufacturers, were awarded £20k to develop a Proof of Concept before four were selected to receive £100,000 to develop a Minimum Viable Product.

One of these companies was Machine Intelligence Ltd, which worked with BAE Systems on the scalable artificial intelligence for visual inspection challenge. They used a novel machine learning technique to identify manufacturing defects, reduce waste, improve product quality, and save money.

• Innovation Network

MADE SMARTER

Multiple communities and networks across the UK work with different technologies, not all necessarily answering manufacturers' calls.

Innovate UK Knowledge Transfer Network (KTN) is joining these communities to transform UK manufacturing through the Made Smarter Innovation Network to address this challenge.

What we do

Made Smarter Innovation aims to shape the future of UK manufacturing to:

- create a net zero world
- strengthen industrial resilience
- grow a sustainable economy.

The Made Smarter Innovation Network connects the UK manufacturing industry and stakeholders to ignite collaborative opportunities.

This network is a vibrant, cohesive community of innovators and disruptors, creating cross-sector collaboration and adoptable industrial digital technologies (IDT) solutions for UK manufacturing.

The network supports start-ups, scaleups and spinouts with the funding, knowledge and connections they need to help them develop and grow their businesses.

With a dedicated team to help guide your business through the Made Smarter journey, the Made Smarter Innovation Network is the first port of call in determining the upward trajectory of your organisation.

Benefits to business

Being part of the Made Smarter Innovation Network brings many benefits:

- connecting with businesses, academics, funders and innovators across the UK manufacturing landscape to make manufacturing smarter
- early access to innovative digital technologies and approaches, along with information and funding
- increased investment in R&D
- exclusive case studies, webinars and events

- the opportunity to inform future funding and support for the UK manufacturing sector
- the opportunity to be part of the Made Smarter Innovation alley at Smart Factory Expo – one of the largest digital manufacturing exhibitions in the UK.

The Made Smarter Innovation Network works with organisations to drive positive change for the UK manufacturing industry.

MAINTENANCE CONNECTION
MACHINE NUMER: S/N 212793

LOCATION ZONE 710
SUBZONE--LANDING GEAR

737
QUANTITY ANALYSIS
DATA SECTION 30-33

0.085 INCH
0.075 INCH
0.90 INCH

SYSTEM NO	SENSOR NO	LOCATION
1	5848	LEFT
2	7845	RIGHT

CEC 9313

THIS MACHINE SHALL ONLY BE OPERATED AND MAINTAINED BY TRAINED AND EXPERIENCED PEOPLE WHO HAVE READ AND UNDERSTOOD THE OPERATOR AND SERVICE MANUAL. IT IS THE RESPONSIBILITY TO FOLLOW THE MANUALS, CONFORM TO ALL APPLICABLE REGULATIONS, AND BE RESPONSIBLE FOR THE SAFETY OF THE OPERATOR AND THE MACHINE. THE OPERATOR SHALL BE RESPONSIBLE FOR THE SAFETY OF THE OPERATOR AND THE MACHINE. THE OPERATOR SHALL BE RESPONSIBLE FOR THE SAFETY OF THE OPERATOR AND THE MACHINE.

MANUALS

LOCATION
ONLINE--LAB--359

Production Capacity: 409/day
Uptime: 99%

Energy State : Active
Pressure : 42/3
Auto Errors : 0

MAXData

RULES

- Enable information using supporting systems
- Report critical safety conditions immediately
- Use eye-protection when working to bring down to job
- Minimize noise levels, wearing hearing protection
- Stay out of safety zone, unless you are operating the machine

S/N 212793

Dashboard Summary:

- Diagrams: 1
- Pipelines: 2
- Alert rules: 0
- Properties: 1
- Tags: 0
- Linked services: 4
- Data Stores: 1

Alert rules S/N 212793: 0 rules

Innovation Hubs

Digital Supply Chain Hub

The Made Smarter Innovation | Digital Supply Chain Hub is developing and empowering a globally competitive digital innovation ecosystem to address and prepare for critical supply chain challenges.

We're harnessing the power of UK manufacturing, bringing businesses and researchers together to:

- develop new solutions
- tackle sector-specific and industry-wide challenges
- build a strong UK supply chain community.

Together, we're making supply chains more efficient, resilient and sustainable.

The Hub is a collaboration between Digital Catapult, Made Smarter, TWI, National Physical Laboratory, High-Value Manufacturing Catapult, and industry leaders accelerating the digital future of supply chains.

Why do digital supply chains matter?

Supply chains involve the flow of goods from raw materials to finished products and consist of complex multiple-tier networks where the efficient flow of information and money is as critical as the physical flow of goods.

Supply chains cover critical functions such as planning, engineering, procurement, logistics and finance. Globalisation has increasingly stressed

these networks, with external shocks such as pandemics, wars and the need to deliver on net zero ambitions having a considerable impact.

Digital supply chains provide manufacturers, retailers and customers with greater visibility over these processes, providing more robust internal systems and data to give almost real-time visibility over the supply chain.

Flagship projects

The Digital Supply Chain Hub is uniquely positioned to initiate, nurture and exploit new knowledge and insights.

As part of this, we are running a series of flagship projects exploring advanced digital solutions in aerospace, automotive, healthcare, logistics, and more supply chains.

The first four of an intended six flagship projects are detailed here.

Flagship one: differentiator

Currently, more than 50% of drugs intended for clinical trials go to waste. By moving demand triggers from distributors to manufacturers and enabling just-in-time manufacture of drugs for trials, we can move towards a more personalised approach to medicines supply and significantly reduce waste and carbon footprint.

Led by HVMC, the differentiator flagship aims to do just by:

- mapping the current pharmaceutical supply chain for clinical trials and using this information to develop a digital twin to design and replicate a new one
- enabling personalised dosing in clinical trials through just-in-time manufacturing, centred around ready access to data
- using this data to combat the wastage in clinical supply chains whilst improving patient outcomes.

Flagship two: connected tempest

Each organisation's digital footprint develops in its own historical context through the structures, systems and data they develop.

When acting alone, this can work well.

However, in increasingly interconnected and global supply chains, it can mean a lack of quick action and limited coordination, with suppliers often forced to react to the last levels of demand rather than the next.

Led by HVMC, the connected tempest flagship is designed to help cross that divide by:

- mapping the information on which many of the biggest manufacturers base their decisions
- using this data to create a new, general standard for engineering information, helping to standardise and connect live data right from material producers to OEMs across supply chains
- enabling these supply chains to unleash the power of our manufacturing base, slashing waste in materials, time, and money that results from manufacturers acting on outdated or incomplete information.

Flagship three: logistic living labs

Logistics describes the physical movement of goods, and the associated information flows between parties within supply chains. It is critical for enabling all parts of the UK economy.

Logistics miles on UK roads have increased exponentially as e-commerce has grown, impacting the environment and logistics efficiency. Up to 50% of logistics miles are wasted through trucks that are not full.

Led by Digital Catapult, the logistics living lab flagship project:

- brings together leading digital innovators, logistics companies, and manufacturers from heavy industry to FMCGs
- works with these stakeholders to develop, demonstrate and test a digital infrastructure which will enable the sharing of logistics assets
- uses the sharing of logistics assets to reduce truck journeys and miles without impacting customer service
- achieves this reduction by using a combination of advanced digital technologies aligned to real logistics challenges, to improve UK distribution through more effective collaboration.

Flagship four: future of supply chain labs

The Future of Supply Chain Labs flagship programme is led by Deloitte and EDGE Digital Manufacturing. It aims to help SME manufacturers realise digital technologies' potential to increase productivity and competitiveness by digitising supply chains.

Through structured workshops and one-to-one support future of supply chain labs will:

- help businesses discover how to leverage digital technologies and develop smarter digital supply chains
- give wider support and funding for digital technology innovation and adoption
- provide companies with ideas and approaches to improve forecasting and demand management, better visibility of real-time data, tracking and traceability
- help to managing disruption and the impact on lead times, measuring and improving businesses carbon footprint and emissions and improving stock control, reducing waste and managing materials price volatility.

Other projects delivered through the Made Smarter Innovation Digital Supply Chain Hub:

Supply chain directory

The Supply Chain Directory platform, delivered by HVMC, will act as a one-stop-shop for UK manufacturing company information, bringing stakeholders together to provide a digitally enabled consensus view of the truth.

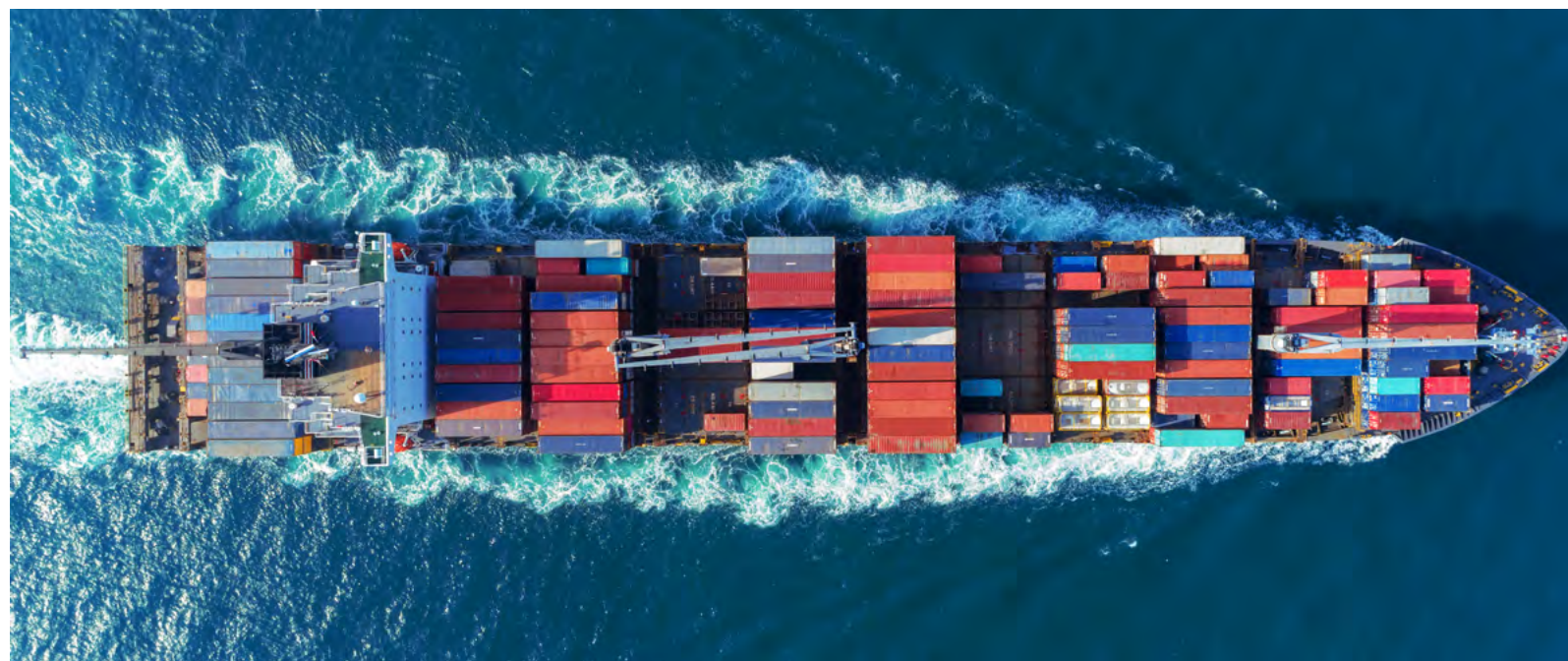
The insights can support revenue generation through:

- consultancy
- supporting the identification of clusters and supply base strengths and weaknesses
- helping industrial transformation where new supply chains are needed, for example, by solving systematic challenges such as climate change.

Digital readiness tool

The digital supply chain readiness (DSCR) tool measures the Digital Supply Chain maturity of manufacturing businesses by providing suggestions on where to focus on the journey to a fully digital supply chain.

It will help SMEs and larger manufacturing businesses understand where they are and prioritise actions that should be taken with or without the hub.



The Smart Manufacturing Data Hub

The Made Smarter Innovation Hubs are creating collaborative environments, joining different agents, professionals and companies with similar challenges. These multiple-partner combined resources are developing joint solutions to address industry challenges and build a more robust, resilient, and productive UK manufacturing industry. Accelerating digitalisation is critical to achieving this success.

What is the Smart Manufacturing Data Hub?

The Smart Manufacturing Hub (SMDH) supports small and medium-sized businesses to become more competitive by harnessing the power of data.

When data is raw and unrefined, there is little value. The hub turns data into timely, actionable insights, creating information to guide manufacturers' decisions to improve their manufacturing business.

How are businesses supported across the UK?

Led by Ulster University, the hub works with 12 delivery partners to help increase productivity, growth and sustainability, supporting businesses, with manufacturers across the UK already utilising the Hub.

The hub team assists manufacturers in developing, testing and adopting the latest data-driven technologies via the hub's data exchange platform and analytics services, virtual and physical testbeds and grant funding.

Understanding the components of the Smart Manufacturing data hub

The Hub will create a mutual data society for small and medium-sized businesses. We will initially achieve this by developing a manufacturing data exchange platform (MDEP) where companies submit their manufacturing data and receive extracted intelligence in return.

This is what the hub component support means:

- the hub is coupling MDEP with the development of virtual manufacturing testbeds (VMT)
- manufacturers can use VMTs to de-risk investment in digitalisation technologies, leveraging anonymised data from existing manufacturing support facilities and ensure sharing of best practices
- the hub team will support larger companies from a technical challenge and supply chain perspective via a £7.5 million digital innovation fund
- this fund will provide small vouchers (circa £50,000) and large grants for flagship projects (up to £345,000). The funds will facilitate companies that

use the MDEP and VMT to implement recommendations for digitalisation.

Let's look at a use-case example. Temperature sensors measure the amount of heat energy or coldness generated by an object or system and alert the user to overheating or insufficient cooling.

Through early detection of problems, the user can avoid unplanned downtime, and limit maintenance checks and repairs to when needed. Data-driven technologies and expert guidance are available to companies through the hub, allowing them to explore and evaluate their processes, make operational savings, de-risk investments and become more digital savvy.

Realising the value of shared data

Manufacturers who understand the importance of data and the need to manage it effectively also understand that sharing data across companies allows the unlocking of additional value, which accelerates innovation.

The hub's manufacturing data exchange platform seeks to create a trusted environment where manufacturers are

secure in the knowledge that their data is safe while realising the value gained from sharing anonymised data.

The potential value of data sharing is significant and runs into millions of pounds even when focussing alone on manufacturing process optimisation. Leaders in data sharing improve processes by using shared data, implementing solutions only made possible with data sharing.

The World Economic Forum white paper, Share to Gain: Unlocking Data Value in Manufacturing, identifies five critical benefits of sharing data:

- enhance asset optimisation by sharing and combining data of similar production equipment across companies to increase machine uptime and product quality
- track products along the value chain by sharing product location, time and quantity data to optimise and automate end-to-end processes
- trace process conditions along the value chain by sharing data on product and process conditions to create a continuous digital product record
- exchange digital product characteristics on product shape, geometry and composition to create a digital product twin and automate processes

- verify provenance by sharing data along the supply chain to ensure the origin of raw materials, the components and the products are as expected.

The Smart Manufacturing Data Hub is seeking to bring manufacturers together, to be stronger together, and through the manufacturing data exchange platform provide:

- a compelling value proposition
- a clear understanding for data sharing
- mutually beneficial agreements
- the use of secure technologies and common standards.

Accelerating digitalisation through Made Smarter innovation hubs

The broader benefits of the Smart Manufacturing Data Hub are:

- through open innovation, we intentionally combine resources across multiple partners, developing joint solutions and offering the market new knowledge, technologies, skills, products and services
- we encourage people to interact, create, undertake, work and innovate together in a network, exchanging vast amounts of knowledge, sharing views and strategies
- we create collaborative environments by being increasingly strategic and

specialised, joining different agents, professionals and companies with similar objectives and challenges

- providing innovation in a more agile and broad way, encouraging the continuous and strategic interaction of engaged, prepared and willing minds to innovate projects with access to an extensive ecosystem
- generating business between startups and large companies, helping the development of technology-based companies with high growth potential.

We businesses increase productivity, sustainability and resilience by growing the UK manufacturing sector through digitalising, one step at a time.

Pilots

In November 2020, three pilot innovation hubs were launched to develop, demonstrate and test digital solutions for manufacturing and supply chains.

The innovation hubs were set up as national network of facilities available to the manufacturing industry.

The £3 million pilot programme delivered three fast start testbeds:

Made Smarter Smart Factory Test Bed delivered by High Value Manufacturing Catapult, enables businesses to test the latest digital manufacturing solutions in a broad range of applications, before investment.

Made Smarter Market Place delivered by Swansea University, developed an online marketplace, designed to optimise manufacturing supply chain networks and create a new industry-wide business model.

Digital Validation & Verification test bed delivered by the National Physical Laboratory has developed a digital demonstrator that is capable of evaluating PPE performance against selected standard requirements.

myMaskFit: delivering a customisable face mask in rapid time

A startup is set to offer a customisable and reusable medical face mask to health workers thanks to funding support both for its development and for a revolutionary new digital marketplace.

The Covid-19 pandemic has highlighted the importance of manufacturers being able to rapidly develop and supply new products in emergency situations.

Former vice-president technology of GKN Aerospace and [MyMaskFit](#) co-founder Paul Perera was a key member of the UK government's Ventilator Challenge team that successfully and rapidly sourced new ventilators in response to the pandemic.

His friends, Gareth Smith and his wife Valerie Bednar, an intensive care unit nurse, naturally turned to him in May 2020 to try to resolve an issue Valerie had with poorly fitting face masks.

They asked if they could use his scanner and 3D printer to make a facemask that would perfectly fit Valerie's face.

The standard mask was a poor fit for Valerie, and, after a little research, they discovered that standard medical-grade masks were a poor fit for around 25%

of people. The trio realised there was a market for customisable and re-usable face masks and together they formed myMaskFit.

Initial development was supported by a £334,000 grant from Innovate UK. The company is now hoping to get its product to market later this year after rapidly putting together a supply chain through a new digital marketplace powered by artificial intelligence.

myMaskFit partnered with the [University of Swansea's Institute for Innovative Materials, Processing and Numerical Technologies](#) to pilot the new digital platform for supply chains, which was funded by the Made Smarter Innovation challenge innovation hub pilot programme.

Artificial intelligence seeks out providers

Work on the marketplace is led by Professor Johann Sienz, of Swansea University College of Engineering.

He said: "It's a marketplace that brings together customers and providers who supply and manufacture the goods. You have a requirement, such as for masks in an emergency, and you want to find the best and cleverest way of getting a supply chain together at times when no supply chain exists.

"It's a place where a customer can go, it could be the NHS or it could be an individual, and say 'we would like 10 million masks'."

The marketplace uses artificial intelligence to find the best potential suppliers, looking at a range of factors such as past performance, finances, digital readiness, and regulatory compliance.



We've built the innovation from a mobile app to getting the testing done, and we have a viable business that others are interested in partnering with.

"It wouldn't have happened without funding support from the Made Smarter Innovation challenge.

Companies can join the marketplace, but it will also use artificial intelligence to look outside the membership for potential supply chain partners.

Johann added: "The tool can be used in multiple ways and that's really powerful. If your company is missing components, the marketplace can do a digital gap analysis.

"It can be used as a digital watchtower to see how production is going. It can spot bottlenecks or blockages and find ways around. It will update itself. Some companies will drop out and others will come in depending on their journey along the digital path."

The project has drawn in expertise from the Manufacturing Technology Centre, Warwick Manufacturing Group and commercial partners including Autodesk, Tech2B, Plyable, Carapace, PXL ICE, Cadarn, AI Idea Factory and Amplyfi.

It is now considering how its digital marketplace could be used to develop UK supply chains for EV battery manufacture and for fuel cell manufacture. The project is also open to partnerships with companies from a wide range of sectors who can see the potential value.

Mask can match anyone's face

Paul, who has a 30-year background in aerospace manufacturing, said: "One of the learnings from the Ventilator Challenge was that it was really hard to find suppliers of particular types in the UK.

"We felt the digital marketplace was a way to use artificial intelligence to get to suppliers who had both capability and capacity."

myMaskFit has developed a transparent mask and an app that allows people to scan their faces. It has also built a flexible supply chain through the 'made smarter' work.

"We mostly find we can fit 90% of people with nine different sizes of seals. Those seals are removable and we can replace them with custom 3D-printed seals for the other 10%. It means we can match the face of anybody and get it to them within two days."

The mask is expected to complete the final stages of the inspection and testing process for medical devices this summer.

Further work is being done with the University of Cambridge on a coating for the mask and filter that could actively

remove coronavirus and other viruses and infections.

"If that programme is proven, we will have a first reusable filtered mask. Literally you will throw nothing away, you only have to clean it. We believe that could save £7 million a month on masks in the UK."

Company set to bid for NHS contract

The Welsh NHS has already bought some prototype masks, and myMaskFit is planning to bid for an imminent contract to supply masks to the NHS.

Paul added: "With very little knowledge, we have introduced ourselves into a new market. We've twisted a supply chain from doing aerospace parts to doing medical parts. We've managed to build a marketplace that works not just for our product but also for others.

"We've built the innovation from a mobile app to getting the testing done, and we have a viable business that others are interested in partnering with.

"It wouldn't have happened without funding support from the Made Smarter Innovation challenge."



Research

InterAct Network

InterAct is a £4.4 million, Made Smarter Innovation-funded, Economic and Social Research Council-led network that aims to bring together economic and social scientists, UK manufacturers, and digital technology providers to address the human issues resulting from the diffusion of new technologies in industry.



Digitalisation and working together

As we embark on the next stage of our industrial evolution, digitalisation will shape the future of our economy, manufacturing ecosystem, and workplace.

Digital technologies can enable us to create the future we want and move beyond consumption driven economic growth.

Our challenge is to create a future digital manufacturing ecosystem that meets our net-zero ambitions, whilst being resilient and productive. We need to ensure that everyone has the things that they need, at a price that they can afford, without damaging the environment or society.

To create the future digital manufacturing ecosystem we want, we need to work together. To combine our expertise from the broadest range of perspectives around this common goal, we need to interact.

Our aims

Working alongside other partners within the Made Smarter Innovation programme, the network aims to:

- build a strong, vibrant, interdisciplinary community where funding can be effectively distributed to researchers who will generate actionable economic and social science insights for the benefit of UK businesses
- in a world faced with the looming threat of climate change, the InterAct Network will also support UK manufacturing's efforts to achieve Net Zero by 2050.

Whilst technology is important, there are many social and economic factors that will be hugely influential in achieving these aims.

The InterAct Network, therefore, has two primary roles:

1. develop and support the creation of an effective digital innovation ecosystem to accelerate the innovation and diffusion of industrial digital technologies
2. act as a repository of social and economic science insights generated by research which is easily accessible by the Made Smarter Innovation challenge and the wider UK manufacturing sector

3. help to shape and define a vision of what a positive, sustainable and efficient UK manufacturing future can be.

Our vision for success is making InterAct a partner of choice for industry representatives seeking innovative solutions to the human issues that arise with the introduction of new technology.

We aim to be a one-stop shop which curates existing and emerging knowledge and capabilities (research and education) whilst showcasing leading practice.

To achieve this vision, we recognise the importance of bringing industry and academia together. We offer numerous events and workshops to develop these collaborative networks and opportunities.

Who is InterAct for?

The InterAct Network is a place for anyone with a stake in the future of manufacturing, such as:

- industry representatives seeking to achieve harmony between technological and personnel innovation through human insights
- policymakers wishing to understand the impact of new legislation and strategies on people within organisations



- academics with plans for ambitious, social science research into the sector
- industrial digital technologists examining the best ways to successfully integrate their products and services with end-users.

Benefits the InterAct Network for industry

Joining the InterAct Network grants members access to an exclusive mailing list, research outputs, networking events, and conferences.

Becoming part of the movement for change, organisations will be able to

contribute unique ideas and views to a network which is helping to drive thinking about the future of manufacturing.

Taking part in this programme is an opportunity to hear from leading voices in the sector, including project Co-directors, Professors Jan Godsell and Jillian MacBryde.

Connected Factories

The future prosperity of the UK will increasingly depend on building and maintaining a resilient and sustainable manufacturing sector that can respond to changing supply and demand by adapting, repurposing, relocating and reusing available production capabilities.

COVID-19 and future manufacturing

The COVID-19 pandemic has influenced our perspective on future manufacturing operations. In particular, it has brought into focus the capacity challenges of delivering critical products and maintaining production in the face of significant disruptions.

The pandemic also accelerated the emerging trend for more localised, greener and cost-competitive manufacturing infrastructure with the ability to produce a more comprehensive set of complex products faster, better and cheaper.

To meet the long-term needs of a high-labour-cost economy and post-Covid-19 challenges, we need transformative new methods of building and utilising future factories by embracing complexity, uncertainty and data intensity in a dynamic and rapidly changing world.

Our aims

The Made Smarter Innovation Connected Factories research centre aims to show that through using maturing digital technologies, such as industrial IoT

devices, AI and big data analytics, we can propose a radical new approach to building the manufacturing infrastructure of the future, which is:

- cost competitive
- can take new products to market quickly
- can adapt to changes rapidly.

The Connected Factories Research centre

Running until 2025, the Connected Factories Research centre is a £6 million programme that brings together a multidisciplinary research team drawing upon skills from across the Universities of Nottingham, Cambridge, and Sheffield, with an established track record in multidisciplinary transformative manufacturing research.

To meet the outlined challenges, we will demonstrate four critical facets of factories of the future:

- **agility:** the ability to respond to incoming demand and dynamically self-configure and self-organise to adapt to product variations and volume fluctuations

- **autonomy:** interacting with the operators and the environment and exhibiting self-learning and self-adapting behaviour
- **multifunctionality:** delivering a variety of processes and skills on a single platform
- **resilience:** the ability to self-adapt, self-repair, self-calibrate and self-qualify.

The outcomes will be supported by an underpinning programme of fundamental research in system design, modelling, control and integration and a set of application scenarios addressing emerging industrial needs.

Working with industrial partners

The application scenarios, created with our industrial partners, will demonstrate the above four facets in various ways, from whole factory digital systems down to advanced processes. To benefit your business, these will include the development of:

- a flexible framework for factory digital infrastructure allowing different operations, sites and companies to work separately, share and communicate



- advanced, adaptable processes that can cope with variation and detect errors in line in parts and processes across multiple tasks, including machining, AM and workpiece holding
- the use of peripheral sensing and low-cost sensors to support connectivity across production sites.

Within the research, something can be taken away and applied at every level of business, from OEMs to SMEs and across different sectors.

We aim to create as broad a reach as possible throughout the industrial network.

There are further opportunities for industrialists from all sectors to get involved and help shape the research output:

- sitting on our industrial advisory board
- providing use cases to our teams
- allowing us to conduct pilot studies on or off-site to help solve your specific problems of today whilst having a say in the manufacturing systems of tomorrow.

Digital Medicines Manufacturing

The Made Smarter Innovation | Digital Medicines Manufacturing research centre (DM2) is an ambitious three-and-a-half-year programme which began in September 2021.

General enquiries:
cmac-dm2@strath.ac.uk



LinkedIn

With a focus on enabling the digital design and manufacturing of medicines, DM2 is a flagship programme delivering strategic priorities for the centre for Continuous Manufacturing and Advanced Crystallisation (CMAC).

These strategic priorities will improve digital maturity in pharmaceutical manufacturing and develop a future workforce that can flourish in digitalised lab environments.

The DM2 aims

DM2 aims to advance medicines development, manufacture, quality control and supply by creating data-driven industrial digital technologies (IDTs), including artificial intelligence (AI), robotics and digital twins.

The programme will accelerate adoption through our focus on co-creation with industry partners.

We are delivering work across five integrated research platforms to achieve our goals:

- **platform 1: the data platform** enabling fair data to support digitalisation in the sector and standardise how data is curated and

transformed to meet pharmaceutical industry needs

- **platform 2: autonomous microscale manufacturing** accelerating the development of medicine manufacturing by creating agile, small-scale, data-intensive production facilities coupled with robotic technologies
- **platform 3: digital quality control** driving the digitalisation of medicine development quality control (QC) to streamline manufacture
- **platform 4: adaptive digital supply** generating new understanding to support the adoption of adaptive digital supply chains for patient-centric supply
- **platform 5: DM² network and skills** leading engagement, collaboration and skills development by establishing the DM2 network and skills programme.

Co-created and co-delivered with industry

A diverse team representing academia, industry, manufacturing regulators, end-users, and culture is delivering DM2.

KEY OBJECTIVES

Generating IDTs to help businesses:

Reduce

- lead time
- QC costs
- waste
- medicine shortages
- write offs

Increase

- productivity
- patient healthcare outcomes
- new business models



Materials Made Smarter Centre

The Materials Made Smarter Centre brings together a community of researchers across the materials manufacturing value chain, developing exciting advances in digital research, edge-artificial intelligence (AI)*, sensors and modelling and making them accessible to industry partners.

The data-centric approaches to materials-intensive manufacturing will enable the digitisation of the thread of materials to achieve a digital materials passport, performance-on demand, and materials as a service.

The UK's ability to manufacture advanced materials underpins ambitions to move towards a cleaner, more resource-efficient economy. Innovation towards a net zero-carbon economy requires new materials with enhanced properties, performance and functionality and new processing technologies with enhanced manufacturing capability.

By digitalising the thread of the material, we will enhance its value by:

- developing the tools to certify, monitor and control materials in-process and in-service
- improving productivity and stimulating new business models.

Our vision

Our vision is to put the UK's materials-intensive manufacturing industries at the forefront of the UK's technological advancement and green recovery. The centre's work focuses on three goals:

1. **performance-on-demand:** developing

modelling and monitoring tools which allow manufacturing processes to be flexible and responsive to the rapidly changing demands of customers

2. **the digital materials passport:** the digitalisation of manufacturing histories and in-service performance aggregated into a record that follows a material through-life
3. **materials as a service:** the development of the technological and organisational tools required to allow for performance-on-demand. The digital materials passport will allow the development of new business models, for example, materials as a service. The aim is that, through this, other opportunities will arise alongside these technologies.

Technologies in development

We have four leading technologies under development. They are:

1. **efficient fused modelling:** modelling capability aiming to reduce the need for trial and error at a computer power level without highly specialised equipment
2. **active sensors and materials-driven edge-AI:** to develop smart sensors that begin to analyse data generated during manufacturing, allowing faster

responses to undesirable manufacturing variability

3. **physical twins:** using advanced characterisation facilities to observe physical phenomena over distance and at a resolution that can't be achieved during manufacturing to inform manufacturing processing controls
4. **social and organisational change in digital transformation:** to recognise the required shift in the way we work, we are collaborating with the Institute of Work Psychology to undertake future scenarios planning. This will provide business support for changes in work processes, both technologically and at a human resource level. It will sit alongside a digital mindset tool to measure and support the workforce during the digitally driven organisational change.

All this challenge-led research into advanced digital technologies and tools enables the verification, validation, certification and traceability of materials manufacturing.

The digitalisation of materials manufacturing will drive the realisation of new business models, changing how we value and use materials.

Digital technologies have the potential to transform manufacturing by increasing productivity and opening up new business opportunities.

However, the UK has had lower levels of adoption than some of our competitors. While this may appear a purely technical challenge to overcome, we can attribute many of the most pressing barriers to a human element.

For example:

- a digital skills gap
- an implementation that fails to support human capability
- employee resistance
- lack of senior management support or vision.

Improvement through digital technologies

The [Made Smart Innovation People-Led Digitalisation research centre](#) aims to improve the outcome of digital technology adoption. We will create a practical and useable industry process to ensure prior, explicit consideration and appropriate action is taken to prioritise human needs and working patterns in designing and implementing digitalised work systems.

This change management process will be one industry can follow if they want to put people at the heart of their thinking when adopting digital technologies.

Integrating expertise and knowledge

We recognise that creating this change process is challenging. It requires the integration of expertise and knowledge from different domains.

In response, we have designed our centre to be transdisciplinary. The team comprises researchers and academics from other disciplines (e.g. engineering, management, policy), and our research is co-created with our non-academic partners.

The process integrates knowledge from three areas:

1. what is already known but is difficult to access outside of academia
2. what the researchers in our centre discover through their work
3. the findings from research conducted in the other elements of the Made Smarter broader ecosystem.

Some of the areas where our researchers are currently focussing their attention include:

- looking at the impact of digitalisation on the labour market
- identifying the important stakeholders and how best to interact with them
- pinpointing the metrics we could use to measure the success of a digital adoption project.

In the future new academics, researchers and PhD students will bring different skills and focus.

How we will work

The fundamental goal for the centre is to ground our processes in academic rigour while remaining practical and useable to the industry. This is where our industry partners are so important.

We will:

- collaborate with our partners to ensure the work we do is relevant
- co-create our research direction to reflect what the industry feels is needed
- conduct case studies and gather data in the real-world context of our partners' organisations
- consult with industry to translate the academic research into outputs which bring value to industry.

Although we are focussed on UK manufacturing, we welcome new industry partners from all sectors and size of organisation. We appreciate that different organisations may have varying levels of resources and motivation for involvement.

We will work to understand what drives you and respond to your particular circumstances and challenges.

General enquiries: P-LD@bath.ac.uk

Smart, Collaborative Industrial Robotics

The Made Smarter Innovation Centre for Smart Collaborative Industrial Robotics, also known as MSI Smart Robotics centre, is a collaboration between six leading UK universities:

- **Loughborough University (Lead)**
- **University of Bristol**
- **Cranfield University**
- **University of Dundee**
- **University of Strathclyde**
- **University of Warwick.**

We have built the centre on solid relationships with a wide cross-section of industrial and research partners both nationally and internationally.

Our centre's mission is:

- create a trans-disciplinary, cross-sector hub that will unlock the vast potential of intelligent, collaborative industrial robotics to increase productivity, quality, and adaptability for the UK industry
- to achieve this, we are creating a research and innovation ecosystem, bringing key stakeholders together to tackle the underpinning barriers to the widespread use of automation and robotics and accelerate adoption.

The key barriers are:

- **responsiveness barrier:** specialised equipment is often inflexible, with either too expensive or impractical modifications.
- **acceptance barrier:** people and automation are separated by inflexible safety, regulatory, procedural, physical and psychological barriers, preventing effective collaboration.

- **skill barrier:** high level of specialist skills required to design, implement and maintain automation.
- **capability limitations:** many processes and components are too difficult to handle (e.g. non-rigid components, variable shapes, variable behaviours), using open-loop, repetitive automation.
- **cost barrier:** perceived and/or actual high initial costs for specialised, automated equipment

Partners and priorities

Our partners envision automation systems moving away from monolithic, dedicated systems and instead towards more dynamic, distributed systems with multiple actors, both human and machine, seamlessly collaborating.

Large enterprises benefit from the vision as it brings automation into traditionally manual production processes. Similarly, better accessibility and agility will allow more small and medium-sized enterprises (SMEs) to benefit from automation, improving their competitiveness.

We have identified four key priority areas for research that will significantly increase investor confidence, reducing the cost barrier by enabling greater return on investment:

1. **collaboration:** robotic systems need better models of how people naturally interact with others to collaboratively leverage the respective strength of humans and automation
2. **autonomy:** robots need to extend their sensory perception and autonomous cognition capabilities to effectively undertake complex tasks and deal with variations and change
3. **simplicity:** the process of designing, verifying, validating, deploying and operating automation must be more accessible to a wider audience of people and organisations
4. **acceptance:** we must better explore and understand the societal, cultural, and economic impact of automation to inform future policy, regulations, and education requirements.



Building a community

We will use open-access feasibility studies that respond to emerging industrial needs to develop and increase UK manufacturing sector investment in industrial robotics and automation research and development and increase their adoption.

To achieve this, we are building a vibrant community to increase collaboration across different manufacturing sectors in the UK and create automation solutions to common problems, including:

- rapidly deploying and adapting robotic systems for a succession of small-batch-size tasks in the same or different locations
- assisting people carrying out skill-intensive tasks by supporting them on-demand with robotic devices supplying components, tools or a helping hand, just-in-time

- autonomously manipulating components with challenging, non-rigid, difficult-to-predict behaviour (eg fabric, cables, organics, cakes)
- coordinating complex, collaborative tasks between a team of robots that would otherwise need integrated and dedicated machines, jigs, and fixtures.
- remotely controlling robotic devices carrying out skill-intensive tasks in hostile or inaccessible environments with operator inputs (eg extreme temperature, under water, confined spaces, vacuum).

Emerging smart automation technologies will create opportunities for developing new products and services with our partners.



Collaborative Research & Development (CR&D)

CR&D 1 • Fast start

Round one of funding, launched in 2019, awarded £20 million to 14 cutting-edge projects, totalling £50 million of activity with industry investment. Projects focused on the use of industrial digital technologies (IDTs) to transform the productivity and agility of UK manufacturing.

Funded projects include:

Smart connected shop floor – real-time data integration with multi-sector applicability

GKN Aerospace is heading up a cross-sector team to trial a combination of digital technologies in live manufacturing environments.

These include artificial intelligence and machine learning technologies, intelligent robots, augmented reality, and 'smart' devices that can exchange information between old and modern computer systems to enable a greater understanding of the data.

The £20 million funding is enhanced by industrial investments worth £30 million giving a total value of £50 million invested in sectors such as aerospace, automotive, and food and beverage.

The projects include IDT concepts such as digital twin, additive manufacturing, and Industrial Internet of Things.

Digitisation of aluminium welding – transforming UK bicycle frame-building

Frog Bikes is a British small and medium sized enterprise (SME) leading a project innovating the design of children's bikes.

Using the latest digital technologies and manufacturing techniques (for example virtual design and testing, and automated, robotic techniques to join bicycle components together), they will create a lighter, better performing bike.

The system streamlines production, reduces cost, and, by allowing suppliers to use recycled materials, creates less waste. The project will bring these manufacturing techniques to the UK, securing control of the company's supply chain and helping to reduce their carbon footprint.

The digital sandwich – digitised food supply chain

Raynor Foods, an award-winning UK sandwich supplier, is leading a project to create the 'digital sandwich'. This is the world's first national and 'open' software platform: a major piece of software that smaller programmes can operate within.

Food and drinks businesses can connect online using these programmes to share valuable data – increasing productivity, improving cashflow, boosting food quality and reducing waste within the supply chain.



MADE SMARTER

INNOVATION

GSK

Smart Connected Shop Floor – real-time data integration with multi-sector applicability

Artificial intelligence, autonomous robots, augmented reality and other technologies have the potential to transform UK manufacturing. A multi-million pound cross-industry project explored how digital technology could be deployed to create the smart, connected factories of the future.

Smart connected factories are central to the vision of Industry 4.0. Connected from the 'shop floor to the top floor' with real-time data, they have the potential to transform production, driving efficiencies to boost productivity and help meet Net Zero targets.

However, transitioning the UK's existing factories into a digital future poses significant challenges. "If we take aerospace as an example, people think of it as a very high-tech industry but, while there are pockets of cutting-edge technology, its digitisation has developed in a piecemeal fashion with lots of different systems that are unable to 'talk' to each other," explains David Mouatt, Programme Director at GKN Aerospace. "There's very little factory-level connection of data."

From aerospace to automotive and

pharma, the challenge of digital integration at scale spans the sectors. The Smart Connected Shop Floor (SCSF) project aimed to help manufacturing industries make this step change by bringing them together to trial the latest digital technologies in live manufacturing environments and, importantly, share their learnings.

With £3.7m funding from the Made Smarter Innovation challenge, GKN Aerospace led the cross-sectoral project with industry partners Nissan, Rolls-Royce, GlaxoSmithKline, Meggitt, BAE Systems, Airbus and AT Engines Controls Ltd. The project explored the potential benefits of using digital technologies including artificial intelligence, machine learning, intelligent robotics, augmented reality, smart devices and data analytics.

"We looked at different technology

providers – their benefits and shortcomings – and how these might fit with different partner requirements, taking into account issues such as legacy equipment and their processes," explains Juljana Peter, Digital Manufacturing Consultant, Accenture's Industry X, which supported the project's co-ordination and digital integration.

Each of the partners developed proof of value pilots for their own shop floor. These use cases were shared to help understand the challenges, how to overcome them and how those learnings could be rolled out across individual factories and wider production networks.

"For example, several partners trialled Microsoft HoloLens, an augmented reality technology, which enables operators to overlay digital instructions so they can see, hands free, the

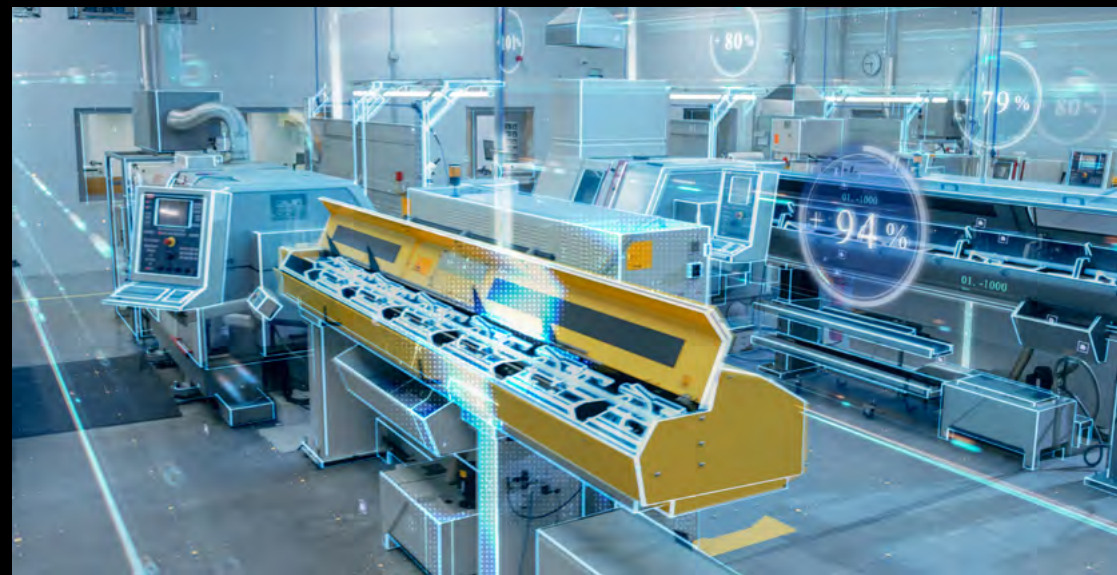
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SCSF is a lighthouse programme; it demonstrates the power of cross-sector collaboration and knowledge sharing within the digital manufacturing space – and how these can help the UK stay at the forefront of emerging manufacturing technologies.

next step,” says Mouatt. “Rolls Royce collaborated with the University of Sheffield Advanced Manufacturing Research Centre to develop machine learning for visual inspection of fan blades. The combination of cameras and a defect-detection algorithm achieved a system with 98% accuracy.”

Such use cases demonstrate multiple, cross-industry benefits, including improvements to production quality and ‘right first time’ manufacturing, increased productivity through better planning and more efficient use of time and machinery, and a reduction in energy usage and waste. “Importantly, the project has also shown the benefits of connected data, which historically has been harder to quantify. This has allowed us to see clearly how increased quality and quantity of connected data can save costs, and improve quality and sustainability,” adds Peter.

An open-source whitepaper shares the insights gained from the associated technical and integration challenges, enabling wider supply chains across the



UK to benefit from the project's learnings. A follow-on project, Project Butterfly, will build on the work by exploring how shop floor data connectivity can enable improvements in environmental sustainability.

“Manufacturing faces big challenges ahead that can only be tackled with a strong focus on developing new skills and capability,” says Mouatt. “SCSF is a lighthouse programme; it demonstrates the power of cross-sector collaboration and knowledge sharing within the digital manufacturing space – and how these can help the UK stay at the forefront of emerging manufacturing technologies.”

CR&D 2 • Digital supply chain

Round two of funding was awarded in July 2021, with £18 million for 27 feasibility study projects and 10 industrial research activities.

The competition aimed to help UK manufacturing supply chains to develop digital technologies to become more efficient, productive, flexible, resilient; encouraging the use of digital approaches to better integrate and optimise the performance of supply chains.

Funded projects include:

- SupplyVue's digital platform, CarbonVue, which will provide visibility of carbon in the whole supply chain and provide a framework to foster greater collaboration in order to reduce carbon emissions
- GSK Limited are leading on the SmartPSC project where the application of digital technologies will be applied to integrate pharma manufacturing supply chain and enhance efficiency, productivity, flexibility, resilience and sustainability
- Food for Thought (Global) Limited will develop an interoperable platform which integrates with existing systems to capture information across the food supply chain in real time.

The funding also covers areas such as:

- traceability of food and plastics manufacturing in within the supply chain
- increased transparency using digital technologies
- enhanced scheduling and manufacturing of advanced therapies.



MADE SMARTER

INNOVATION

Autonomous

Empowering the NHS advanced therapies ordering prototype IT system with Manufacturing insight from an electronic batch manufacturing system

A prototype software platform aims to increase efficiency in the production of advanced therapies – helping to drive down costs and increase supply of these cutting-edge medicines.

Advanced Therapy Medicinal Products (ATMPs) – also known as gene or cell therapies – are at the cutting edge of personalised medicines. They are driving remarkable changes in clinical practice across multiple fields of medicine, including new cancer therapies, regenerative treatments, and enhanced wound healing. However, they are also very expensive, often costing hundreds of thousands of pounds to millions of pounds per treatment.

This is because many ATMPs are made from a patient's own cells. While this bespoke production creates a truly personalised medicine, it means the manufacture and supply of advanced therapies is uniquely challenging.

"Making ATMPs is very different from paracetamol or vaccines, for example. Each batch needs to be tested, approved

and the manufacturing data captured, but whereas ordinary medicines can be made in batches of 100,000+ in one manufacturing run, each batch of ATMP only produces one treatment," explains Kwok Pang, COO of Autonomous, a company that designs software solutions for the ATMP supply chain. "It's a major challenge for both manufacturers and the NHS to deliver the process at scale."

With £500k funding from the Made Smarter Innovation challenge, Autonomous led a project with Advanced Therapies Facility, University of Birmingham and the University Hospitals Birmingham NHS Foundation Trust to integrate its software platform – AutoLoMATE – to the NHS prototype advanced therapy ordering system that streamlines the scheduling and ordering system for ATMPs.

Creating an advanced therapy requires a drug company to organise the collection of patient cells, transfer them to a manufacturing site, undergo a complex manufacturing process, and then precisely time the delivery of the therapy back to the hospital in time to treat the patient.

"Currently, the scheduling is largely managed and organised by individuals using diaries, white boards and emails being sent back and forth. In addition, they are dealing with a live cell product, which leads to unpredictability in the supply chain. And on top of all that, there is no margin of error in this type of manufacturing; the wrong product to a patient could kill them," says Pang. "To account for all these considerations, current schedules allow large buffers of time. It means the manufacturing teams cannot work at full production capability."

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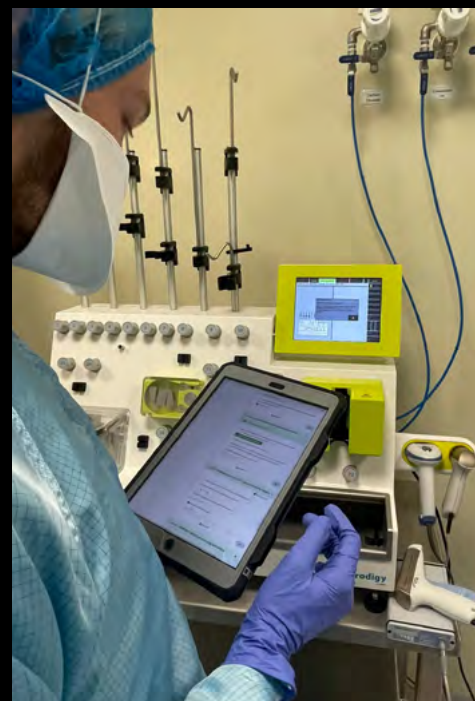
Increased efficiency along the value chain can drive down costs and help create a better understanding of the product, all of which will help cure more patients in future.

By creating an interface between these systems, AutoloMATE aims to increase efficiency and maximise production capacity – enabling greater quantities of advanced therapies to be produced, and at a lower cost.

The project builds on and integrates existing technology developed by the Advanced Therapies Treatment Centres initiative funded by UKRI. In this project, the integrated platforms demonstrated an 85% reduction in scheduling and 50% reduction in manufacturing time. “Importantly, because it removes so many of the manual elements, it also improves the overall safety profile of these complex medicines. This is key to demonstrating to regulators that scaling up can be achieved with no increase in risk,” adds Pang.

Moving forward, Autolomous is working to demonstrate the platform could be rolled out across NHS centres of excellence. “This is a fast-growing sector, with more 2,000 clinical trials in progress for personalised medicines – and some of these are for treating diseases with much larger patient populations,” says

Pang. “Digitisation frees up production capacity and optimises the skills of those working in the industry. Increased efficiency along the value chain can drive down costs and help create a better understanding of the product, all of which will help cure more patients in future.”



MADE SMARTER

INNOVATION

SORT-IT

Low-cost, smart labels could help increase the accuracy and speed of recycling for plastic food and drink packaging

Unsure if your yoghurt pot can be recycled or whether it needs to be washed first? A project has developed 'smart' labels that could enable recycling centres to sort plastic packaging more efficiently, and even provide consumers with instructions on how and where to recycle their waste.



The SORT-IT project explored the feasibility of electronically 'tagging' packaging so that it can be identified and tracked. "Typically, material recovery facilities sort packaging using a near-infrared optical sorting machine. However, the complexity of packaging materials, differences in color and contamination with food residue mean a large proportion is missed or incorrectly sorted – and a lot of valuable material instead ends up landfill or incineration," says Joshua Young, Circular Economy Lead at PragmatIC Semiconductor, which led the project.

PragmatIC Semiconductor innovates and manufactures low-cost, flexible electronics that enable everyday objects to become smart and connected.

With £274,000 funding from the Made Smarter Innovation challenge, the company worked with the University of Sheffield Advanced Manufacturing Research Centre (AMRC) to demonstrate how its ultra-low-cost Near Field Communication (NFC) technology could be used to identify, track and sort waste moving along a conveyor belt.

Labels using PragmatIC's NFC technology were applied to items of packaging to provide them with a unique identity. Sensors deployed on a conveyor belt were then able to read the label, identify the packaging, localise its position and remove it for sorting using a robot arm.

"It means the packaging can tell a machine about its material composition, as well as where or how it has been used," explains Bobby Manesh, Head of Research at AMRC Cymru. "It significantly improves the sorting accuracy of mixed recycling, which not only reduces the amount going to landfill, but also means materials are not 'downcycled' into lower grade materials."

This is important because the food and drink packaging industry is struggling to secure enough high-quality material for recycling, known as recyclate, says Young. "There's growing demand for high quality recyclate, both from industry commitments to plastic targets and from brands and retailers who face a

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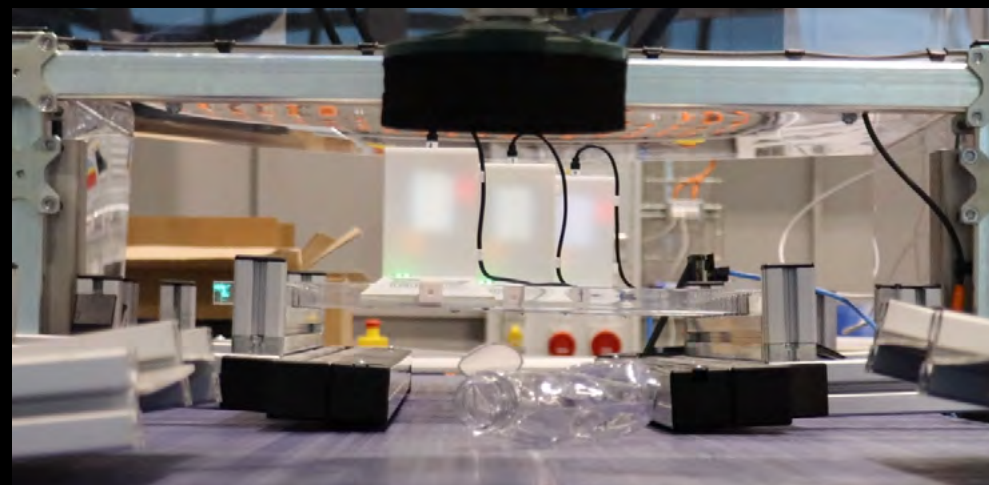
[The technology] significantly improves the sorting accuracy of mixed recycling, which not only reduces the amount going to landfill, but also means materials are not 'downcycled' into lower grade materials.

plastic packaging tax at £200 per ton of packaging with less than 30% recycled content."

The technology also offers potential benefits for other industries under scrutiny for recycling, such as fashion and textiles. "More widely, there is scope for it be used to improve the automation and traceability of manufacturing processes and operations, or within the logistics and e-commerce industry," says Manesh. "Being able to identify and track items around a manufacturing facility or along a supply chain is key to creating the smart factories of the future."

Building the success of the SORT-IT project, PragmatIC Semiconductor and the AMRC are now working on the £1.4m project TRACE (Technology-enabled Reusable Assets for a Circular Economy), which aims to maximise the recovery and reuse of high value materials through digital technologies. "We are exploring opportunities for the technology to digitalisation reusable systems, enabling them to become a reality at

scale. For instance, could consumers return packaging in-store or through online delivery and obtain incentives or rewards for doing so?" says Young. "For environmental and economic reasons, we need to dramatically increase the return and capture of food-grade plastics. This type of engagement could help consumers see plastic as a valuable asset to re-use many times rather than as something to use once and throw away."



ARGUS

Home and personal care products need to be kept free from microbial contamination, but current testing methods slow down the supply chain. A project is exploring how sophisticated sensors could be used to detect microbes inline and in real time.

Protecting home and personal care products, such as shampoos and washing up liquids, from microbial contamination is a key challenge for manufacturers. A build-up of microbes can create manufacturing problems, requiring cleaning and sanitisation of the equipment, or even pose a risk to consumers, leading to expensive product recalls.

To help ensure only 'fit for purpose' products make it to the supermarket shelf, stringent checks are in place, with samples taken at each stage of the supply chain for testing. "The issue is that the current microbiology-based tests involve a very slow and laborious process – samples can sit in an incubator for up to three days," explains Andrew Dorset, Senior Director for Quality Innovation at consumer goods multinational Procter & Gamble (P&G). "It means a lot of product – and therefore money – is tied up waiting to see whether any microbial

contamination has grown on an agar plate or whether it is safe to continue to the next stage of the process."

With £248,000 of funding from the Made Smarter Innovation challenge, P&G led the ARGUS project, which investigated how digital technology could be used to test in real time and without stalling the product on its journey through the supply chain. Like the giant in Greek mythology after which it was named, ARGUS has many 'eyes' – in this case, the very latest in optical sensor technology from University of York.

Using the supply chain of the well-known Fairy Liquid brand as a case study, with one of its raw materials supplier Libra Speciality Chemicals, the project explored how sensors could be deployed at key points to detect the build-up of microbes (biofilm) on surfaces or in flowing liquids. A digital platform prototype was developed to capture the data and provide real-time

measurements. "The technology can pinpoint any problems inline and as they occur, which enables more targeted interventions, whether that's sanitising or shutting down that particular line," says project lead Lucia Mendez-Mata, Senior Manager for Corporate Quality Assurance at P&G.

The technology has the potential to create around \$1million of direct savings to the UK Fairy Liquid supply chain. Savings come through increased productivity and agility, as well as a reduction in inventory. There are also savings – both economic and environmental – in terms of a more targeted approach to cleaning.

"Currently, equipment is sanitised routinely with hot water. Knowing exactly where and when to clean could save energy and water," says Mendez-Mata.

Such instantaneous measures of material quality and supply chain health could



The technology can pinpoint any problems inline and as they occur, which enables more targeted interventions.

combine to create digital Certificates of Analysis, which would be of benefit to manufacturers within Fast Moving Consumer Goods (FMCG), as well as other industries. As part of the project, an innovation advisory board was created, including members from paints and coatings, biofuels, food and beverages, and agricultural products industries.

"This innovation is very relevant to our FMCG liquids businesses, but it has potential application across many other UK supply chains," says Dorset. "We are already working on ARGUS II, which takes the proof of concept trials from the feasibility study lab pilots to real factories – but there is scope for this to be scaled up further and create a whole new, highly-skilled sector for this technology across a range of industries."

CR&D 3 • Sustainable smart factory

Round three of funding was announced in October 2022, with a combined £14 million awarded to 12 projects to identify and support digital innovations to improve the sustainability of manufacturing processes, resulting in either reduced material or energy consumption.

It is estimated the projects could create 1,000 jobs in the 3 years after their completion, while reducing manufacturing carbon dioxide emissions by 300,000 tonnes a year. This is the equivalent to taking nearly 65,000 cars off our roads.

Funded projects include:

- **Smart and Sustainable Manufacturing for Baking Industry, led by Rakusen Limited** – using AI to improve the consistency of the products produced by their century old baking machinery and helping reduce energy consumption by 60%
- **LEAD Factory, led by Photocentric** – the first technology that will enable products to be 3D printed at scale using recycled materials
- **WasteMap, led by Topolytics** – using machine learning to develop a visual map of useful, reusable manufacturing products that can be extracted from our waste system
- **Reducing Energy Consumption and Material Loss in Steel Production Using Predictive Machine Learning, led by Deep.Meta** – using machine learning to boost sustainability in the production of steel by predicting where inefficiencies lie before they happen
- **INSPIRE by Pragmatic Semiconductor** – tackling global semiconductor shortages by using AI to optimise manufacturing productivity and efficiency
- **Smart People + Smart Process = Smart Factory, led by Raynor Foods Limited** – turning sustainability into a game at the Raynor Foods sandwich factory to enable staff to see and then act on their energy use and CO2 footprint in real time.



CR&D 4 • Robotics & Automaton

Scheduled to launch in January 2023, the next CR&D funding call scheduled will focus on driving industrially ready robotic solutions for deployment within all types of manufacturing factory settings.

Aimed at late stage higher Technology Readiness developments, projects will be able to run for around one year and culminate in trials within a production environment. Projects must be an innovative development or novel application which overcomes a technical challenge.

Robotics is one of the fundamental industrial digital technologies (IDTs) that will help grow UK manufacturing productivity. The scope of this call will span hardware solutions such as:

- fixed or mobile robots and software innovations to improve system integration
- improving the flexibility and agility of future re-deployment opportunities will be an essential innovation theme, with project applications encouraged in topics such as
- modularity, no-code programming and optimised gripper design.
- development of innovative solutions to maximise the potential of collaborative robots (co-bots)
- to improve the safety of Human Machine Interface (HMI) will also be within the scope of the call.

Successful applications will need to demonstrate clear post-project scalability and routes to commercialisation beyond the initial deployment. Projects of up to £2 million will be eligible to apply, with collaborations comprising multiple manufacturers and technology developers encouraged.



Focus on standardisation & interoperability

The standardisation & interoperability challenge

Digital transformation and innovation within the UK's Manufacturing Sector have brought significant challenges in acquiring and integrating large quantities of data. The data comes from many different sources, incorporating these elements into an automated manufacturing system.

Establishing interoperability is crucial to meet these challenges, with standards development and adoption playing an essential role in achieving this.

Supporting the UK's standards ecosystem, working in partnership

The Made Smarter Innovation Challenge seeks to support the UK's standards ecosystem, ensuring it continues to be internationally agile and supportive towards innovation and emerging sectors. We will, in part, achieve this through working in collaboration with the British Standards Institution (BSI) and the National Physical Laboratory (NPL).

The Made Smarter Innovation Challenge team works directly with BSI and NPL through the Made Smarter Innovation Hubs.

Here's what that means:

- working with BSI, the overall objective of the Standards & Regulations programme was 'to create an integrated portfolio of open, impartial, industry-driven generic and sector-specific international standards for interoperability in manufacturing and its supply chains'
- this portfolio will therefore build on existing standards, many of which already address interoperability and any significant blockages to adopting industrial digital technologies (IDT)
- ultimately, we will establish a common open standards environment for manufacturing IDTs, allowing developers and users to exploit the benefits of IDT rapidly.

Fast track standardisation pilot process

The final phase in the BSI-led programme will test a pilot process to identify and prioritise a key challenge expediently and then develop a guidance base document as an interim deliverable for subsequent standards development.

This programming phase used an opportunity analysis process as a precursor step to fast-track and identify critical challenges to technology adoption. BSI is testing this process for the first time. It is a pilot project, and we hope it will inform a pipeline of subsequent projects.

The first pilot project is developing a guidance base document for the selection and application of collaborative robots (cobots) for use in manufacturing. This guidance document may be developed into a full standard at a later phase and will be separate from this project.

Standards for the fourth industrial revolution

Standards exist in different forms, from creating definitions and a vocabulary when a new emerging sector starts to form to technical specifications that enable infant technologies to make that crucial jump to commercialisation.

Voluntary standards that describe agreed good practices can be a great enabler of innovation, playing a critical role in bridging the gap between brilliant ideas and commercial success.

Through standardisation, we can:

- disseminate knowledge, and know-how
- speed up the adoption of cutting-edge technologies
- maximise the benefit from our target of increasing total UK research and development expenditure to 2.4 per cent of GDP by 2027.

Standards, measurement, and accredited conformity assessment are critical in supporting innovation and enabling its swift and safe commercialisation.

At the early stages, standardisation, as a process in itself, can:

- create network effects by bringing communities of innovators together to establish a common language and understanding around new technologies and foster collaboration
- act as, by codifying an agreed way of doing things, a means of knowledge transfer to leverage R&D outputs and ensure interoperability, facilitating widespread adoption and deployment of new technologies.

In interplay with measurement and accreditation, standards underpin a system that fosters trust in novel and complex technologies throughout the supply chain and with consumers, thereby helping drive investment.

Ref: BIES Standards for the Fourth Industrial Revolution (July 2021)

Global perspective

The fundamental goal underpinning the Made Smarter Innovation challenge's work in this area is to support the development of roadmaps for standardisation and architecture.

Ensuring globally agreed methodologies are in place to, for example, establish semantic interoperability amongst devices.

As the UK builds its manufacturing sector fit for the future, establishing global networks incorporating machinery, warehousing systems and production facilities will be possible if a single set of common international standards is developed.

Eureka Global Stars

Eureka Global Stars is a EUREKA programme promoting international innovation collaboration between EUREKA member countries and innovative markets outside the network.

In 2018, the Netherlands launched the first EUREKA Global Stars call with Taiwan on the topic of Photonics in collaboration with France and Denmark. To continue this innovation synergy, a new call was organized with Taiwan, The Netherlands, the United Kingdom, and Canada in 2021. A total of eight projects were selected for funding, covering fields such as semiconductors and photonics, smart manufacturing, and circular economy.

Made Smarter Innovation funds three industrial collaborations between Eureka Global Star Taiwan/UK digital.

Prime-3D

Printed electronics can be an enabling technology for lightweight, functional components in many applications, including automotive, aerospace and consumer electronics.

Although processes for forming 3D-printed circuitry are available, the technology has limitations on usable substrate materials. Alternative, material-agnostic processes are possible but require development for commercialisation.

How Prime-3D is helping business:

- developing the equipment and processes required to build 3D-printed components with integrated electronics
- these integrated electronics use a combination of a spray-coated precursor, which is subsequently selectively activated by laser into a seed layer for electroless plating
- this plating means that the thick conductors formed by plating are suitable for high-frequency antenna required in the latest generation mobile phones. Demonstrator phone antenna will be manufactured as part of the project.

Bioproduction in CHO cells by interdisciplinary engineering and AI

GeneNet Technology, in collaboration with the Centre for Process Innovation (CPI) and Taiwan-based Cytena BPS and Instant NanoBiosensor, engineers a stress-sensing genetic circuit and artificial intelligence (AI) cell embedded into current bioproduction (incubator) using a real-time testing method.

Combining cutting-edge technology from Cytena BPS' next-generation bioreactor, this technology has many benefits:

- culture fine-tuning and real-time data collection from culturing and physiological conditions
- instant NanoBiosensors' Fiber Optic Particle Plasmon Resonance technology, which detects biomarker expression. With this, we will gather comprehensive culturing, physiological and biomarker data during CHO cell bioproduction
- we will feed this comprehensive data into GeneNet's ground-breaking technology – artificial neural network (ANN) genetic circuits
- ANN genetic circuits are the cutting-edge in synthetic biology and genetic engineering
- in the past decade, synthetic genetic circuits only applied simple logic (AND/OR/NOT) gates to biocomputing
- GeneNet's ground-breaking technology makes genetic circuits analogous to deep learning computers, turning CHO cells into smarter AI computers

- all this allows us to engineer smart, stress-sensing CHO cells to maximise protein production efficiency and yield, benefiting our downstream clients and wider industry and society as a whole.

AI-driven automatic regression creation for digital IC design

Through this project and the resulting product digital automated test creator (Digital ARC), we want to open a new chapter in the workflow utilities compendium for HDL testing.

We will do this by:

- automating test creation and generating human-readable test source code which can then be further maintained by developers
- focusing on unite regression testing, a type of testing required for already managed code. This code keeps track of changes in code behaviour through development iterations and flags-out bugs in the form of undesirable changes in behaviour across atomic units of code functionality.

Technology Accelerator

The Made Smarter Technology Accelerator connected leading UK manufacturers with pioneering technology startups to develop innovative technology solutions for some of the UK's most relevant industry challenges. The programme was delivered by Digital Catapult and funded by UKRI through the Industrial Strategy Challenge Fund, as part of the wider Made Smarter national movement.

The Made Smarter Technology Accelerator ran between October 2020 and December 2021. With funding and support, startups developed their ideas into prototypes and minimum viable products (MVP) in less than a year. In return for their valued support and match-funded financial contributions, our Industry Challenge Owners (ICOs) benefited from outputs and learnings, as well as seeing proofs of concept developed in response to the challenges they set. There were two tech sponsors, Verizon Business and Software AG.

The challenges

The programme focused on five key themes across the challenges:

- Intelligent factory/site management and control
- Intelligent product verification and validation
- Transparent and data-driven procurement
- Digitally enabled factory workforce
- Resource measurement and analytics.

Manufacturers are increasingly looking to partner with startups to stimulate innovation, with nearly three quarters of manufacturing leaders (73%) saying that

collaborating with startups is part of their long-term business strategy in a survey with Digital Catapult. The aim of the programme was to introduce advanced digital technologies into manufacturers' processes. These technologies are powering the fourth industrial revolution in the UK manufacturing sector: driving productivity, digitalisation and innovation in factories, OEMs, warehouses and supply chains.

There were seven industry challenge sponsors each running two challenges for technology startups.

Babcock International Group wanted a digital twin solution for its Warrior Base overhaul, and support with digital shipbuilding using complex 3D design data.

BAE Systems sought scalable artificial intelligence for visual inspection systems that could operate on a small training data set, alongside a dynamic workflow management tool that could react to disruptions and changes.

GAF were looking for support with its asphalt material characterisation through production and machine vision systems for product conformance and assessing machine condition.

Northumbrian Water Group were building a smart version of their 'Porcupine' device used in sewers to trap unflushables, as well as looking at water network monitoring and real-time analysis to manage water quality.

O'Neills worked to identify any errors or requirements for adjustment in a production line with automation.

Safran Landing Systems wanted adaptive scheduling and performance monitoring, with implementation of statistical process control on all test rigs in the assembly shop to identify and halt failures.

Sainsbury's wanted to identify and inactivate bacteria on raw and cooked foods without altering appearance, taste or nutritional properties. Their other challenge was to increase shelf life and sell-through of products while reducing waste with real-time data.

The MVPs

Four companies worked to develop full minimum viable products (MVPs) for the challenges based on their initial prototypes.

Working with Babcock International Group on the Warrior base overhaul

challenge, **JetSoft** developed a solution using existing equipment and combined data output to create an automatic 3D dataset that eases the hull inspection process.

The **Machine Intelligence** prototype for BAE Systems uses a custom, novel machine learning technique to identify defects within X-ray images during routine inspection. Detecting issues quickly and reliably improves the quality of the end product, reduces waste and results in a more economical production process.

Riscon Solutions Ltd partnered with **Inventia UK** to work with Northumbrian Water on the water network monitoring challenge. The ITERATION project delivers a cloud-enabled remote water quality monitoring solution.

TotalControlPro uses a dynamic, data-driven planning scheduling and resource optimisation solution for Safran. They identify best possible planning options and make recommendations for scheduling, and as learning occurs, these become more accurate and responsive to manufacturing conditions.

The prototypes

As well as the full MVPs, ten companies developed prototypes for these challenges.

Manufacturing technology company **Ascalia** used high-tech cameras and AI to automatically analyse all fresh food items to ensure they were free from bacteria in the Sainsbury's challenge on microbial control in ready-to-eat foods.

CAE Tech paired cutting-edge technologies from the gaming and music sector with a cloud-based application to enable Babcock engineers to connect with their CAD and bill of materials (BoM) data sources for real-time data sharing and updates in their digital shipbuilding

Using AI, the manufacturing scheduling and workflow management solution designed by **DIEM Innovations** reacted to disruptions and changes at BAE Systems. The integrated system enabled targeted measures to be used to improve supply chain performance.

From the Northumbrian Water challenge in sewage stream, **Innvotek's** Smart Porcupine provided remote observation and tracking of potential blockages. Operating continuously, it harnessed artificial intelligence to provide users with data and alerts using wireless connectivity.

Metis Automation converted customer order data from O'Neills into simple manufacturing steps and checks. The system automatically updated processes for customised products, enabling the

user to easily make bespoke and mass-produced clothing at the same cost.

Pentiot's robotic solution used artificial intelligence to dynamically alter the feed rate of material through sewing machines and achieve consistent results at O'Neills.

Using an AI-based decision-making system, the solution for Sainsbury's from **Singular Intelligence** predicted food product shelf-life at every stage of the supply chain, and the automated control system made corrective actions.

Volatile Technologies designed a solution for rapid, portable chemical testing for asphalt variations produced by GAF based on its Scout-2 chemical and olfactory testing instrument without specialist lab equipment.

The solution from **Zeta Motion** and **Dakota** used smart cameras and advanced AI for continuous quality controls with no need to stop the production line at GAF.

The **Zizo Software** solution for the Safran Landing Systems challenge created an end-to-end repository and platform to manage data from across teams and functions, combining device management and analytics without the need to implement a factory-wide network and without relying on an internet connection or cloud-based database.

Find out more about

**MADE
SMARTER**

INNOVATION

Made Smarter Innovation

To find out more information about Made Smarter Innovation, wider Made Smarter activities and to get involved with any of the challenge programmes, head to madesmarter.uk

Completed list of CR&D winners

CR&D 1 | FAST START

Data-Driven Additive Manufacturing for Highly Regulated Industries: DAEDALUS | **HIETA Technologies Ltd**

WeldZero | **ATS Applied Tech Systems Ltd**

Digital Integrated and Intelligent Continuous (bio) Manufacturing (DIICBM): An Explosion of Innovation | **Perceptive Engineering Ltd**

Digital Design Accelerator Platform to Connect Active Material Design to Product | **Astrazeneca UK Ltd**

InTiFi: Industry 4 Technologies into Foundation Industries **Speciality Steel UK Ltd**

Next-generation Digital Design technology for Formulated Products involving complex materials | **Process Systems Enterprise Ltd**

The Digital Sandwich: Digitised Food Supply Chain, fusing IoT, Blockchain and AI data layers to improve productivity, traceability and reduce waste | **Raynor Foods Ltd**

Smart Connected Shop Floor | **GKN Aerospace**

Rapid Sand Casting Production | **Raplas Technologies Ltd**

DIALOG: Dynamic Integration of Automation with LOGistic **Atlas Copco IAS UK Ltd**

Digital Designer Robot: Assisted Self-Service Design For Customers In Bespoke Manufacturing | **Account Management Online Ltd**

SIMPLE: Smart InforMation PLatform and Ecosystem for Manufacturing | **Fully Distributed Systems Ltd**

Transformative industrial digitisation of UK frame-building **Frogbikes Ltd**

CR&D 2 | DIGITAL SUPPLY CHAIN

Feasibility Studies

SPACE: Supplier Planning And Capacity Estimation **Autonomous Manufacturing Ltd**

Data-Driven Luminaire Remanufacture Supply Chain **Treegreem Ltd**

MBQP: Model-Based Process Design and Quality Planning **Perpetual Labs Ltd**

Environmental Transparency & Traceability Platform (ETTP) **Proarch IT Solutions Ltd**

Quality and Freshness Assurance for Dynamic Pricing in the Seafood Supply Chain | **SafetySpect UK Ltd**

Enabling resilient supply chains with AI-driven data sharing, forecasting and collaboration | **Attentiv Ltd**

Goods-as-a-Service: Feasibility with pallets | **Miralis Data Ltd**

REMP: Remanufacturing E-Marketplace for a Circular Digital Supply Chain | **Intelivita Ltd**

Automated manufacturing cost estimator and supply chain management portal | **I4 Product Design Ltd**

A New Approach to Manufacturing Supply Chain Risk Management **Crossword Cybersecurity PLC**

Digital Spare Parts Supply Chain: An Integrated Solution of Spare Parts Inventory Management and Predictive Maintenance **NBT Group Ltd**

ARGUS | **Procter & Gamble Technical Centres Ltd**

Composite Service Orchestration Platform (COMPAS) **Valuechain Enterprises Ltd**

SORT-IT: Increase plastic food and drink packaging recycling rates for Extended Producer Responsibility (EPR) and Deposit Return Schemes (DRS) | **Pragmatic Printing Ltd**

Delivering Digital Ingredient Transparency for Personal Care sector **Croda Europe Ltd**

Digital Supply Chain Adoption Curve (DSCAC) | **Authentise**

A Crowd Sourced Anti-Counterfeiting Imaging AI platform (ACACIA) **Intogal Ltd**

Smart logistics network cost optimisation | **Inception Consulting Ltd**

A Revolutionary Workflow Tool Automating the Fashion Industry and Reducing Overproduction and Errors That Cause Unsustainability **SupplyCompass Ltd**

Rebar 4.0: Supply chain made smarter | **UK Certification Authority for Reinforcing Steels**

Diverse Supply Chain Programme (DiSC) | **Simply Do Ideals Ltd**

Digital Innovations for Niche Sector Industry Supply Chain Optimisation (DINS) | **Westfield Sports Cars Ltd**

Coldchain 4.0 Feasibility Study | **Food For Thought (Global) Ltd**

A Blockchain-Enabled Digital Twin for Leather Traceability: From Farm to Vehicle | **Jaguar Land Rover Ltd**

Waste Insights: A Downstream Supply Chain Revolution **Topolytics Ltd**

Blockchain Traceability for HTRPs Recycling Value Chain **Circular Ltd**

To Me, To You: Improving Supply Chain Communications with Digital Technologies | **Elements Technology Platforms Ltd**

INDUSTRIAL RESEARCH

Smart integrated digital supply chain for MMC House manufacturing (SIDsHouse) | **Project Etopia UK Ltd**

SCORE: supply chain optimisation for demand response efficiency **Alford FE Ltd**

SmartPSC (smart pharma supply chain) | **GSK Ltd**

SecQual: secure quality assured logistics for digital food ecosystems **Lloyd's Register Group Ltd**

UK fashion and textiles: data-driven platform, enabling manufacturing supply chain real-time decision-making, effective track and trace and sustainability | **UK Fashion and Textile Association Ltd**

Empowering the NHS advanced therapies ordering prototype IT system with manufacturing insight from an electronic batch manufacturing system | **Autolomous Ltd**

INtelligent TrustEd SuppLy Chaln (INTELI)

BAE systems (operations) Ltd

A digitally connected food supply chain to deliver transparency, sustainability and efficiency | **Foods Connected Ltd**

Trusted Bytes: trusted, decentralised, digital supply chains for the food industry | **Produce Logistics (UK) Ltd**

CarbonVue: integrated carbon and productivity end-to-end supply chain management | **SupplyVue Ltd**

CR&D 3 | SUSTAINABLE SMART FACTORY

Butterfly | **GKN Aerospace Services Ltd**

Smart and sustainable manufacturing for baking industry **Rakusen Ltd**

A scalable IoT solution utilising machine-learning to discover actionable insights to reduce energy or resource consumption utilising manufacturing process data | **EdgeMethods Ltd**

ECO-SPRINT: environment centred optimisation of SME productivity using realtime intelligence | **FitFactory Technology Ltd**

INSPIRE: integrated sustainable production through innovative resource efficiency | **PragmatIC Semiconductor Ltd**

Finding materials efficiencies with WasteMap | **Topolytics Ltd**

Reducing energy consumption and material loss in steel production using predictive machine learning | **Deep.Meta Ltd**

AI 3D-printing factory network across the UK | **Batch.works Ltd**

Smart digitisation of bed and fine wire spring manufacturing: building a predictive tool for resource or operational innovation | **Spinko Ltd**

COMPASS: comprehensive machine and process analysis for sustainable production systems | **Domin Fluid Power Ltd**

LEAD: low energy autonomous digital factory | **Photocentric Ltd**

Smart people + smart process = smart factory | **Raynor Foods Ltd**