

2018-2019

High Value Manufacturing Catapult  
Annual Review  
2018-2019

Making UK industry  
a global leader

**CATAPULT**  
High Value Manufacturing

4,650

innovation  
support projects  
with businesses

Top 20 interventions  
creating

£15.7bn

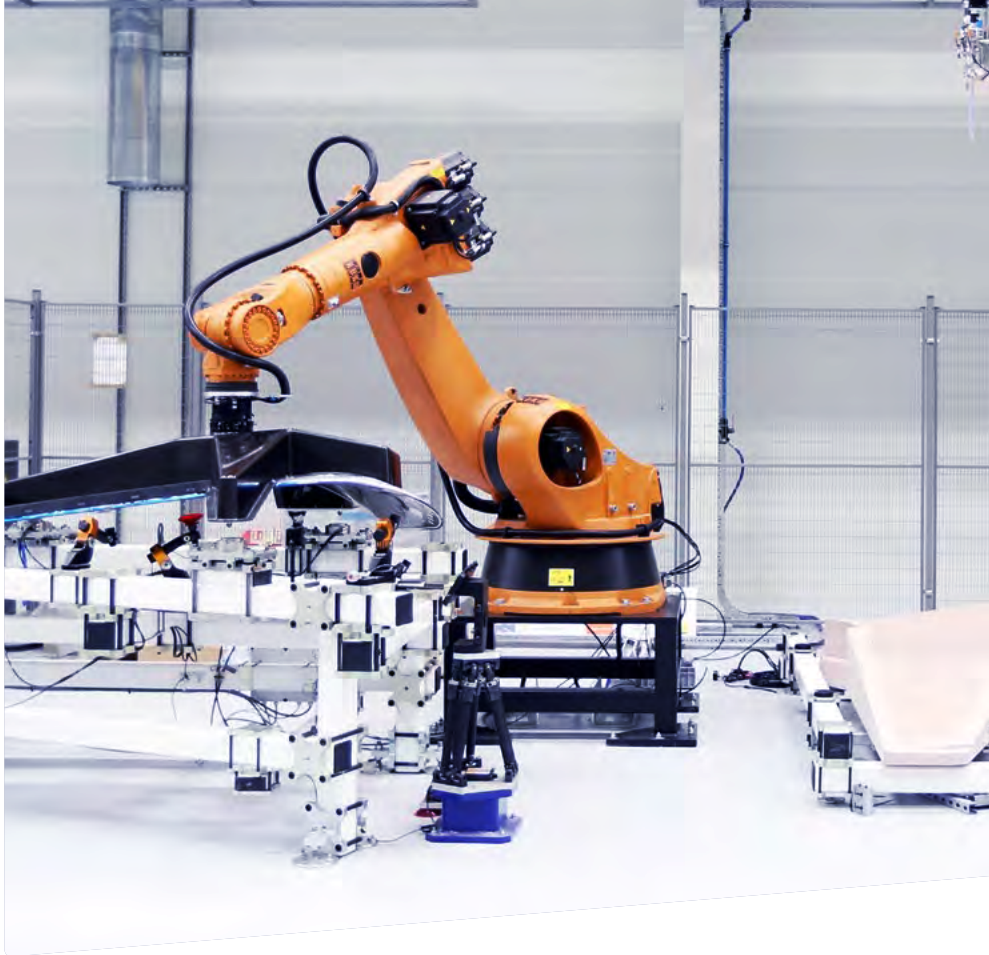
GVA gain over 10 years

£504m

total industry  
R&D linked to  
Catapult activity



We are key drivers of  
UK economic growth



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## Our centres

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AFRC:	Advanced Forming Research Centre
AMRC:	Advanced Manufacturing Research Centre
CPI:	Centre for Process Innovation
MTC:	Manufacturing Technology Centre
NCC:	National Composites Centre
Nuclear AMRC:	Nuclear Advanced Manufacturing Research Centre
WMG:	WMG Centre



**Allan Cook CBE**  
Chairman (2018-)  
High Value Manufacturing Catapult

# Chairman's statement

Investment in productive capacity is the foundation of economic growth.

The High Value Manufacturing (HVM) Catapult remains central to the UK's industrial and economic development. Our seven centres of industrial innovation continue to nurture and inspire the UK manufacturing industry, working with all sizes of business to create and develop a bright future for the UK.

In last year's Annual Review, I reflected that the UK's manufacturers were faced with major risks and significant opportunities flowing from emerging technologies and strong global competition. Little has changed. Our manufacturers are used to making fine judgements about how best to prepare for the future against these familiar challenges but with turbulence in global markets and increased uncertainty in the UK, 2018/19 saw manufacturers more nervous about the shape of their near-term future. For some, that uncertainty has slowed or halted investment in new activity and a pause in their plans to innovate. Others have recognised that a downturn elsewhere is exactly the moment to invest in new products, better processes and an improved offer to their customer. These businesses turn challenge into opportunity and I have been pleased to see an increasing number of them reaching out to the HVM Catapult to help them develop these plans.

I've been particularly delighted to see more and more of the UK's smaller businesses making fuller use of the Catapult's services and expertise in translating ideas into great bottom-line results and more secure, expanded markets. Others are turning to us for help in using new technologies – boosting their productivity and reducing their production costs. This means that whatever the terms of trade with key markets, the offer of UK manufacturing remains attractive and competitive.

In total, the HVM Catapult saw a 24% increase in the number of projects with those businesses who looked to beat uncertainty with innovation in 2018/19. They included firms of every shape and size, from charities and small family-run businesses to the large multinational companies that sit at the top of supply chains. In every case, the HVM Catapult was able to give the business greater confidence that its investment in innovation would deliver a sustainable return. That confidence is key to driving up the UK's total investment in research and development and vital to delivering the ambitious Industrial Strategy target of increasing expenditure – currently just 1.7% of our GDP – to the OECD average of 2.4% by 2027.

Our ambition is that the HVM Catapult will keep UK manufacturing businesses at the top table of global markets by delivering over £2bn of new R&D activity in the UK between 2018 and 2023. We are well on the way to achieving that goal. This year we used the £109 million core grant we received from Government to invest in building technology capabilities that went on to generate a total R&D investment of £504 million. That will translate into a real strengthening of the UK's manufacturing base, new and better jobs and more prosperous communities across the nation.

Our ability to inspire investment confidence at a time of business uncertainty is not only down to the offer of grants or other incentives. It's because firms recognise that the High Value Manufacturing Catapult offers a unique combination of deep sectoral insight, world-leading expertise and the facilities needed to fast track ideas from concept to reality. I have had the good fortune to spend over 50 years in international manufacturing and have never before seen such a concentration of talent, energy and innovation geared to establishing, and sustaining, the UK as one of the leading manufacturing nations in the world.

The future of UK manufacturing is in safe and capable hands.





**Dick Elsy CBE**  
Chief Executive  
High Value Manufacturing Catapult

# Chief Executive's statement

Innovation is the fuel for a thriving economy.  
In challenging markets the High Value Manufacturing  
Catapult's offer turbocharges a company's plans to succeed.

The HVM Catapult was created in 2011 with the goal of increasing the contribution the UK's manufacturing community makes to the health of our economy overall. Seven years into our journey, we have clear evidence that we are delivering overwhelmingly positive impacts that often flow far from the manufacturing sector. Independent evaluation has concluded that, in aggregate, the effect of our work with large firms is likely to be "very substantial." Assessing the potential economic impact of our 20 most substantial interventions alone, that study suggested that our work would deliver some £15.7bn of GVA into the UK economy over the next 10 years. But our impacts are not limited to the major players at the helm of global markets. A survey of our impact with SME clients found that 61% of those surveyed will introduce a new or improved manufacturing process as a result of the support we gave and 54% a new product or service.

Business recognition of our economic impact is driving extraordinary growth for the HVM Catapult. Despite uncertainties in our economic backdrop as global markets contract and trading regimes change shape, the Catapult has grown its customer base, seen a 15% growth in the number of collaborative R&D projects it is engaged in and increased its commercial revenues.

This year we helped 4,650 companies. The majority (53%) were SMEs. This is a substantial show of confidence in our capacity to grow smaller businesses and increase their impact in the wider economy. Across the seven centres that make up the HVM Catapult we had over 2,900 technicians, engineers and support staff working on 1,493 projects. We are an innovation powerhouse in the sector.

We have continued with our commitment to deliver and I'm happy to report that this year's results were fully on budget.

The former Chancellor Philip Hammond confirmed a five-year funding package totalling £643m in August 2018. This core funding will be matched with similar levels of commercial project income and funds from collaborate research projects which we win competitively. The total activity from these three sources will total over £2bn with this new five-year funding proposal.

A five-year funding grant requires a comprehensive five-year plan to be developed, the highlights of which are featured later in this review.

Beyond our economic impact listed above, the independent review into our work also considered our influence, at a national level, in strategic leadership. The report showed that the HVMC's contribution to strategic leadership effects is high because of our unique position within the sector. We are chair or support over 130 industrial and trade groups and our insight into the future of manufacturing through these groups and our 4,650 industrial clients puts us in a unique position at the fulcrum of the sector.

This strategic contribution is reflected in the success of some of the industry sector deals and Industrial Strategy challenges that we have helped to secure.

A key success this year came from *Made Smarter*, a national programme for digital manufacturing, which we helped to develop and garner industrial support.


In *Transforming Construction*, we have also helped the industry to develop a collaborative sector deal which secured £170m of government funding to be matched with £250m of industrial support. As part of this, MTC – our centre at Ansty near Coventry – built a consortium with the Building Research Establishment, and Cambridge University's Digital Built Britain Centre to win funding for the Construction Innovation Hub, a £72m programme at the heart of this sector deal.


From this success, it's clear that our work makes UK manufacturing a more prosperous, more dynamic and more innovative engine for the wider economy. Now, more than ever, it is important that Britain retakes its title as *the* world-leader in advanced manufacturing.




# 2018/19 in numbers

**7**  
**centres**  
across 18 locations

**4,650**  
innovation  
support  
projects  
  
Up 24%

**2,469**  
projects with  
SME clients  
  
Up 22%

**4,804**  
SME  
engagements  
  
Up 9%

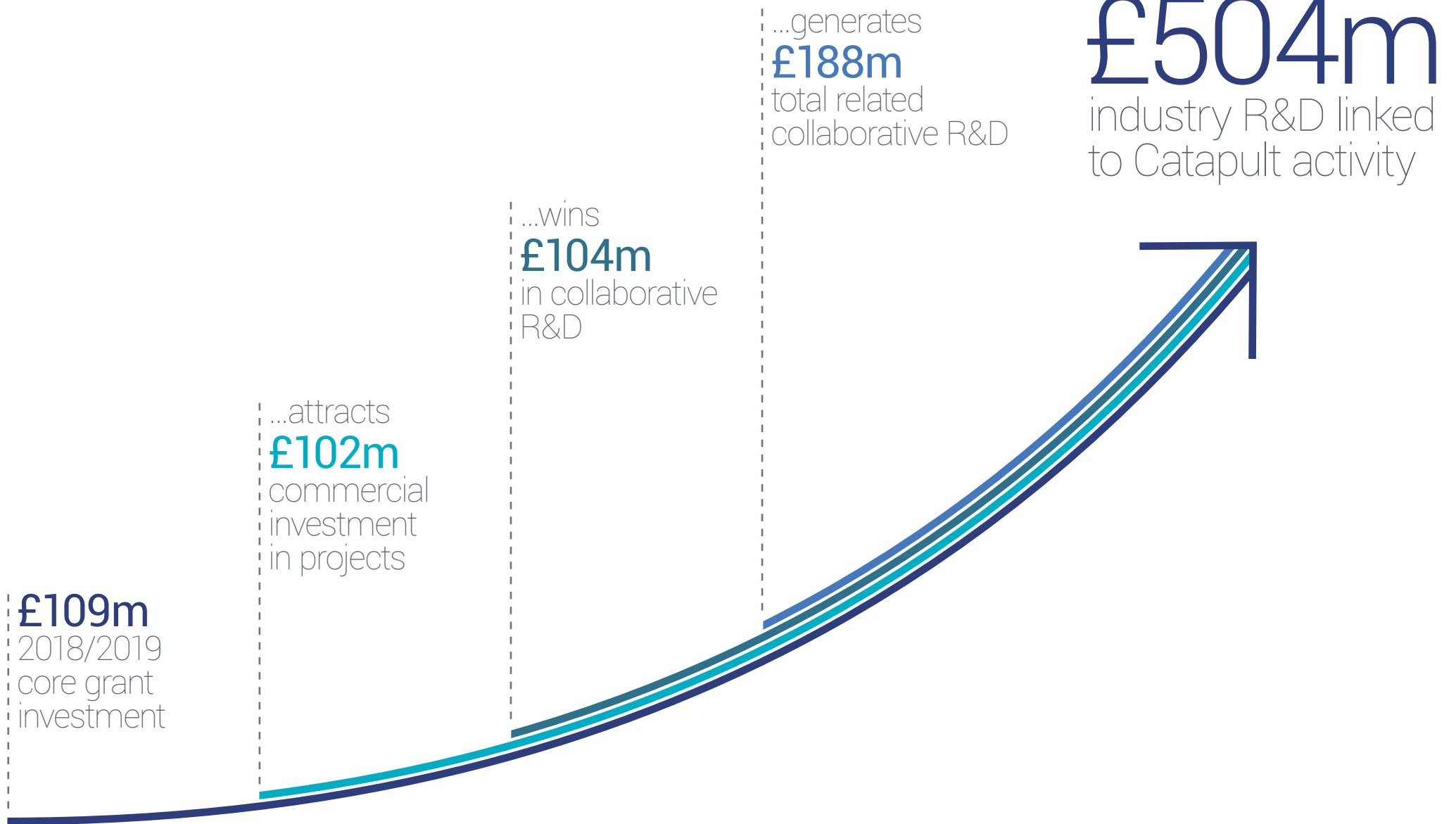
**1,018**  
engagements  
with UK academic  
institutions

**2,913**  
staff as FTEs

**£778m**  
asset base



# Stimulating R&D investment



# Success stories

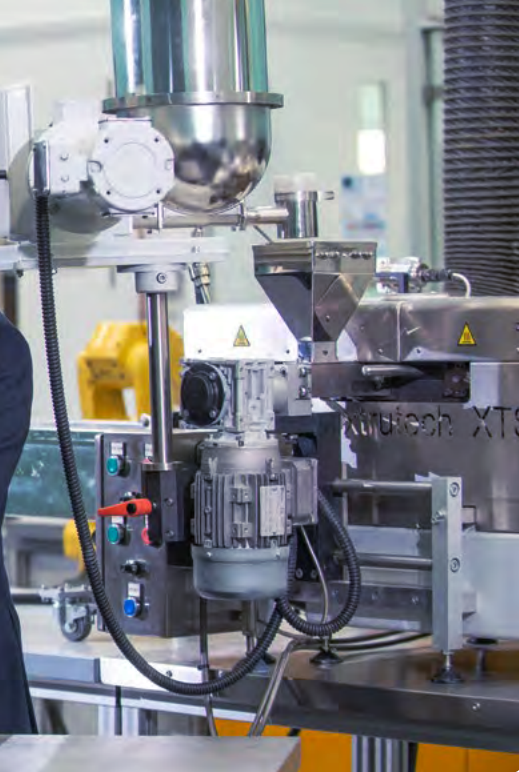
In 2018/19 the High Value Manufacturing Catapult's Centres helped 4,650 companies to harness the power of innovation to strengthen their performance. Those companies ranged from small social enterprises to global giants employing thousands of people both directly and through their UK supply chains. A recent independent evaluation of our impact concluded that the work we do was helping companies to achieve results they would not otherwise have achieved.

Here are just a few examples of how working with the HVM Catapult is transforming company performance.



## Garbage to gold – saving on landfill

One person's trash is another person's treasure. The HVM Catapult centre at WMG have helped Delta Waste Management save around 3,000 tonnes of waste from landfill with material reprocessing. The Warwickshire-based SME recovers plastic waste for resale and reuse but recognised that more valuable reprocessed materials would have a bigger impact on their bottom line and help to improve the environment. With Delta's input, our team used their expertise and knowledge to develop a reprocessing method using thermal analysis to determine individual polymers and their characteristics. The different polymers are then moulded into pellets as feedstock for injection moulding. By using waste plastics in a more efficient way, Delta and our team have reduced both the financial and environmental costs of landfill and the manufacturing of thousands of different products.



## Sustainable desalination

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Access to clean water is in crisis. It has been estimated that nearly half the world's population could struggle to access clean water by 2030 so the Catapult was keen to help when approached by London-based Desolenator. The SME had developed a novel solar-powered desalination system which could disrupt the global water desalination market – estimated to be worth more than \$26 billion by 2025. HVM Catapult experts at the AMRC ran a workshop with Desolenator's team to review the company's existing system prototype and advise on design and assembly for batch volume production. CEO, William Janssen, whose goal for his fast-growing SME is to produce one trillion litres of water sustainably by 2030, said: "The AMRC is a bastion of knowledge and expertise in finding relevant ways to make things better, simpler and cheaper."

## Project Century tackles automotive energy consumption

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Weight reduction in vehicles is one critical way to reduce energy consumption in transport. In collaboration with GKN and other leading organisations, the NCC have applied wet press composite manufacturing processes in new and innovative ways to produce automotive components. These components weigh an impressive 20% less than their metal counterparts whilst retaining structural capabilities. With minimal capital investment needed for wet press technology, the innovation is easily scalable, producing cost-effective components that help to improve fuel consumption across the sector. The project and this development in particular goes a long way towards GKN's ambition to establish themselves as a tier one supplier of structural composite components to the automotive industry. With several GKN sites in the UK (including its International Automotive HQ), this innovation helps to increase inward investment nationally.

# Success stories



## Wearable innovation

The work our Centre for Process innovation (CPI) has been doing with Pireta Limited is a great example of how the HVM Catapult can help shorten the time between an initial idea and the market. Pireta developed an innovative method of manufacturing truly wearable technology in textiles with increased flexibility, breathability and performance of garments even when washed or stretched. Drawing on its world-leading expertise in printed, hybrid and stretchable electronics a team from the CPI worked to help Pireta to scale-up this technology, reducing manufacturing timescales and demonstrating the commercial viability of its product. With wearable technology as an integral part of the Internet of Things, the CPI team helped progress this game-changing technology towards market.

## Improved output for long-standing producer

MacTaggart Scott has spent over 100 years supplying the naval defence and marine industries. It approached the High Value Manufacturing Catapult's Advanced Forming Research Centre (AFRC) for help to improve manufacture of its cam ring, a core component in its main hydraulic motor product. Producing the cam ring involved a range of processes including heat treatments and grinding so MacTaggart Scott needed to tap into a diverse range of testing and examination expertise which the company was able to find at the AFRC.

The AFRC's engineers and researchers provided close examination and testing of the company's materials and processes and made recommendations on how it could reduce the stresses induced during manufacturing and optimise the overall cam ring production process. The recommendations meant that not only did MacTaggart Scott see improved and more consistent cam ring output, the company saw production times tumble by two days, lead times fall by more than three days and significant reductions in their energy costs – a real boost to company competitiveness.



# Our offer

The High Value Manufacturing Catapult offers manufacturers of all sizes open access to the equipment and expertise they need to develop new and existing products and processes.

Our approach allows firms to test and prove their innovative ideas before they commit to significant capital investment, giving them the confidence to move forward. The breadth and depth of our expertise moves innovation in all areas from concept to commercialisation, underpinned by the workforce training required to maintain productive capacity far after our involvement.

**There are five key aspects of our offer.**



# 1

## Manufacturing expertise

We offer manufacturing businesses access to a unique reservoir of manufacturing insight and expertise.



# 2

## Access to cutting edge equipment

We provide companies with access to world-class facilities and skills to scale-up and prove-out high value manufacturing technologies.



# 3

## Workforce training

Our Centres offer apprenticeships, training courses and student placements to help build and maintain the high-level skills UK manufacturing needs.



# 4

## Research

We are a meeting point for academics and businesses, playing a key role in stimulating demand-led research.



# 5

## Policy insight

Our business insight and technical knowledge make us a valuable partner in the development and delivery of national or more local policy.

# Our technology



Advanced Assembly



Automation



Biologics



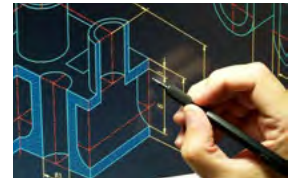
Biotechnology



Casting



Composites



Design



Digital Manufacturing

Case studies on pages 20–21



Electronics



Flexible Manufacturing



Formulation



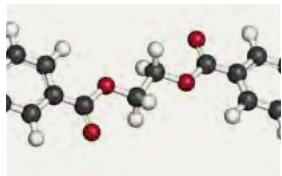
High Temperature Processing



Joining



Machining



Manufacturing with Polymers



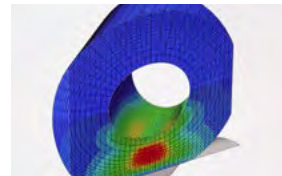
Materials Characterisation



Metal Forming and Forging



Metrology



Modelling and Simulation



Net Shape and Additive Manufacturing



Powder Technology



Power and Energy Storage



Printable Electronics



Sustainable and resource efficient manufacturing

Case studies on page 32-33



Surface Engineering



Tooling and Fixtures



Visualisation and Virtual Reality

Two thirds of all UK R&D spend is in manufacturing – connecting research and business is the way to lead the world







# Driving economic growth

The UK currently ranks as the ninth largest manufacturer in the world, accounting for 3% of global output. It employs 2.7 million people at pay levels well above the national average and is a big exporter, with nearly 50% of all UK exports coming from manufacturing. Our manufacturers are also in the vanguard of positive industrial change, driving productivity improvements with productivity growth three times the UK average and spurring the UK's investment in R&D with around two thirds of all business R&D spend coming from manufacturing. Those statistics leave little doubt that manufacturing matters to the UK's wider prosperity now, but maintaining or growing the contribution our manufacturers make is challenging in the face of fierce global competition. All nations want a rich seam of advanced manufacturing value in their economies. The ability to scale up and commercialise research, to be the fastest and first to market can often be the difference between success and failure.

The HVM Catapult is a key enabler. We take the very best of the UK's research and work to apply it in the light of market need to lock more manufacturing value into our economy. At any one time we will be involved in projects covering every aspect of manufacturing. They might include digital design and verification of nuclear components and systems, developing the use of virtual reality and augmented reality in the construction sector, helping a company to weld the strongest joins, or using digital technologies to transform the performance of a production line. Some of our projects have even taken us down to the farm as we apply our manufacturing insights to the challenge of food production.

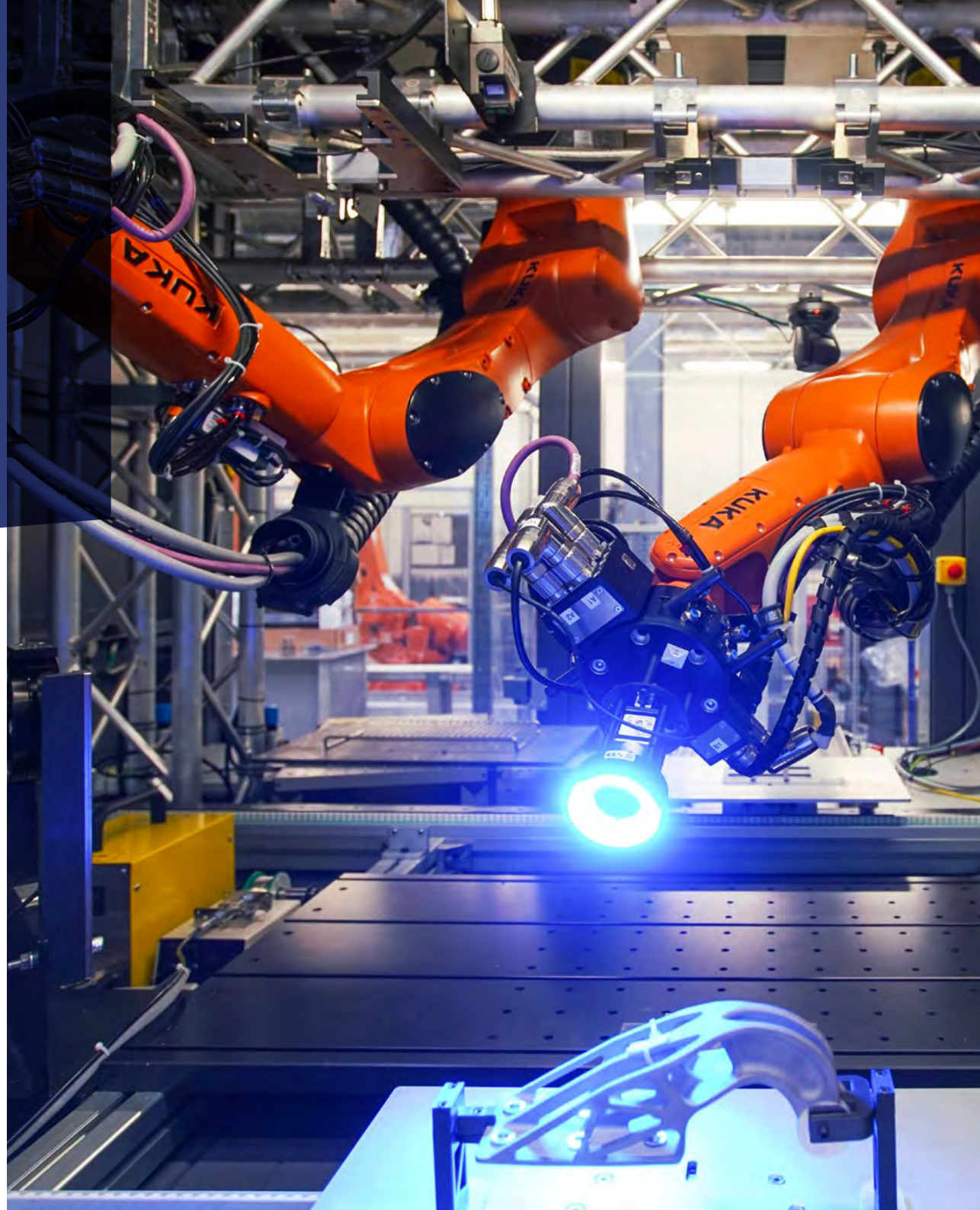
2018/19 saw us driving activity in areas where we see significant opportunities for the UK. This part of our Annual Review introduces you to some of our work in these areas.

# Digital manufacturing and automation

Increasing the uptake of digital and automation technologies to increase UK productivity and global competitiveness

Digital technologies are transforming almost every aspect of our world. For manufacturers they hold the key to raising productivity, increasing competitiveness, forging more dynamic links with customers and delivering better products and processes more tailored to their needs and less damaging to our environment. In 2017, the *Made Smarter Review* found that the positive impact of faster innovation and adoption of these digital technologies could be as much as £455 billion for UK manufacturing over the next decade.

The HVM Catapult has therefore been working with businesses across the UK to spur their application and adoption.





# Programmes

## **Digital Transformation**

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This SME-focused project helps businesses plan their digital journey. With a powerful tool to assess digital readiness and relevant actions across business areas, the MTC supports SMEs in developing and maturing their processes. Central to this project is the adoption of new technologies and procedural streamlining, leading to better efficiency, decreased lead-time and improved quality.

## **Digital Innovation for Manufacturing (DI4M)**

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Digital Innovation for Manufacturing (DI4M) at WMG helps manufacturing SMEs benefit from the latest manufacturing technologies and thinking, including Manufacturing & Materials, Digital Manufacturing, Business Transformation, Connected Autonomous Vehicles and Energy Innovation.

## **Digital Reconfigurable Additive Manufacturing facilities for Aerospace (DRAMA)**

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DRAMA is a three year, £14.3m collaborative research project, building facilities and digital tools to help UK supply chain companies position themselves at the forefront of the additive aerospace supply chain. The project is gathering pace and is receiving good feedback and support from aerospace suppliers. In progress are the development of a new metal additive manufacturing facility at MTC and our Additive Manufacturing Knowledge Hub – an online portal to support supply chain companies in the adoption of additive manufacturing. By reducing time, cost and risk of set-up, planning and validation, the project allows faster adoption and implementation of this transformative technology by UK businesses.

## **Digital Meet Manufacturing**

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The SME-focused Digital Meet Manufacturing is the AMRC's campaign to lead the way in connecting digital and manufacturing together in a way that brings big benefits to both sectors. As part of this campaign, the AMRC has been running a series of 'brew and bytes' events. These are informal 'meets' to connect the region's SME manufacturing base with AMRC engineers to provide specialist, impartial advice and encourage adoption of industrial digitalisation.

# Digital manufacturing and automation

## Vehicle conversion firm plugs into Virtual Reality

**A family-run vehicle conversion firm is embracing Virtual Reality technology to boost productivity and reduce turnaround times for designing and kitting out vehicles for customers.**

A team from the Integrated Manufacturing Group at the AMRC worked with Clarks Vehicle Conversions to show how it can use Virtual Reality to revolutionise the design stages of converting a vehicle and that with some clever optimisation of its CAD models, the process time can be improved and complexity reduced.

The Doncaster-based company kits out vehicles such as welfare vans, lifestyle vehicles and crew carriers to clients' individual specifications. Customers include firms such as National Rail, Enterprise and Lex Autolease. Currently, when a job comes in, a skilled team of fitters, electricians, engineers, mechanics and designers has to build a physical prototype to show the customer. This involves kitting out a van to the customer's exact requirements.

The development of virtual models of the van base in conjunction with the AMRC now allows the customer full control over the design process. They are able to pick items from a displayed bill of materials and virtually place them in the van where they want them to go. The bill of materials also lists the mass of each item selected, the installation time and cost – updating in real time whenever a new item is chosen. This greatly reduces production lead-time, with no added expense of building physical demonstrators for each project.



## Robotics revolution in farming

**Experts from the MTC have been working with the agri-tech start-up Small Robot Company to develop a new generation of agricultural technology, bringing the power and precision of robots to farming.**

The small digitally-controlled farmbots are able to plant, feed and weed arable crops autonomously with precision and minimum waste. This improves the way food is produced, minimising chemical use and making farms more profitable while increasing yield and efficiency.

Prototypes of the robots have been produced and are carrying out field trials on 20 farms across the UK including the Waitrose Leckford Estate Farm and the National Trust's Wimpole Estate. Boosted by £1.2 million in crowd-funding alongside Innovate UK support, we're helping this farming robotics company revolutionise farming and the way food is produced.



Visualisation in action with Boeing DES project architect Ruby Hughes

## A footprint for productivity

**The AMRC has developed a virtual simulation model of the new Boeing Sheffield facility. The model will help to validate the opportunities Boeing has to increase productivity by up to 50 per cent.**

Using Discrete Event Simulation, DES for short, a method of simulating the behaviour and performance of a real-life process, facility or system which models the operation of a system as a discrete sequence of events in time, Boeing was able to optimise factory flow to improve productivity, examine the impacts of uncertainties and validate new technology introduction. In future the approach will also allow Boeing opportunities to increase through-put.

## Digital tools for single-platform manufacturing

**The Nuclear AMRC's Simple project demonstrated the digital manufacturing techniques which will underpin its vision of single-platform manufacturing of large nuclear components.**

The centre worked with industry and academic partners to develop techniques to integrate data from a host of in-process sensors and analysis tools. These were successfully demonstrated on an integrated welding and monitoring tool, capable of automated in-process weld inspection to improve quality and productivity. Studies by the Nuclear AMRC have shown that single-platform manufacturing can halve the cost and time of producing large components such as pressure vessels.

# Vehicle electrification

**Delivering the enabling capabilities and technologies to be manufactured by a capable and competitive UK industry for electrification in support of low emissions mobility (LEM)**

Electric vehicles (EVs) have the power to transform our environment, driving down carbon emissions and significantly reducing local air pollution, the second-highest cause of avoidable mortality in the country. Electric Vehicles also offer firms the opportunity to tap into a rapidly growing market. The International Energy Agency has estimated that the number of electric passenger cars and light commercial vehicles could reach 125 million by 2030, on the basis of existing policies, significantly more if governments bring forward policy changes in line with international climate change goals.

**The HVM Catapult is helping UK manufacturers prepare to capture this growing market.**



## Innovation in light rail vehicles

**Coventry is set to be a national focus for light rail electrification and future automation through a project with WMG.**

A team of experts are using their automotive engineering and battery expertise in partnership with Transport Design International (TDI) to develop a lightweight, electric, rail-based vehicle which will operate in Coventry. Holding 50 passengers, the vehicle will be battery operated with longer term development planned to convert to fully autonomous operation. Its battery power will be key to its success, allowing the vehicle to travel on non-electrified routes and little negative impact on the city-scape. The first-of-a-kind design is available to view in 3D via WMG's visualisation suite, and the first test vehicle will be manufactured by mid-2020. TDI have partnered with Coventry-based Company RDM who will manufacture the vehicle once the design is complete.



## Project RESOLVEs electric vehicle range concerns

**Traditional cars no longer fit the needs of today's city-dwellers. They need cars which are more cost effective, more energy efficient and, crucially, space efficient.**

A consortium of fourteen partners including WMG, Piaggio, KTM, Bosch and Ricardo won €6.92m Horizon 2020 funding to develop two small lightweight Electric L-category Vehicles (ELVs).

As part of project RESOLVE (Range of Electric Solutions for L-category Vehicles), researchers with WMG's Advanced Propulsion Systems team led the design of two demonstrators. The team undertook a rigorous programme of research, to optimise the design and integration of active stability control software with smart range management and regenerative braking algorithms.

With a drive range of up to 100km and a number of smart systems to conserve energy, the future of the commute is on the horizon.

## Ready for Electrification

Do EVs dream of electric streets? To develop the UK supply base for the growing and future electrification market, WMG have launched a 'ready for electrification' programme of support. This programme will provide practical support to businesses supplying or with an interest in the supplying electrification sector. The project will encompass a network that brings together the whole supply chain from SME to OEM as well as packages of support to assist UK manufacturers to get ready for the challenges and opportunities the future market will need.

## Electrifying rail and aerospace

In 2018/19, our offering has continued to move beyond automotive electrification to rail and aerospace. Globally, rail and aviation are the fastest growing sectors in terms of greenhouse gas emissions, creating an international market for electrification. We are making progress in this important area. For example, WMG is currently focused on effective knowledge transfer from automotive electrification and leveraging capabilities specific to each sector's needs. The EPSRC Future Electrical Machines Manufacturing Hub also launched. Involving the AFRC and AMRC, this is a major national collaboration to put UK manufacturing at the forefront of the electrical revolution in aerospace, energy and high value automotive.

In rail, feasibility studies are ongoing for battery options in rail vehicles, in conjunction with two of the UK's rolling stock operators and interest from third party players. These projects will lead to electric vehicle solutions and increased efficiency of vehicle use, helping to battle global increases in carbon emissions.

# Aerospace

## Securing the future of air transport vehicle and system manufacture in the UK

Aerospace is a cornerstone of UK high value manufacturing. The UK aerospace industry has an annual turnover of almost £28bn, and around of 90% of its production is exported. Over 29,000 new large passenger aircraft are needed by 2032, worth around £3.5tn. In the same timescale, there is also a requirement for 24,000 new business aircraft, 5,900 regional aircraft and 40,000 helicopters.

But new aircraft cannot be developed on the traditional model. They must be greener, quieter and more economical to run than those they replace. This makes technological innovation key to winning future market share and securing sustainable growth in the UK economy.

The High Value Manufacturing Catapult is well-placed to support this innovation and help UK aerospace businesses fly.







## Robotic machining slashes aircraft production cost

**Researchers at the AMRC, in collaboration with KUKA Systems UK, have developed technology to enable robots to accurately machine holes accurately in composite aircraft components, cutting crucial time and costs from production.**

A group of robots jointly deal with handling composite components, locating and correcting positioning with non-contact metrology, and then countersink high tolerance pre-drilled fastener holes. A separate robot also provides support to the component eliminating expensive holding fixtures. The system is controlled via the latest S7 Siemens programmable logic controller and includes the use of augmented reality to aid component fixturing.

This development is set to save millions of pounds in capital and operating costs over the coming years. The system has now been installed at BAE Systems in the UK, where it will be used in the production of a wide range of composite components for military aircraft.

## Production boost for aerospace supplier

A family-owned precision aerospace supplier increased its orders by 10% and made double-digit productivity gains with the help of experts from the HVM Catapult's Manufacturing Technology Centre. Harris RCS, based in Exhall, Coventry, was struggling with waste and efficiency when it approached the MTC. The Centre's team helped with production planning and productivity, transforming fragmented manual processes with digital solutions that drove productivity, efficiency and waste reduction. Harris RCS Managing Director Graham Harris said "They took the big data we already had, made it more visible and linked our existing machine assets, building digital assets to make the processes more efficient. We are now able to handle more orders without having to bring in more resources."

## Advanced Aerospace Assembly

Advanced Aerospace Assembly Ltd worked with the AMRC on a pioneering project to develop an innovative aerospace maintenance, repair and overhaul system, which has opened up opportunities for further research and future collaborations to pilot the technologies in real-world scenarios. The product is a paperless maintenance system that gets real-time data to engineers as they do maintenance work. It uses automated 3D and scanning data capture using wearable and handheld technologies to deliver diagnostics and customisable digital workflow instructions bespoke to each task. The system will provide significant time and cost savings alongside more effective control and management of Maintenance Repair and Overhaul processes – all using the latest technologies in 3D capture, photogrammetry, augmented reality visualisation and wearable technology. This will ensure greater accuracy in aerospace maintenance, repair and overhaul, making our skies a safer place to be.



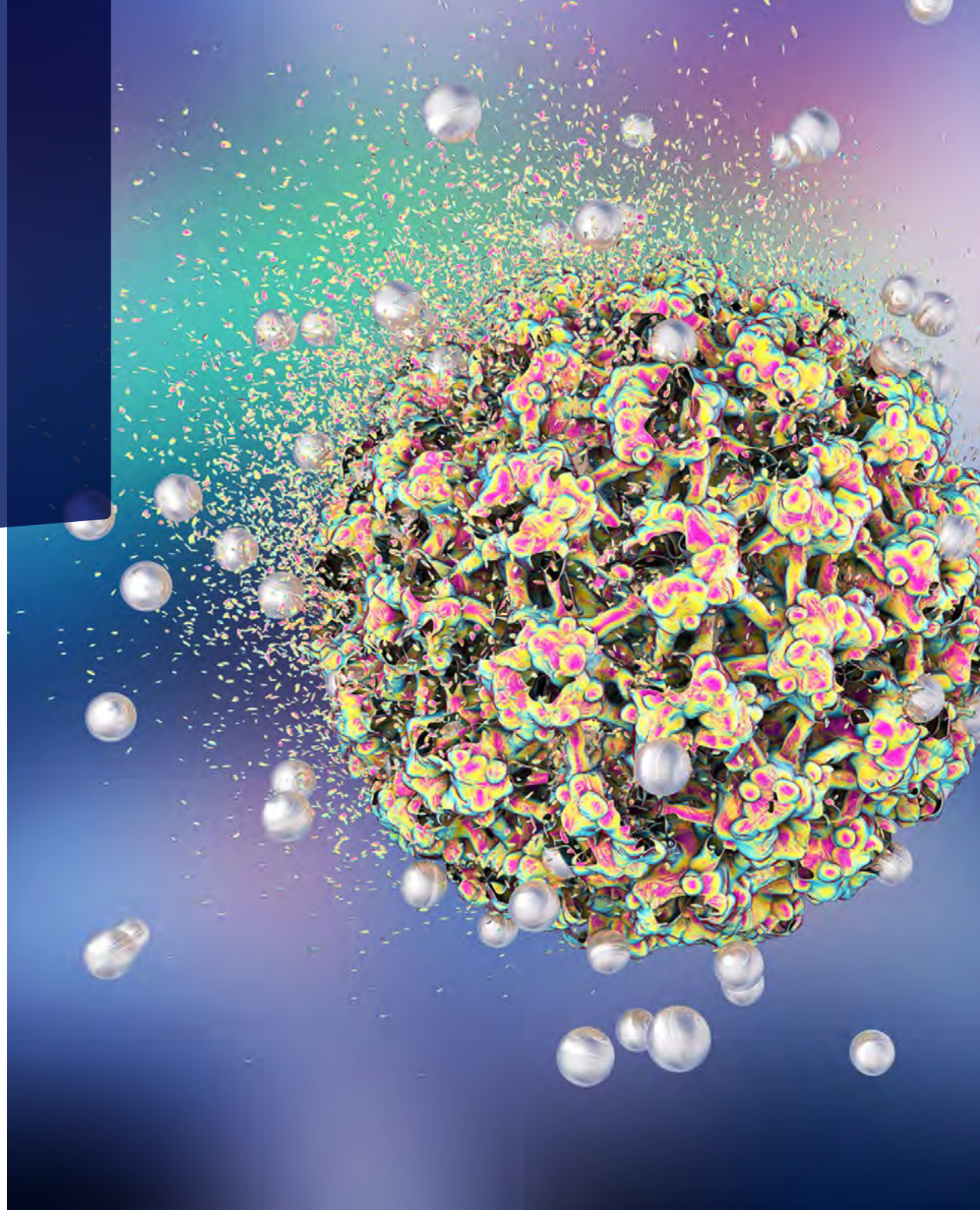
# Healthcare

## Promoting growth in UK healthcare manufacturing

The healthcare industry is changing. Where once there were generic solutions, we now have an ever-greater focus on personalised, targeted, more effective treatments. At the same time, though we have eradicated some of the historic medical threats to humanity, we are faced with growing number of ailments that need addressing urgently.

The HVM Catapult is using its manufacturing expertise to help businesses scale up biomedical technologies from academic research to consumer product.

**Our intervention is often an important step in moving from the lab to the patient, improving lives across society.**



## Nanotech revolution in drug delivery

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**CPI collaborated on a pan-European nanopharmaceutical project to develop new manufacturing methods and improve supply chain co-ordination to advance treatments for rare cancers, autoimmune diseases and viral infections.**

The project centred upon the processing of glycan-coated gold nanoparticles as a delivery method for pharmaceuticals. This technology has potential to treat rare diseases such as DIPG, a rare paediatric brain cancer which currently has a 1% survival rate, and liver cancer, the third leading cause of cancer death. Nanocarriers, which include glycan-coated gold nanoparticles, are forecast to account for 40 per cent of a \$136 billion nanotechnology-enabled drug delivery market by 2021. Following the project, the lead partner Midatech, secured private investment of £8m to continue the development of its product pipeline and ensure maximum global reach.

## The sky's the limit

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**MEDeus is flying high thanks to support from the AMRC.**

The idea behind their MEDrone is to deliver emergency medical supplies in remote or hard to reach areas, cutting down the time taken to receive life-saving treatment. Realising the impact of well-executed visual representations, MEDeus worked with the AMRC to develop a series of CAD and early-stage graphics of MEDrone. This, combined with other compelling illustrations produced by the AMRC, demonstrated the positive effect this technology could have and helped to secure UK Space Agency funding. Whether deployed at inaccessible road incidents or deep in mountainous regions, this budding project promises to provide the crucial interventions which could increase the chance of survival for casualties.



## Medical tech innovation set to improve stroke diagnosis

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**The HVM Catapult's WMG team has worked with Sarissa Biomedical to drive significant progress in stroke diagnosis without the false positives of 'stroke-mimicking' conditions.**

Building on an innovative high-sensitivity blood chemical sensor, the project developed a series of device prototypes using digital design and additive manufacturing techniques. This technology exploits the discovery that purines are present in the blood of those suffering from a stroke. Combining the device with the widely used FAST (Face, Arms, Speech, Time) test, this device is expected to reduce misdiagnosis considerably, avoid the burden of treating non-stroke patients in expensive specialist units. This work will be subject to clinical trials in 2019, with positive results anticipated, leading to full scale, commercially viable production and faster, more accurate stroke diagnosis.

# Working with smaller businesses

Smaller businesses are at the heart of UK manufacturing. Whether in their supply of essential components and services to larger firms, or in their adaptability to new processes, these firms are key to the success of the sector.

The High Value Manufacturing Catapult may be known best for its work with companies at the top of the supply chain, but the reality is that more than 50% of the projects we work on are with smaller businesses keen to adopt new technologies, improve and develop new products and processes or boost their overall productivity and competitiveness.

In 2018/19, we worked on 2,469 projects with smaller businesses. We know that, for them, innovation can seem a risky and daunting business. All of our Centres have evolved services and approaches geared towards reducing the risks of innovation and helping SMEs to bridge the gap between concept and commercialisation.

Here are just a few examples of the excellent work they are doing.





## Solar powered refrigeration

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**The AMRC is collaborating with the Peterborough renewable energy start-up Solar Polar to develop solar powered refrigeration technology.**

This technology would enable life-saving vaccines and medicines to be safely transported into some of the most remote and hottest places on the planet. It could also provide low-carbon solutions to keeping cities cool or help reduce the vast amount of food wastage through lack of refrigeration. By providing consistent temperature to vaccines and medicines, this project has the potential to radically improve the lives of rural households, communities and farmers in Africa and South Asia, as well as others in remote regions.



**Working with HVM Catapult and the AFRC provided us with vital data about our product that will help us take the project forward with further confidence in our offering.**

Paul Howlett, Managing Director and Founder, Sudelac

## When lightning strikes

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**WMG worked with the machining/assembly services SME Mako to expand their business beyond automotive and motorsport to lightning protection.**

With Mako's core skills and WMG's world-leading expertise, the team developed a new business model based on Mako's identified opportunities for expansion. The dedicated WMG SME group worked with Mako to create a new computer model and carried out a Finite Element simulation with 90 mph wind loads applied, demonstrating that the product would withstand 90 mph winds. Based on this work, we enabled Mako to expand their product line and increase their revenues by around £600,000 each year.

## Helping Scotland's Bravest

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**The AFRC has helped to establish a new base of operations with cutting edge technology for Scotland's Bravest Manufacturing Company – a social enterprise set up to provide quality jobs for armed forces veterans which produces signage for some of the UK's biggest buyers.**

When the company needed to find a new home it tapped into the AFRC's experience and expertise to plan for its new factory nearby and get it up and running. The AFRC was able to use visualisation technology to demonstrate how the factory would look prior to its opening and it helped train the company's team on the new technologies that will allow it to expand their service range.

# Working with smaller businesses

## Bringing innovation to market

**The Nuclear AMRC worked with innovative metrology start-up Insphere to help the company develop and commercially launch its rapid machine tool verification technology.**

Bristol-based Insphere is developing a new system called Baseline which can measure and verify a large machine tool in less than 30 minutes. To support testing and development, the Nuclear AMRC provided access to its largest machining platform, as well as hands-on support and advice from its metrology and machining experts. The centre then hosted the commercial launch of the Baseline technology in March 2019, a significant milestone for the company.



Working with the High Value Manufacturing Catapult gave us access to large-scale machine tools and industry-leading expertise, allowing us to develop our innovative machine verification product and bring it to market. Holding the commercial launch of Baseline at the Nuclear AMRC also helped us make a real impact with our industry customers.

Ben Adeline, CEO and founder, Insphere



## Made Smarter through digital adoption

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New digital technologies have the potential to enable faster, more responsive, and more efficient processes to deliver higher-quality products at a reduced cost. Despite this, a 2017 review led by Professor Juergen Maier, CEO Siemens UK & chair of Made Smarter UK, found that the adoption and application of these technologies was not consistent across all industrial sectors and that the UK was failing to capitalise on the potential advantages they could bring.

The HVM Catapult has long played an important role in helping its existing customers to seize the digital opportunity, but will now boost its efforts through participation in a major pilot programme that will help test the best way to deliver practical and tangible advice to those smaller firms who may see the potential of digital technologies but need help to apply them. Working through five North West Growth Hubs and the AMRC North West, the £20m pilot aims to engage with 3,000 local manufacturers and provide intensive support to 600 businesses.

The HVM Catapult is using its insight and experience to help shape the programme and make sure British businesses can tap into high quality business advice and support. Over the next few years, the pilot will test out the most effective ways to encourage manufacturers to adopt technologies such as artificial intelligence, virtual reality, IoT and sensors, 3D printing and robotics. The result is certainly worth having: the *Made Smarter Review* calculated that adoption of digital technologies could improve our industrial productivity by more than 25% by 2025 while driving down carbon emissions.

## Project Innovation Accelerator

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In 2018/19 WMG concluded its Product Innovation Accelerator project, which helped SMEs to create, test and develop new products, improve processes and access innovation support. Exceeding its delivery targets, the project supported 109 companies and enabled 48 SMEs to implement new processes and get new products to market. This represents a marked improvement in SME innovation support within the Coventry, Warwickshire and Black Country areas, driving growth in the region. Andrew Thurston, Finance Director at project participant Purity Brewing said: "The WMG SME Group quickly identified our technical and business challenges. The new production tool [developed through the Product Innovation Accelerator] will save us money and support Purity with its rapid growth."

### Fit for Nuclear

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Fit For Nuclear (F4N) is a unique service to help UK manufacturing companies get ready to bid for work in the nuclear supply chain. It lets companies measure their operations against the standards required to supply the nuclear industry – in new build, operations and decommissioning – and take the necessary steps to close any gaps.

A further eight companies have been granted Fit For Nuclear (F4N) status under the Nuclear AMRC's flagship supplier development programme over the year, bringing the total to 153 – almost all SMEs – by March 2019. F4N-granted companies agree that the programme has helped them to capture new contracts. Together they have tendered for over £1 billion of new contracts, and won £183 million worth of new work, creating or safeguarding 588 jobs.

To provide additional value to granted companies, the Nuclear AMRC has now launched a series of events with Sellafield Ltd to help companies enter the decommissioning supply chain. The Centre's contract with the Welsh government to provide additional support to Welsh manufacturers continues to make good progress, with nine participating companies now granted F4N.

### Business Launch Centre

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The MTC's Business Launch Centre (BLC) is a hub of innovation, set up to support start-ups and bring ideas to market. This unique technology and manufacturing incubation centre provides up-and-coming entrepreneurs with the expertise, the tools and the space to develop their product in a de-risked environment. In 2018/19, their Incubator Cell facilities gained traction with BLC confirming four incubating SMEs within its walls. Many others moved through their support programme, bringing big ideas to their smaller businesses.

### NCC Connect

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Near the end of 2018/19, the NCC launched NCC Connect, a business support service that will help open up the world of composites to even more companies. Based on support, training and rapid response, NCC Connect provides an SME gateway to the full suite of Centre services including specialist knowledge, equipment and facilities. Over 50 SMEs have engaged with the service so far and started on the journey to exploiting the capabilities and solutions offered by composites.

# Supporting our environment

The High Value Manufacturing Catapult is playing a key role in reducing society's impact on the environment and delivering the goal of net zero carbon emissions by 2050.

Our Nuclear Advanced Manufacturing Research Centre is at the heart of the challenge to reduce carbon emissions from energy generation, and all HVM Catapult Centres help UK manufacturers drive down the emissions of their production processes and their products whilst in use. We are a key part of the move to low carbon mobility.

The Catapult is also leading work to increase the recycling of materials, reduce material waste, and make sure that waste materials are less harmful to the environment. Here are just a few examples from 2018/19 to highlight our impact.





## Low Carbon Energy

Decarbonising electricity will depend on a mix of renewables and other low-carbon technologies to provide firm and flexible power to balance the variability of wind and solar. Nuclear is the only technology which can meet this need on the timescale required but it can be costly. The HVM Catapult's Nuclear AMRC is working with industry to develop a new generation of small and advanced modular reactors designed to avoid the financing hurdles of current gigawatt-scale power plant and which could be delivering electricity to the grid by the early 2030s.

These new power plants are designed to be largely made in factories, using modular manufacturing techniques to drive down costs and ensure quality and safety. The Nuclear AMRC is working with developers including Rolls-Royce and UKAEA to make sure their designs can be manufactured efficiently, and the Centre is also involved in developing a host of advanced manufacturing processes to prove that they meet nuclear industry requirements. The results will help to bring down the cost of new nuclear generation and help make sure UK carbon emissions tumble.

## Fast charging batteries of the future

With a consortium of collaborators, CPI is developing a solid-state lithium battery to deliver ultra-fast charging for electric vehicles. The PowerDrive Line project aims to produce next generation, solid-state battery cells to power plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs). Working alongside lead partners Ilika, Ricardo and University College London, CPI is applying its knowledge across the formulation sector to accelerate their solid state battery development and establish a pre-pilot line facility.

Automotive use is one of the biggest single sources of carbon emissions in the UK, accounting for over 20% of the total. The innovation promised by this project will help to lower emissions and lessen air pollution. This will be achieved without significant inconvenience to the consumer – safer and more power-dense battery systems will enable charging of electric vehicles in as little as 15 to 25 minutes.

## Microorganisms for the production of bioplastics

CPI is working with ReBio Technologies Ltd and the University of Bath to create modified strains of microorganisms to produce D-lactic acid for the manufacture of bio based products such as high performance bioplastics. The project has the potential to help the industrial biotechnology community move away from petrochemical and agricultural-based feedstock to waste-derived feedstocks from animal waste or scraps from food production. This is an ideal approach to low-carbon production and reducing waste in the wider economy.

An added benefit is that bioplastics generally do not produce a net increase in carbon dioxide gas when they break down, unlike traditional plastics and biodegradable plastics. This means that overall pollution is reduced both in the production stage and at the end of a product's life-cycle.

Industrial biotechnology is recognised by UK government as a promising means of developing low carbon products and processes. The technology that the project is hoping to demonstrate has the potential to unlock an economic approach to transforming the millions of tonnes of food and sugars derived from landfill waste into sustainable, high value chemicals.

## Accelerating future mobility

Connected and Automated Mobility (CAM) technology will bring significant societal and environmental benefits, from making traveling more efficient, safer and cheaper, to increasing access to mobility for the elderly and disabled. In 2018/19, WMG launched Midlands Future Mobility (MFM), the UK's largest real-road CAM testbed. This unique test environment involves 50 miles of Coventry and Birmingham roads equipped with smart monitoring and wireless connectivity to trial new CAM systems and mobility services.

The £25m programme is funded by Innovate UK and industry partners, and will act as the springboard for scalable, future mobility technologies and services. The journeys of tomorrow start here today, for the benefit of society, the environment and business, as part of the UK's National Strategy.



# Attracting inward investment

High quality inward investment makes a significant contribution to the UK economy – from job creation and wages through to productivity gains, and research and development. Through their world-leading facilities, equipment and expertise, the High Value Manufacturing Catapult Centres have become a vital magnet attracting global companies to locate in the UK and anchoring their investment here.



## Boeing Sheffield opens for business

October 2018 saw the opening of Boeing's first European manufacturing site, a 6,200-square metre space alongside AMRC's Factory 2050 in Sheffield. Located to allow greater collaboration with the AMRC, the £40 million facility will manufacture components for Boeing's Next-Generation 737, 737 MAX and 777 aeroplanes – enhancing production efficiency and reducing costs whilst maintaining quality.

Alongside this new site, Boeing is also working on a major research and development programme with the AMRC on new manufacturing techniques that can be applied to the Boeing Sheffield facility and then implemented across Boeing internationally.

With earlier inward investment projects from other global companies attracted to locate close to the AMRC, the Boeing investment has spurred regeneration of the area of deprivation that once surrounded the Orgreave Coking Works in Rotherham transforming it into a prosperous, positive innovation hub with up to 3,500 new jobs.



## GSK and the future of pharmaceuticals

CPI is collaborating with partners GSK and AstraZeneca to establish a bespoke, continuous wet granulation manufacturing facility for small-scale development of oral solid dosage pharmaceuticals. The new facility, built as part of a project called PROSPECT CP, will include blending and feeding of raw materials, twin screw wet granulation, drying and ultimately tableting.

Once complete, the capability will be available as an open-innovation facility to support the UK pharmaceutical industry and potentially other industries where the development of controlled complex solid forms is critical. It will be ideally suited to the rapid development of robust processes enabling reduced development timelines. It could also be used in the future to aid real-time monitoring and control of product quality.

As a significant investment in UK capacity, this facility will help grow the national pharmaceutical industry – anchoring global firms like GSK to our economy to protect as well as create UK jobs. In the longer term, the ambition is to reduce or remove the need for labour intensive testing of products at the end of manufacture and decreasing drug release timeframes. This could provide the added benefit of alleviating pharmaceutical cost pressures on the UK healthcare system.

## Airbus invests in autonomous robotics for North Wales

Entire aircraft wing assemblies could be transported by intelligent, autonomous robots at the vast Airbus production facility in North Wales following a collaborative research project with engineers at the AMRC's Integrated Manufacturing Group.

The robots were developed by AMRC as part of the joint project for an automated component handling process, which provided Airbus significant benefits in terms of capacity and rate ramp-up of their aircraft production. It has now moved from small-scale development of safe, automated means of delivering tooling supplies internally, to a full-scale adoption of the technology across the factory floor.

HVM Catapult is key in facilitating this kind of significant investment. We help to ensure that companies like Airbus continue their operations in the UK for years to come, with jobs and the wider economy safeguarded.

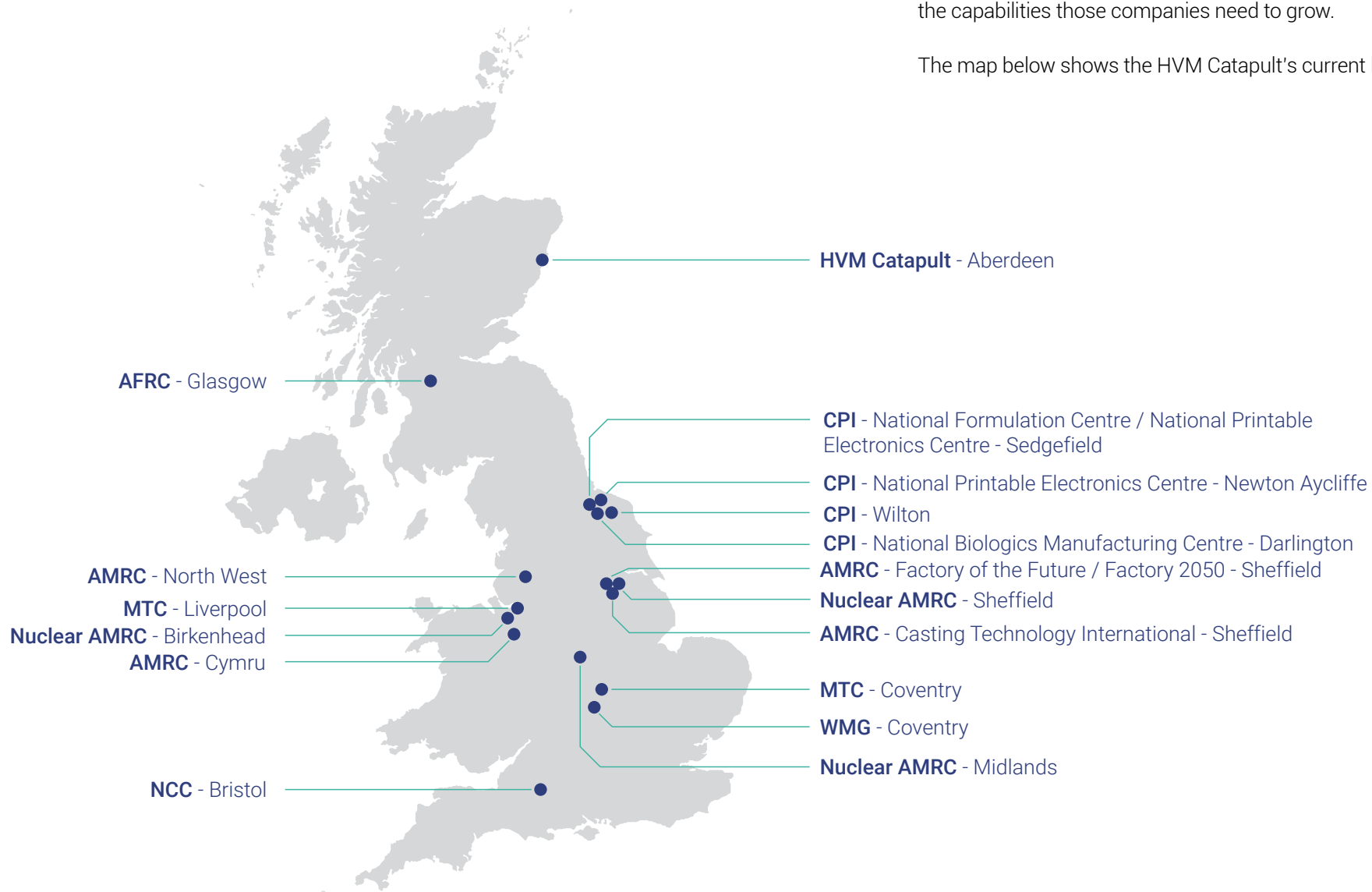
## Meggitt invests in the West Midlands

Our Manufacturing Technology Centre at Ansty has become a beacon for high value manufacturing investment in the West Midlands. 2018 saw international aerospace, defence and energy engineering group Meggitt PLC begin work on construction of a new £130m manufacturing and office facility close to the Centre, providing a base for up to 1,000 employees and a range of operations within a world-class aerospace engineering and technology environment. It will also serve as the new home for Meggitt's international headquarters. As construction got underway Meggitt also introduced its new Corporate Apprenticeship Programme which will ensure that it continues to build the skills required to meet future needs. The programme includes training in partnership with the Manufacturing Technology Centre and, as Meggitt CEO Tony Wood comments "If it were not for MTC we would probably be moving our Manufacturing Engineering off shore. MTC is becoming the magnet for manufacturing that it was established to be."

# Developing our footprint

When the High Value Manufacturing Catapult was created in 2011, its footprint reflected the locations of the seven founding centres which came together to boost UK manufacturing performance. Responding to demand for our services and for support linked to particular emerging technologies, the Catapult has built on that initial map to ensure that its services are visible to companies across the UK and that it can offer the capabilities those companies need to grow.

The map below shows the HVM Catapult's current locations.



# Key developments

## Nuclear AMRC Midlands launch

In February 2019, Nuclear AMRC Midlands opened for business in the iHub at Infinity Park, Derby. This new research and innovation centre is a major expansion of their current capacity, and will support manufacturers across the region. Initially with two workshops, the site acts as an incubator for new manufacturing technologies, operating at an earlier level of manufacturing readiness than the Nuclear AMRC's facilities in Rotherham and Birkenhead.

The iHub facility is just the first phase of Nuclear AMRC Midlands. The centre continues to work with Derby City Council, the D2N2 LEP and industrial partners to develop proposals for a bespoke research facility of around 6,000 square metres on Infinity Park. The proposed centre will focus on later-stage development in technology areas which will deliver the maximum impact for the UK's supply chain.

## NCC capacity expansion

As the world looks for new materials to produce lighter, more fuel-efficient vehicles and stronger, more durable structures, the composites sector is growing rapidly. It has been estimated that by 2030 it could be worth some £12bn to the UK economy. To keep pace with both the growing demand for its services and with new composites technologies, the NCC has been growing both its capacity and capabilities.

The development has seen the launch of a new NCC site at Filton, Gloucestershire and ten new technology capabilities. These include a new iCAP machine, which has an innovative combination of automated fibre placement and filament winding capabilities and is already delivering research work to UK-industry. The new facility will deliver a step change in innovation to the composites industry, transforming the scale of the parts that can be made, increasing manufacturing speeds and automating the Non Destructive Testing process.

## New National Healthcare Photonics Centre

CPI opened a new, state-of-the-art facility focused on the development of next generation light-based healthcare treatments. The National Healthcare Photonics Centre will support the scale-up and commercialisation of MedTech products. It will also act as a hub for businesses of all sizes and academic partners to work on innovative methods of diagnosing disease, imaging systems and light-based treatments. The aim of the facility is to reduce the barriers that are preventing promising research and early-stage inventions from moving beyond the laboratory and into innovative healthcare solutions for patients.

The new centre includes a suite of specialist laboratories with a range of research and manufacturing capabilities, including: diagnostic test development, microscopy and imaging of bio-materials, and pilot manufacturing work. It will help SMEs drive forward innovative products and services at reduced risk and with increased capital efficiencies, while supporting large companies to undertake more disruptive innovation in the healthcare market.

## MTC transforming construction

The Manufacturing Technology Centre has joined an alliance of experts in manufacturing, digital, building performance standards and construction technology to lead a new national facility geared to driving innovation in the construction and infrastructure sectors. Following a nationwide competition, Innovate UK awarded £72 million to the Transforming Construction Alliance to deliver a national Core Innovation Hub, which is a key element of the Transforming Construction programme.

The Core Innovation Hub will be the catalyst to transform the way buildings are designed, manufactured, integrated and connected within the built environment to create high-performing buildings and infrastructure with high levels of safety, quality and energy performance. The Hub will also support collaboration to develop and commercialise digital and manufacturing technologies for the construction sector.

# Our resources

Based on best practice established by the German Fraunhofer approach, the High Value Manufacturing Catapult strives to secure broadly equal amounts of income from:

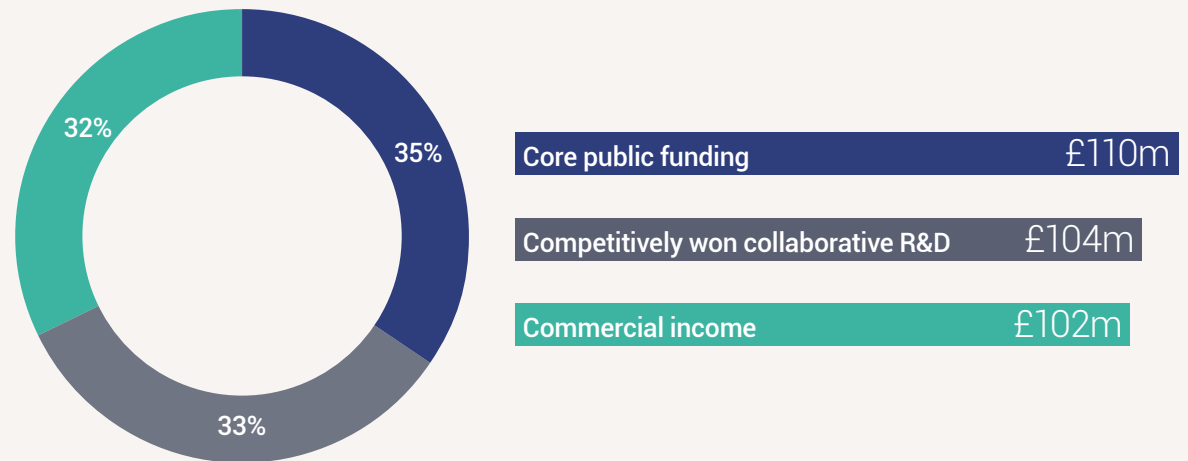
- Core public funding from the Innovate UK grant for long term investment in infrastructure, expertise and capability development.
- Collaborative R&D projects funded jointly by the public and private sectors and awarded on a competitive basis.
- Commercially funded R&D contracts.

Maintaining the funding model in proportion ensures that an innovation 'sweet spot' is maintained – encouraging risk taking, collaboration and stimulating innovation in areas that are relevant and of benefit to industry.

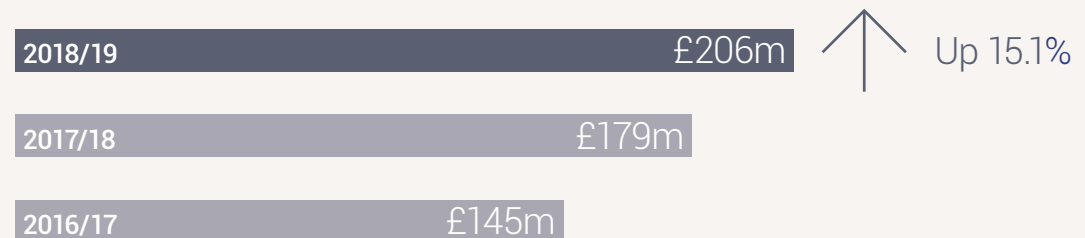
These charts show HVM Catapult income sources in 2018/19.

2018/19 saw strong growth in our Collaborative R&D and Commercial income which rose 15.1% on the previous year.

## HVM Catapult Income Sources 2018/19



## HVM Catapult Collaborative R&D and Commercial Income



## Our sales order book

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£276m

↑ As at March 2019  
**Up 18%** on 2017/18

£206m of this is Collaborative R&D

## Investment in capital projects and capability during 2018/19

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£71m

## Total value of our assets

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£778m

↑ **Up 14%**  
on 2017/18

## Our people

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2,913 full-time  
equivalents

↑ **Up 17%**  
on 2017/18

# Our five-year plan

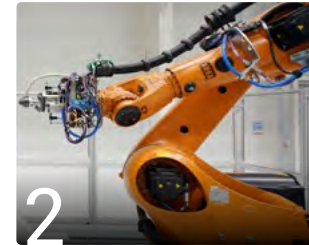
Since the HVM Catapult was created in 2011, we have been driven by the simple ambition to increase the contribution manufacturing makes to our economy, by helping the sector apply new knowledge and technologies and to innovate.

We give firms support across a very broad range of technologies, but we have identified five technologies which we believe offer significant opportunities to strengthen manufacturing performance.

## Five technologies



**1**  
Digital manufacturing



**2**  
Robotics and automation



**3**  
Materials processing  
and new materials



**4**  
Process engineering,  
biologics and  
biotechnology



**5**  
Product design  
and verification

With these in our sights, we direct investment from our core funding and commercial income towards improving access to cutting edge technology and expertise to stimulate and support innovation.



We have identified 12 areas in which we believe we can play a particular role:

1. Increasing the uptake of digital and automation technologies to increase UK productivity and global competitiveness
2. Establishing the UK as a global leader in additive manufacturing
3. Developing world leading capabilities and differentiating technologies to secure the future of air transport vehicle and system manufacture in the UK
4. Increasing the uptake of technology to create a more sustainable and productive food and drink sector
5. Delivering the enabling capabilities and technologies to be manufactured by a capable and competitive UK industry for electrification in support of low emissions mobility (LEM)
6. Shaping and influencing the UK's nuclear energy policy to support the enhancement of the nuclear supply chain and delivery of the Industrial Strategy
7. Modernising UK construction practice and develop an affordable construction supply chain
8. Promoting growth in the UK healthcare manufacturing sector (both pharmaceutical and medical devices) by providing technical support to healthcare companies to de-risk the product and process development cycle, resulting in more affordable healthcare solutions and improved patient outcomes
9. Accelerating resource efficient manufacturing that enables a global circular economy, which drives UK prosperity
10. Increasing the UK's share of the through-life services market by better integrating design, manufacturing and through-life performance
11. Identifying and developing the capabilities for UK industry to maximise benefits from successful deployment of connected and automated mobility (CAM)
12. Enhancing the UK's position as a global defence manufacturing nation, maximising value to the UK taxpayer

# Impacts

Our aim is to use our resources in these targeted areas to deliver measurable impact in the wider economy. We are well on the way to delivering these results. This has been confirmed by an independent evaluation and many of the numbers you can see in this report.

1  
£2bn of investment in R&D by 2023

2  
Increased productivity

3  
Increased manufacturing GVA

4  
High value inward investment

5  
Clean growth

6  
Increased and safeguarded employment in manufacturing

# Putting the UK in the lead

Our offer is unique across the UK – open access innovation support, world-leading collaborative R&D and cutting-edge technologies that drive strong economic impact year after year



Manufacturing is a central pillar of a sustainable modern economy. With 10% of UK GVA and 45% of our exports coming from the sector, its success is crucial. This is where the High Value Manufacturing Catapult remains key. Our approach strips away the risks of innovation and allows firms to make confident investment decisions in the new technologies which will ensure their longer-term competitiveness, increase their productivity, boost their export performance, reduce waste and become more resilient. We build on the enormous strength of technological development in Britain's economy.

Too often, the outstanding ideas generated in our research institutions are either lost or picked up by overseas competitors. The HVM Catapult changes this dynamic by helping UK firms of all sizes connect with the latest research findings and accelerate new ideas to a commercial reality. This investment in R&D generates an important multiplier effect and, with £109m government investment generating £504m total R&D activity, this makes us an extremely cost-effective method of surpassing the 2.4% OECD average of investment as a proportion of GDP. By connecting research and business, we will continue to generate added value for the country.

Moreover, the boost that we offer to companies across the sector acts as a magnet for inward investment – encouraging global leaders such as McLaren and Boeing to set up in the UK, close to our centres. Alongside this, SME engagement continues to grow, with more and more smaller businesses disrupting their industries and bringing commercial products to global supply chains. Looking ahead, we will deepen our relationships with businesses of all sizes – increasing dynamism in the sector and drawing in global talent. And we are determined to build on the foundations of our current success, expanding our offering to all firms.

Guided by our five-year delivery plan, we will continue to invest in high tech equipment in additive manufacturing, automation and advanced assembly; and to reduce the UK's carbon footprint with the commercialisation of sustainable biomass and vehicle electrification. Our world-leading development of battery technology will help cut CO<sub>2</sub> emissions and produce green jobs for the next generation. And our innovation in healthcare and construction will drive the positive impact of technology from the factory to the heart of every community. This will bring the benefits of the future to the people of today.

With demand growing from overseas buyers and almost 20% of manufacturers looking into new export markets, it is now more important than ever to invest in UK manufacturing innovation. According to the Lloyds Bank Business in Britain Manufacturing Report, 79% of manufacturers forecast that their turnover will increase over the next five years, by an average of 12%. This will only be realised through their investment in sustainable and productive new technologies – and, with our world-class facilities and expertise, we are best placed to facilitate this growth. Our ambition for manufacturing technology is only matched by our resolve to turn that into growth, stability and wealth for the whole economy.

On the global stage, the UK is heading into a future of great opportunity but also great risk. Whatever our trading relations with the rest of the world, the High Value Manufacturing Catapult will ensure that our manufacturing sector remains productive, competitive and sustainable.





## HVM Catapult

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