

## Annual Review

2016-2017

The go-to place  
for advanced  
manufacturing  
technologies  
in the UK





As the UK pursues an ambitious industrial strategy and navigates the uncertainty of Brexit, HVM Catapult's expertise plays an important role in anchoring high-value manufacturing activity in the UK.

Terry Scuoler  
Chief Executive Officer  
EEF, The Manufacturers' Organisation



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## **Our centres**

<b>AFRC:</b>	Advanced Forming Research Centre
<b>AMRC:</b>	Advanced Manufacturing Research Centre
<b>CPI:</b>	Centre for Process Innovation
<b>MTC:</b>	Manufacturing Technology Centre
<b>NCC:</b>	National Composites Centre
<b>Nuclear AMRC:</b>	Nuclear Advanced Manufacturing Research Centre
<b>WMG:</b>	WMG Catapult

# Chairman's statement

## HVM Catapult will maintain its resolve to work with industry, academia and government to help make the UK an even more attractive place to invest and do business.

Many of us will remember 2016 as a year of extraordinary events. The UK became the first country ever to vote to leave the European Union, starting a period of uncertainty and unprecedented and complex negotiations and agreements. The US elected a new president, whose fiscal and monetary policies and potential protectionist measures will have effects on the UK economy which are, as yet, hard to predict.

The scale and nature of these changes in the UK and the world over the past 12 months has gone beyond what many people expected. Although industry, in general, was in favour of the UK remaining in the EU, our manufacturers were among the first to realise the need to adapt to the new reality and to 'get on with it'. British pragmatism at its best.

A recent EEF survey showed that over 50% of companies surveyed expected to increase investment in technology and innovation in 2017 and 56% of respondents reported that they will undertake process innovations to increase productivity. Industry's undeterred resolve and focus to deliver long-term growth can be seen as an extraordinary event in its own right.

It should therefore not be a surprise that the pessimistic forecasts on manufacturing output and overall economic performance have not become a reality. Supported to some extent by a weak Sterling boosting export figures, performance in UK manufacturing was strong throughout 2016, with the UK economy being the fastest growing of the G7's leading industrial countries.

This resilience and clear constancy of purpose was reflected in the work of the High Value Manufacturing Catapult (HVM Catapult) last year. Once again, we have seen customer numbers grow, and we have been instrumental in a number of high profile examples of overseas investment in new high value manufacturing capability in the UK. Companies such as the iconic McLaren Automotive and American aerospace giant Boeing, for example, announced significant investment and job creation in this country on the back of the longstanding commitment and leading technology from our centres.

It is encouraging to note that we continue to see many small and medium-sized businesses come through our doors, both in real terms and as a proportion of our overall customer base. We are committed to ensuring that the benefits of working with us are fully exploited by small and medium sized enterprises (SMEs), not least because they play a critical role in safeguarding and creating jobs in this country.

On a similar note, we continue to broaden the range of sectors we work with, recognising that the value of our services are not restricted to the advanced technology sectors such as aerospace and automotive. Much of what we do can deliver game-changing improvements in other industries such as food and drink, medical technologies and construction. In construction in particular, this year has seen us make real headway in transferring manufacturing process and technology know-how from aerospace and automotive to this industry, which has much to gain from exploiting new and emerging manufacturing technologies.

The progress that we are making could not be achieved without the considerable input from my board colleagues, the efforts of our core team, and the increasing collaboration between all of our seven centres and I wish to thank everybody involved for their continued dedication and enthusiasm.



*Bob Gilbert*

**Bob Gilbert CBE**  
Chairman  
High Value Manufacturing Catapult





# Chief Executive's statement



A handwritten signature in blue ink, appearing to read 'Dick Elsy'.

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

## This year saw the HVM Catapult reach its 5th anniversary and this has led me to reflect on what has been achieved since we started in 2011.

In 2011 our seven centres had a collective asset base of buildings and equipment totalling £255m. We now have £617m in play, supporting industry to bring new manufacturing technologies to market. It has been a remarkable growth story driven by industry demand, a demand that had remained pent up until the Catapult was set up to fix the market failure: the fact the UK is great at scientific research but consistently fails to exploit it as manufacturing value-add.

This has defined our mission over the last five years and sets the scene for the next five years. We are uniquely positioned to understand the needs and challenges of advanced manufacturing companies and convey this at a national level to government in policy development.

We continue to support ground-breaking innovation in the way we design, make, and use products, based on major technological advances in areas such as materials, processes, robotics, virtual and augmented reality, additive manufacturing, artificial intelligence and data analytics.

We have a government which has put industrial strategy at its core, understanding the importance of a rich seam of manufacturing value-add in the economy. Through the Industrial Strategy Green Paper, government calls for the right institutional arrangements to be put in place to support this. I contend that it need look no further than the HVM Catapult as one of its key delivery mechanisms.

### **Proven track record**

Our performance figures demonstrate the continued appetite for our support and services.

Through the year, we have worked on more than 1,700 projects with over 3,300 industrial clients to develop and deploy innovation in manufacturing. Our commercial and our collaborative research and development (R&D) income has increased by 8% and 17% respectively on last year. This is set to continue to rise into next year as our confirmed order book for 2017-18 currently sits at £205m.

One of our most encouraging statistics for the year is the number of apprentices that we support in training. Although skills development was never part of our original brief when we were founded, the determination of our centres to champion this, has led to over 860 young people in apprentice training in our centres in the past year alone.

### **A winning formula**

We have stayed true to the established principle that the HVM Catapult should receive broadly equal amounts of funding from Government, public and private co-financed collaborative R&D projects, and commercially funded R&D contracts. We believe that this model continues to serve as a simple yet remarkably effective driver of our efforts to take risks and develop new technologies and processes in those areas that are most relevant to industry but which cannot be achieved without coordination, collaboration and expert support.

### Impact Evaluation

We have previously reported on our economic impact, through a study we had commissioned, which showed that we yielded a 15:1 benefit of economic value for every pound of core government funding invested. This year we have submitted ourselves to an extremely comprehensive and fully independent evaluation, looking at circa 140 organisations which ranged from between 1 and 1,500 employees. This study, commissioned by Innovate UK, is due to report this summer. We are confident that it will show continued and significant impact. Given experience, we also expect it to show the importance of constancy of purpose, and that much of the economic impact results from sustained efforts to develop technology, both internally within the centres and externally with our customers.

### Renewed focus as the go-to place for advanced manufacturing technologies

In addition to our ongoing and growing work with our industry customers, we have stepped up our investment and efforts in addressing key issues of national concern, such as the development and exploitation of vehicle electrification and battery technology, affordable composites, digital manufacturing as well as technology applications in the construction industry. These represent opportunities which require a coordinated response from industry, academia and government. The HVM Catapult has been very influential in bringing the right stakeholders together to articulate the issues and identify measures to position the UK at the forefront of manufacturing technology innovation and stimulate both public and private sector investment.

### Forward View

Last year we made no apologies for calling for “more of the same”. We have proven that we have the right model to support UK industry. This is validated by the sheer volume of business in both commercial work and collaborative R&D. If our offer was not relevant to industry we would not win its business, and in the case of collaborative R&D, the proof is that we win competitive bids as a proven collaborative partner. In 2016-17 this accounted for £67.3m of our income.

We are therefore confident in continuing with our strategy to:

- Stimulate and de-risk investment in innovation while accelerating growth and anchoring high value development activity in the UK
- Deliver step changes in productivity and competitiveness and solve big problems for whole value chains
- Enable the UK to move towards more digitally connected factories and supply chains
- Support more companies and more SMEs and broaden our regional presence.

With the emergence of a UK Industrial Strategy we clearly have a government which understands the importance of industry and the backbone it provides for the UK economy. Government has invested in the HVM Catapult to help to translate more of our science into commercial reality. It’s now our job to leverage this investment and accelerate the deployment of the Industrial Strategy.

Our constancy of purpose on this mission will require constancy of government support and we will be working with our sponsors in 2017-18 to secure funding for the next five years.



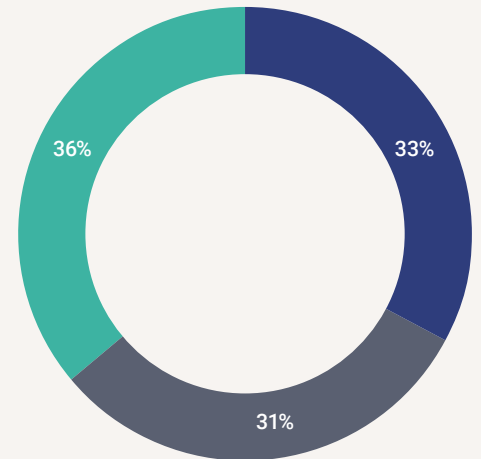
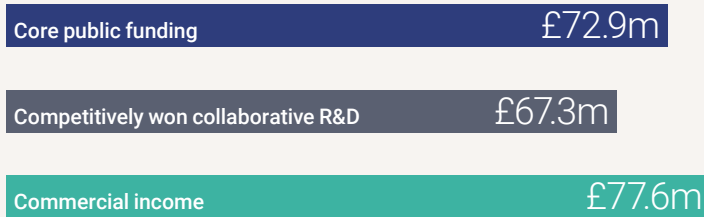
# Performance highlights

2016-17 was a year of strong performance, with industry continuing to collaborate with HVM Catapult to take technology innovations forward.





Funding breakdown:



Total value of our assets:

£617m

↑ Up 10%  
from 2015-16

Investment in large capital projects:

£52m

Number of employees:

2,114

Number of private sector projects:

1,730

Size of order book:

£205m

→ Of which £137m is collaborative R&D

Private sector clients:

3,387

→ Over 40% of whom (1,383) are SMEs



Every year, the HVM Catapult works on a wide range of collaborative and industry projects, many of which are commercially confidential and cannot be publicly reported. Here we capture a small selection of case studies to illustrate the breadth of the technologies, sectors and businesses we work with, as well as showing examples of SME business growth, productivity improvements and inward investment achieved with our support.



# Success stories



## Ground-breaking sustainable fish feed plant at CPI

USA-based Calysta partnered with CPI to develop the manufacturing process for FeedKind®, a new fish feed ingredient aimed at reducing the aquaculture industry's use of fishmeal or soy protein. FeedKind is a natural, traceable and safe non-animal source of protein, produced from naturally occurring microbes found in soils worldwide. Using a natural fermentation process, these microbes produce a nutritious, high-protein feed that is a sustainable alternative to high-protein feed ingredients such as fishmeal.

Calysta engaged with the experienced research, development and scale-up team at CPI to deliver a business-critical objective: developing the world's first single-cell protein production facility using methane as

a feedstock, which is located in the UK. Completing this objective has enabled Calysta to further commercialise its technology and meet the quantities needed for trials whilst positioning the UK at the forefront of the race to address the world's growing protein demand with novel technologies.

Alan Shaw, Calysta President, said: "CPI played a fundamental role in getting us to our current position. Working with CPI enabled us to concentrate on our strengths and have a partner explore and deliver in areas where we are more limited. The opening and operation of this plant represents the end of a decade of development and heralds a new era in the race to sustainably feed the world's growing population".

# Success stories



## NCC helps Dymag re-invent the wheel

Pioneering Wiltshire-based wheel manufacturer Dymag worked with the NCC to support their composites technology. Their latest wheels are made in one-third of the original cycle-time and at a reduced cost. The improvement in productivity and unit cost supports Dymag's aspiration to increase OEM market reach. The wheels are typically 40% lighter than standard cast aluminium wheels and 25% lighter than equivalent forged aluminium wheels, when tested to the same OEM standards.

To achieve these improvements the NCC staff optimised design, materials and processing know-how, together with Dymag's application of knowledge. The team applied design and simulation tools to produce a solution with light weight composites material as an alternative to heavier metal wheels.

Application of manufacturing process knowledge at the product design stage has ensured improved repeatability and efficiency. The NCC has provided high standards of product and process prototype development, test and analysis support, and iteration which has led to further work with Dymag to help with refining design and increasing the rate of manufacturing output.

"We worked very closely with the NCC in developing our new and patented Boxstrom carbon rim. We are absolutely delighted at the way the market (OEM's and aftermarket) is responding to the Boxstrom. Thanks to our design and development work in partnership with the NCC the Boxstrom offers a wide range of performance features that make it our lightest, stiffest and strongest carbon composite wheel yet".  
Chris Shelley, CEO, Dymag.



## Flexible inspection automation cell shortens cycle-time by 60%

The AFRC and partners, including KUKA Robotics UK, produced a full size, flexible inspection automation cell for Spirit Aerosystems to help meet the growing demand for highly accurate measurements at reduced timescales.

The cell's three high accuracy robots are configured to operate independently or co-operatively, and are controlled using CAD/CAM software through an intuitive and effective user interface.

This truly flexible and future-proofed automation facility at the AFRC represents a significant technological shift in manufacturing inspection.

The project has generated significantly reduced cycle-times in the complex geometry inspection of the large wing systems that Spirit manufacture. For a 6m<sup>2</sup> part, overall inspection time is reduced from 2.4 hours to around 50 minutes, a reduction of 60%. This step change will underpin the productivity of Spirit as it responds to industry demand which is expected to double to 100 wing sets per month.

The flexible automation cell is now a centrepiece of the AFRC workshop space, and represents the culmination of many years of close collaboration between academics, industrial end users, supply chain companies and various funding bodies. The partnership is continuing to work together to develop new high technology automated manufacturing solutions for the UK aerospace sector.

# Success stories



This project has provided a key step in developing the industrial viability of ALM processes and has established a vital body of knowledge to inform and shape the next steps of this journey.

Neil Mantle  
Head of Additive Layer Manufacturing  
Centre of Competence  
Rolls-Royce

Image courtesy  
of Rolls-Royce

## Largest ever 3D printed aero engine component

The MTC worked with Rolls-Royce on the additive manufacture of a flight test front bearing housing, resulting in a 30% improvement in lead time for first part to stores, for the engine development programme.

Rolls-Royce have pioneered the use of additive layer manufacturing (ALM) in the development of larger significant parts and associated technologies for structural engine components. The front bearing housing which was developed in this project was the world's largest aero engine structure to fly, incorporating ALM components, last year.

The MTC offered a secure and confidential development location for this project and facilitated fast iteration of designs. Working in conjunction with Rolls-Royce and Arcam, the manufacturer of the ALM machine, MTC

developed processes from powder inspection and characterisation through component manufacture to post process non-destructive testing of the ALM components.

As a result of this work, hundreds of aerospace quality components were manufactured under full Rolls-Royce control with tens of thousands of equipment run hours allowing for extensive data capture. This resulted in the electron beam additive manufactured components being incorporated into ground and flying test bed XWB-97 engines. Rolls-Royce saw a 30% improvement in lead time for first development parts to stores, as well as fast iteration and design change implementation throughout the project. It also allowed for product and process knowledge captured for use in future Rolls-Royce programmes and transferable capability and knowledge obtained as a result.

## Medical innovators aid former Marine's drive to bring freedom to millions with mobility problems

Researchers from the AMRC's medical division, Medical AMRC, are working with a former soldier to develop an advanced mobility aid that could change the lives of millions of disabled people.

Corporal Phil Eaglesham contracted Q Fever – also known as Helmand Fever – during active service in Afghanistan and is increasingly reliant on mobility devices as his condition deteriorates.

Phil, his wife Julie and businessman Brian Meaden set up Conquering Horizons to create VICTOR – a mobility device with none of the drawbacks of conventional wheelchairs and scooters.

VICTOR is being developed at the Medical AMRC and incorporates an adjustable lifting device that can raise users to a "social height", enabling them to look people in the eye and sit at the right height to eat or work. VICTOR is also modular, so that it can be modified as a user's condition changes.

Julie Eaglesham said: "Having this device will enable Phil, and millions like him, to gain a more active, independent and normal life."

For Phil, as a father of three lively boys, the ability to travel on most surfaces or terrains and the support, comfort and control of a device that he has complete confidence in, will be revolutionary.

The Medical AMRC are currently developing two prototypes after Victor Mobility recently surpassed crowdfunding targets to develop the designs up to a pre-production level.



I am grateful to WMG for providing design and prototyping assistance, which enabled us to present a strong collaborative bid which helped win the contract. These are exciting times for Pashley and it's great we will be able to access world-leading facilities, resources and technologies at WMG to help us develop an exciting new range of bicycles for the future.

Adrian Williams  
Managing Director, Pashley Cycles

## Pashley Cycles develop a bicycle for the London Cycle Hire scheme

Pashley Cycles is the longest-established British bicycle manufacturer and one of only a handful remaining in the UK. With a desire to grow the business, an opportunity arose to develop a new bicycle for the London Cycle Hire (LCH) scheme, popularly known as Boris Bikes.

Building on an existing relationship, Pashley and WMG worked together using additive layer manufacturing (3D printing), laser scanning and metrology technology to create accurate prototypes of the proposed bicycle components. A significant part of the new design features plastic and aluminium, a direct move away from the leather and steel traditionally used on Pashley bikes. WMG's expertise in light-weighting, polymers, reverse engineering and materials testing directly benefitted the company, helping de-risk the design development, whilst reducing cost and labour.

With its new design, Pashley was successful in being selected as the sole supplier for the next generation of LCH bicycles. The five-year contract provides stability for the company, securing the jobs of the 52-strong workforce in Stratford-Upon-Avon, with plans to recruit an additional 15 staff in the next year. WMG and Pashley continue to collaborate to advance the product further, and to establish a UK supply chain to fully re-shore the LCH bicycle manufacture.



Through the Civil Nuclear Sharing in Growth (CNSIG) programme, the Nuclear AMRC is developing new methods of manufacture to support the suppliers of the current 3m<sup>3</sup> Intermediate Level Waste (ILW) containers for Sellafield Ltd. This programme includes developing new machining methods aimed at increasing the security of supply and cost effectiveness for Sellafield Ltd to support their high priority decommissioning programmes over the next decade or so. With an eventual requirement of over 100,000 ILW containers over the next 120 years, Sellafield has also engaged the Nuclear AMRC in a longer-term programme to develop alternative designs of waste containers with the objective of reducing the unit cost by 50%.

Colin Walters  
Programme Director, Nuclear AMRC



## Nuclear AMRC exceeds all business support and growth targets

Civil Nuclear Sharing in Growth (CNSIG) is the Nuclear AMRC's flagship programme of intensive business development for key members of the UK civil nuclear supply chain. It is supported by the Regional Growth Fund and by industry leaders including Rolls-Royce.

Ten participating companies receive a four-year programme of business development and training worth £1 million, tailored to the specific needs of their business. This includes shop-floor manufacturing improvement, process improvement, leadership development and specific nuclear sector knowledge.

After three years – with a year remaining to run – the CNSIG companies reported:

£410 million  
of new contracts won, against  
a target of £177.4 million

4,900  
jobs created or sustained,  
against a target of 2,077

£45 million  
of additional private sector  
investment committed

Over 100 companies have now completed and passed the Nuclear AMRC's Fit For Nuclear (F4N) programme, a unique service to help manufacturing companies test and develop their readiness to bid for work in the civil nuclear supply chain. F4N is delivered exclusively by the Nuclear AMRC, and is supported by top-tier partners in nuclear new build and decommissioning.

Since its launch in 2011, over 600 companies (mostly SMEs) have taken the online F4N assessment, with most receiving ongoing support. Precision engineering group Paul Fabrications became the 100th company to be granted Fit For Nuclear, after driving business improvements through a tailored action plan. Based near Derby, Paul Fabrications has decades of experience in civil nuclear and aerospace. It currently produces intricate spacer grids for the fuel assemblies produced at Westinghouse's Springfields facility, but wanted to target new opportunities in new build and other markets. F4N allowed the company to focus on the particular requirements of the modern nuclear sector, and identify opportunities in new build, decommissioning and SMRs.

"Fit For Nuclear helped us see what the nuclear industry requires that is a little different to what we do in aerospace, and gave us some structure about how these improvements go across the site."

Kevin Dexter, Business Development Executive,  
Paul Fabrications.

117  
companies  
completed the F4N  
initial questionnaire

101  
companies  
completed the  
online assessment

55  
companies received  
site visit from F4N  
industrial advisors

570  
action plans  
received/updated

35  
companies were granted F4N

F4N figures relate to the 2016-17 financial year.

# Success stories

## Major inward investment and re-shoring of advanced manufacturing capability.

### McLaren Automotive Composites Technology Centre

Luxury, high-performance sports car manufacturer McLaren Automotive announced the development of its new Composites Technology Centre alongside AMRC in Sheffield.

The AMRC will use its expertise to develop and prove advanced manufacturing processes, in readiness to transfer them to the new centre for full-scale manufacture of the advanced carbon fibre chassis for McLaren's future sports cars.

The centre will host more than 200 hi-tech automotive jobs and will be built near the AMRC's Factory 2050 development; where a new Lightweighting Centre will also be built to house the AMRC's existing Composite Centre. The AMRC Training Centre will start training McLaren apprentices who will work in the new facility.

The new McLaren Automotive facility is due to start construction in 2017 with the first pre-production carbon fibre chassis, built using trial manufacturing processes in the AMRC is expected to be delivered to the McLaren Technology Centre in the second half of 2017. Full production at the facility will begin by 2020.



Why Sheffield? Because of the local expertise and experience of working with new materials and advanced composites, plus the development facilities offered by the AMRC facility. With other high-tech organisations, such as Boeing, Airbus, GKN and Rolls Royce plc alongside us at the AMRC, we are in very good company.

Mike Flewitt  
Chief Executive Officer  
McLaren Automotive





The UK provides Boeing with the talent and infrastructure we need to grow and maintain a high level of productivity and quality to meet our significant order book. We are proud to expand our relationship with the UK still further with Boeing Sheffield. Our decision to start manufacturing high-value components in the UK is a step-change in our engagement and a further example of Boeing's commitment to grow here, supporting the UK's long-term prosperity.

Sir Michael Arthur  
President – Boeing Europe and  
Managing Director – Boeing UK and Ireland

### Boeing Sheffield

US aerospace company Boeing announced it will open a brand-new manufacturing facility alongside the AMRC in Sheffield. The announcement is the culmination of a successful relationship that has developed since the AMRC was founded 16 years ago.

With a planned Boeing investment of more than £20 million, the new 2,300m<sup>2</sup> facility – to be named Boeing Sheffield – is part of a broader plan by Boeing to bring in-house the manufacturing of key actuation components and systems used in Boeing's Next Generation 737, 737 MAX and 777 aircraft to enhance production efficiency and reduce cost in its extended production system. Boeing Sheffield will employ approximately 30 people when it opens as part of Boeing Commercial Airplanes' Fabrication operations and its establishment will open up new opportunities for UK suppliers to bid for work.

As part of its plans, Boeing will initiate a major R&D programme with the AMRC to develop new manufacturing techniques. Boeing Sheffield is expected to hire new employees in 2018 – capitalising on the skilled workforce in Sheffield as well as the AMRC's existing capabilities.



# Strategic influence

Our consistent and strong performance of scaling up manufacturing technology has earned us recognition as the go-to place for advanced manufacturing technologies in the UK.



We are in a unique position to understand industry's current and emerging challenges and technology trends. We increasingly apply this insight to contribute towards the development of strategy, policy and support to industry on all matters manufacturing. We have:

- Supported thousands of customers to develop new technologies as a trusted delivery partner and embed the value created in the UK.
- Taken the lead, with the national interest in mind, in responding positively to challenges posed to manufacturing such as battery innovation and electrification, affordable composites, construction and digital manufacturing.
- Chaired and participated in strategic industry groups, co-authoring sector strategies, contributing to roundtable discussions, speaking at conferences and events, hosting visits from senior decision makers, and responding to consultations and enquiries.
- Maintained a well-informed view on key developments and trends in relation to high value manufacturing, based on relevant data and intelligence, and shared our view pro-actively with relevant audiences.
- Worked with international partners, including other Research and Technology Organisations, to build relevant partnerships for the benefit of manufacturing in the UK.

#### **The Government's Industrial Strategy**

This year also saw the initiation of a UK Industrial Strategy, the launch of a Green Paper and consultation exercise and the announcement of a UK Industrial Strategy Challenge Fund. We fully support the introduction of an Industrial Strategy and are especially pleased that leveraging the UK's strengths in science, research and particularly innovation, is at the heart of it. Importantly, the Industrial Strategy reinforces the growing recognition that research and innovation leads to new products, services and better ways of doing business; these are key to economic growth and UK competitiveness. We worked closely with Government, Innovate UK and industry to help inform the Industrial Strategy Challenge Fund, providing our insight and expertise to identify, quantify and prioritise the challenges and opportunities that lie ahead for UK manufacturers.

#### **The next five years**

This year also marked the final year of our initial five-year grant from Government. During the year therefore, we have been working closely with Government and industry to refresh our strategy and build a new and ambitious plan that will guide us through until 2022. Innovation, and the ability to commercialise new technology, remains the essential ingredient in achieving a sustainable and globally competitive manufacturing sector. Industry cannot achieve this goal in isolation and so our plan for the next five years will be to continue to provide industry with access to equipment, expertise and an environment for collaboration in those areas where the opportunity to make an impact is greatest.

Our strategy is to support industry with its defined needs and develop an independent forward look to ensure that the necessary groundwork is done to develop the new manufacturing technologies in readiness for the programme needs of industry. Examples of these technologies include; robotics and automation, virtual and augmented reality, processing of novel materials, new battery technology and electrification, additive and net shape manufacturing, and biotechnology. All have a rich digital content which characterises our advanced manufacturing world. Progress will be digitally driven in this world and will have a profoundly positive impact for those who embrace it and the opposite for those who don't.

In our strategy, we plan to demystify I4.0 – the fourth industrial revolution, for big companies and small, to ensure that the UK has the best chance to exploit its strong digital base and gain advantages in productivity and efficiency.

In our first five years we have accumulated significant knowledge in the course of our work. We plan to make more of this accessible to help more companies, especially innovation hungry SMEs. We also plan to transfer this valuable knowledge across sectors into construction and infrastructure so that these proven tools and processes can be rapidly adapted to help deliver challenging targets for new homes, new schools and other infrastructure projects.

# Strategic influence

## Electrification

As concerns over air quality in urban areas are mounting and as we remain committed to meeting ambitious decarbonisation targets, reducing car emissions by increasing the presence of electric and hybrid vehicles on our roads has grown in importance.

The so-called 'electrification' of passenger cars and light commercial vehicles creates significant supply chain opportunities. It will generate a demand for the manufacturing and recycle/re-use of more and better batteries, motors, power electronics and associated devices.

This is a global market opportunity and international competition to secure the supply chain is strong. With the automotive industry forecasting a significant shift towards vehicle electrification, the opportunities for those who can create the energy storage solutions to make this happen are huge. If the UK were able to carve out a share of the market, the supply chain opportunity alone could be worth over £5 billion per year. The UK has significant strengths in the form of its world-class academic base, its strong industry and government relations, its profitable existing car industry and a full-scale battery manufacturing plant in Sunderland, which to date is the only one of its kind in Europe.

To exploit this global opportunity and to secure the value in supply chains in the UK, a national co-ordinated effort between industry, government and academia was called for.

In response, the UK car industry, through the Automotive Council UK, has set itself the challenge to 'self-disrupt' with an ambition of 50% of UK car production to be electric and plug-in hybrid vehicles by 2030. This will require a step change in technology and an acceleration of the development, launch and scale-up of high quality electric vehicle systems. Improving the power, performance, and cost of batteries is critical in this.

The Automotive Council UK tasked its Manufacturing Working Group – chaired by our HVM Catapult CEO Dick Elsy – to develop a roadmap towards achieving its mission of world-leading batteries, designed, developed and manufactured in the UK.

The convening power of the HVM Catapult brought together the right players across the UK supply chain into a focused task force which worked with the academic community to pull together a co-ordinated proposal which will allow the UK to fulfil its industrial potential in this area.

The Energy Innovation Centre (EIC) at WMG came to the fore in this process. The EIC provides open access for both academia and industry to scale up battery innovations and is the only facility in Europe which covers not only battery chemistry, but the entire battery system, including the coating of electrodes, the forming of battery cells and the testing of modules and complete battery packs. Already, the EIC can make batteries which are 70% to 80% better in terms of energy density than those made by leading US energy storage and electric car manufacturer Tesla. It's an excellent example of how our model of combining public and private sector investment, and continuing to offer cutting-edge equipment, expertise and collaboration, helps us look forward and stay ahead of the curve, conducting research and putting in place technology capability before industry demands it from us.

The EIC's technical leadership was central in bringing together academic networks, such as Supergen, the Advanced Propulsion Centre (APC) and industry through the major UK manufacturers and suppliers.

The outcome of this work was a proposal that was submitted to the government as part of the Industrial Strategy Challenge Fund. This resulted in the announcement in April this year of £246 million of funding for the Faraday Challenge, which will match-fund early-stage research into new battery technology, mid-stage innovation work to develop industrial applications and later-stage production scale-up to help to take the technology to market and create new and valuable supply chains in the UK.

The funding for energy storage technologies will help move us further on the road towards putting the UK's battery industry back in the global game for batteries, not only in automotive but also in domestic and grid storage.

We have also gone beyond this to convene work with other Catapults, such as Future Cities, Transport Systems and Satellite Applications, to manage the push towards greater electrification and how advanced battery technology will play an increasing role in our lives in the future.



**Automated Module-to-Pack Pilot Line  
for Industrial Innovation**

WMG successfully secured and now leads the Innovate UK funded AMPLiFiI project (Automated Module-to-Pack Pilot Line for Industrial Innovation). This project will create a UK supply chain for fully qualified battery packs to suit hybrid and electric vehicles across a broad range of markets. By creating a modular battery architecture, based on standard format cylindrical cells, developed for both high power and high energy requirements, the supply chain will be able to aggregate demand for components from different OEM's applications and achieve economies of scale. WMG hosts the special purpose pilot manufacturing line within the EIC. The facility will be available after project completion (October 2017) for industrial collaboration with other battery manufacturers looking to conduct prove-out trials of new module manufacturing technology.



The convening power of the HVM Catapult is impressive. The work it did to bring industry and academia together was the foundation of our successful bid to secure funds for the Faraday Challenge.

Nigel Stein  
Industry Chairman – Automotive Council  
(and CEO of GKN)

# Strategic influence

## Digital manufacturing



I see the HVM Catapult as a key enabler for the faster adoption of 4th industrial revolution technologies by UK Industry.

Juergen Maier  
Chief Executive, Siemens UK





Digital engineering and manufacturing represents a significant economic opportunity for the UK: double digit increases in productivity by 2030, a predicted £91.6 billion additional value and the opportunity to create over 300,000 new jobs in manufacturing alone<sup>1</sup>.

In late 2015, representatives from UK manufacturers, research establishments, industry bodies, trade associations, non-governmental bodies and other organisations established the Digital4Industry (D4I) group to consider the threats and opportunities that digital technologies present to the engineering and manufacturing sector. The HVM Catapult co-chairs the group, helping it to articulate guidance on how to make the UK the best place for the exploitation of such technologies.

The D4I group focuses on key areas that enable the effective adoption of digital technologies, processes and business models by UK industry to drive productivity, competitive separation and economic growth. These key areas include:

1

#### **Business Transformation**

Understanding the opportunities and addressing the barriers to the adoption of digital solutions, thus adding value to industry by transforming business and production processes.

2

#### **Implementation**

Driving the implementation of digital solutions into industry through demonstrators that de-risk the solutions and stimulate engagement with technology suppliers.

3

#### **Research**

Developing collaborative research programs that will shape the research agenda and ensure that the UK is well placed to support future industry needs.

4

#### **Skills and Society**

Understanding the digital manufacturing skills needed to address the current lack of capacity and the future skills gap.

5

#### **Standards and Regulation**

Using the global standards development processes to support manufacturing sectors and to claim leadership.

6

#### **Cyber-Security and Infrastructure**

Fostering faster adoption of relevant security measures and quicker implementation of relevant digital infrastructure.

1. Figures derived from estimations made on the basis of the growth already generated in Germany and national statistics. Sources of data: 2016, Industry 4.0: Building the digital enterprise, PwC. 2016, Annual Manufacturing Fact Card, EEF. 2015, Industry 4.0: The Future of Productivity and Growth in Manufacturing Industries, BCG. 2016, United Kingdom Unemployment Rate, Trading Economics ([www.tradingeconomics.com/united-kingdom/unemployment-rate](http://www.tradingeconomics.com/united-kingdom/unemployment-rate))

# Strategic influence

## Digital manufacturing

The D4I group contributes to the national Industrial Digitalisation Review which is being chaired by Juergen Maier, CEO of Siemens. It has articulated the needs of specific sectors (e.g. food and drink, pharmaceuticals, aerospace and automotive), as well as by UK industry as a whole, to fully exploit the opportunity of industrial digitalisation and to deliver a targeted doubling of productivity by 2030.

### Demonstrate and educate

Whilst it is generally recognised that digitally-enabled manufacturing can transform productivity at a business and supply chain level, many companies are still trying to understand where to start. Industry needs support to articulate the future landscape and business opportunity derived from the fourth industrial revolution.

In this context, the HVM Catapult has been building a network of digital manufacturing technology demonstrators. Each demonstrator will evidence a tangible business improvement through the application of digital solutions including augmented and virtual reality, analytics, digital twins and co-operative robotics. This network will include demonstrators across the wider university and Research and Technology Organisation (RTO) landscape and, critically, industry use cases across multiple sectors and regions.

The HVM Catapult has developed an “app” to help users navigate the virtual representations of these demonstrators and point them to the relevant physical installations.

Factory 2050 at the AMRC in Sheffield is a showcase for the digitally-enabled factory and is an excellent demonstrator platform for digital manufacturing technology, providing a sandpit for companies to explore and understand the benefits and potential applications and a platform to explore future business models.

### Thought leadership

The HVM Catapult has developed a model to map out future business opportunities and direction for supply chains. This model enables companies to map the connectivity and business opportunities through the supply network and the product lifecycle, from conception to end of life and re-use.

Several international seminars on digital manufacturing were held at the MTC, convening thought leaders and politicians from across Europe, and a joint paper outlining the future vision of distributed autonomous manufacture was developed with the Digital Catapult.

### Next steps

The HVM Catapult with D4I is launching an SME outreach programme, comprising a series of roundtable events and workshops, followed by diagnostics and interventions to help companies harness digital technology to deliver their business strategy. We are also working with partners including Digital Catapult on a business Digital Readiness Level tool.

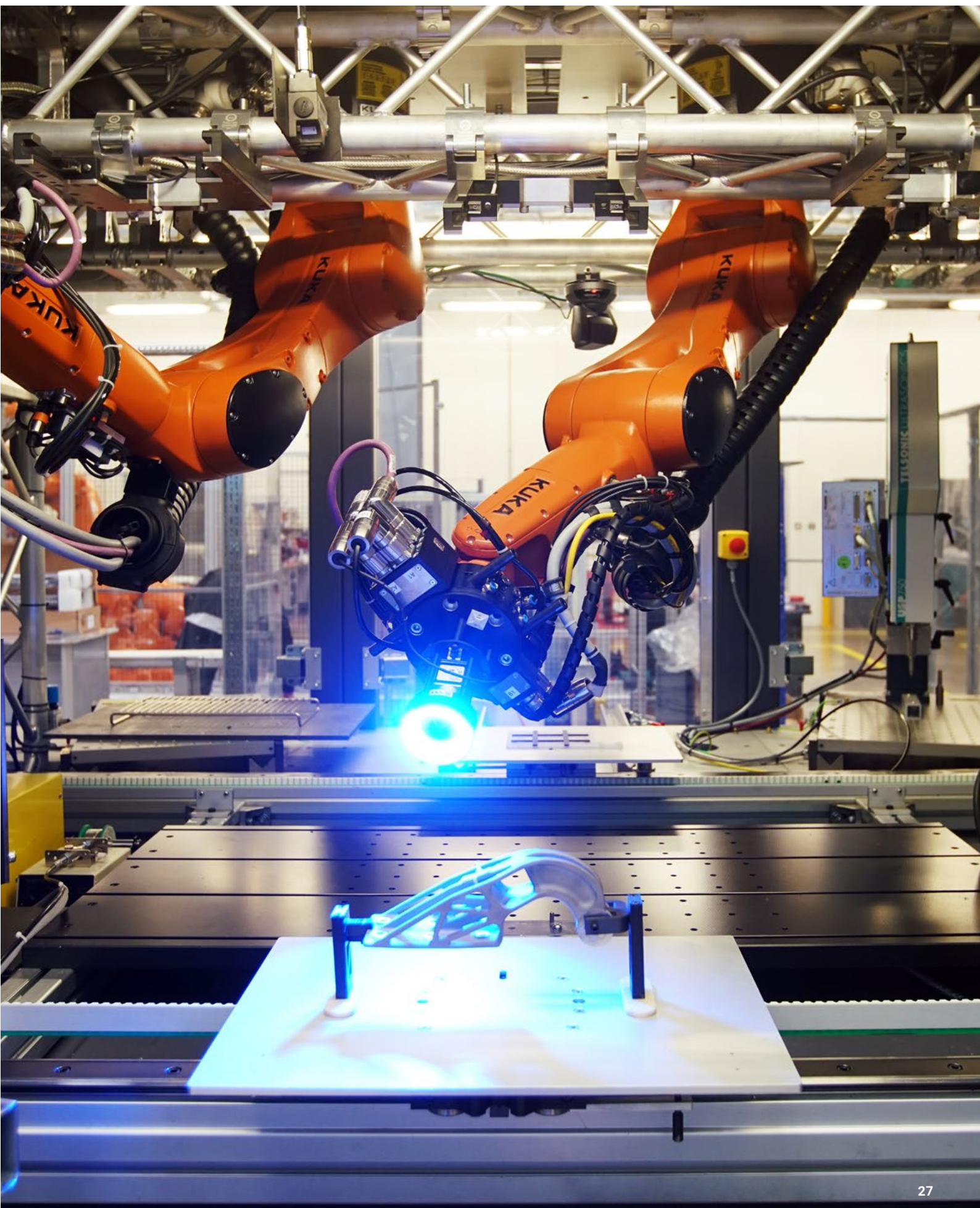
### MTC helps Thermal Energy Research Accelerator and Dearman Engine establish mini factories in foreign markets

Backed by the Thermal Energy Research Accelerator (T-ERA), the MTC, together with the universities of Birmingham and Loughborough, have developed the ‘Factory in a Box’ concept that deploys custom-designed mini factories into established manufacturing operations across the world.

The “Factory in a Box” will soon be able to deliver British technology solutions to the doorstep of manufacturers across the globe who can’t get key components from local suppliers.

The mobile factories – which can be shipped in a container – use next-generation Industry 4.0 technology, such as smart sensors, super-fast broadband and big data to measure and control production processes remotely, thus transforming small and medium-sized UK manufacturing companies into some of the most efficient digital factories in the world.

Professor Martin Freer, who leads T-ERA says “This is a fantastic opportunity for ERA to invest in a facility that will not only help drive UK productivity, but will be a research platform for universities to position themselves at the cutting edge of innovation in manufacturing.”



Strategic influence  
Affordable composites



Composite materials and products were seen as an emerging technology in the 1960s and 70s for high-end engineering applications. Now – some 50 years later – they are undergoing a rapid development phase, with multiple industry sectors considering how they might exploit the use of composites.

A recent study conducted by the UK Government and published through the Composite Leadership Forum (CLF), forecasts that the UK composite products market will grow from £2.3 billion per year in 2015 to a potential £12.5 billion per year by 2030. However, approximately half this value resides within the raw material supply, most of which is currently imported.

The ability of composite materials to deliver great strength whilst being very lightweight makes them a key tool in delivering the transport sector's emissions targets. However, they currently remain expensive and take longer to process into finished products than many other materials.

The world-class strength of the UK's science base combined with the applied R&D capability of the HVM Catapult creates a real opportunity for the UK to take a lead in future composite material and processing developments. This is going to be vital if the UK is to avoid a substantial negative impact on its future balance of payments from industry having to import their material from Europe, the US and Japan.

The UK's challenge is in three areas:

1

**To drive the development of new and better manufacturing technologies to improve the efficient use and applicability of existing materials.**

2

**To establish a capability for the development of the new materials of tomorrow.**

3

**To build a strong UK-based supply-chain for the materials that our industries will need if they are going to capture a share of the global growth in demand.**

In the past year, recognising the opportunity, the HVM Catapult was instrumental in forming the 'Affordable Composites Group', a collaboration between the Automotive Council's Manufacturing Working Group, chaired by the HVM Catapult, and the Composites Leadership Group. This group is leading the first of the challenges; developing new manufacturing technologies.

The group is also leading a project to address the second challenge, and potentially the biggest prize: the development of new materials. The project is seeking to establish a UK materials R&D capability in the form of a National Composites Materials Centre. In a combined project with academia and industry this would create an open-access capability, similar to other HVM Catapult centres, that will enable companies that (intend to) manufacture in the UK to innovate in the areas of chemistry, formulations, fibres and textiles conversion processes for new fibres, as well as recycling and disposal of the materials. It will allow them to produce sufficient material to prove applications in their processes and products.

Working with industry and the Department for International Trade, the HVM Catapult is also supporting the third challenge; establishing a UK supply chain by supporting and encouraging the growth of UK companies wanting to service the composites materials and products market, and by liaising with overseas companies that see the UK as an attractive place to invest in composites.

Historically the UK developed the innovative principles underpinning polymer composites, including the development of high performance carbon fibres. However, as with so many of our other great innovations, this was commercialised overseas and the UK did not exploit the economic benefits. This time – with the benefit of a strong translational mechanism in the HVM Catapult – the UK will be well positioned to reap the opportunities from this growing market.

# Strategic influence

## Construction

The UK's construction industry contributes £90 billion to the UK economy, with around 10% of UK jobs depending on it. The pressure on the sector to build new homes and infrastructure is higher than ever, and at the same time it faces new sustainability standards, lagging productivity and a shortage of skilled workers.

The Government's 'Construction 2025' strategy and the 'National Infrastructure Delivery Plan 2016-2021' both call for reduced costs, faster delivery, lower emissions and increased exports. Many in the industry believe that collaboration is the only way the industry can meet these demands.

The HVM Catapult stepped up its engagement with the industry through the Construction Leadership Council. The construction industry can benefit from our experience of developing and implementing technology solutions in a wide spectrum of manufacturing sectors. It can learn from sectors such as aerospace and automotive, which have transformed through leadership in shared knowledge, innovation and successfully leveraging research and development investment from industry and government.

The sector can drive up quality and generate step-change productivity improvements in off-site and on-site construction by adapting and introducing advanced manufacturing technologies such as in the areas identified below.

### Digital manufacturing philosophy and technology

The adoption of a fully digitally-enabled construction process which considers the engineering life-cycle of a built asset right from design, through operation and adaptation to end of life, can produce benefits by:

- Reducing capital cost by reducing risk, improving productivity and increasing capacity in the design and build process, using feedback from existing assets to aid the design of new assets.
- Reducing operational cost by removing the performance gap between design and finish-built and by the use of sensors and analytics to monitor and optimise performance, allowing predictive rather than scheduled maintenance to extend the life of the asset.
- Increasing residual value at the end of the asset's life by capturing data throughout the whole life so the condition of an asset or product is known at any time. This, in turn, may drive different investment, business and contractual models such as leasing and performance focused models.
- Benchmarking and sharing of best practice by considering the process across a portfolio of assets.

The adoption of these processes will ensure that government-led infrastructure projects are delivered more efficiently; the UK Government's 2050 CO<sub>2</sub> targets are met; health and safety of construction workers is improved; the workforce is upskilled and resources are better utilised. Taking a lead in this area creates potential for high value UK export growth.

### Virtual Reality

Being able to virtually test and fine-tune aspects of the building design and simulate the construction process improves efficiency by reducing the time and cost of rectifying errors during or after construction. Centres such as the MTC and AMRC are already applying their virtual reality (VR) and augmented reality (AR) capabilities to the construction sector.

The AMRC have worked with construction organisations such as BAM and Balfour to demonstrate the added value of using VR systems to better understand design-oriented challenges around the building, site and masterplan. Work is currently underway to better understand the opportunities for utilising game-orientated platforms as VR moves towards a low-cost mainstream market. We are also engaged with the utilities sector to help them further integrate their use of applied visualisation as they work towards the level 3 Building Information Modelling (BIM) mandate. BIM is a process for creating and managing information on construction projects and includes a digital description of every aspect of the built asset. It is currently seen as the holy grail and represents full collaboration between all disciplines by means of using a single, shared project model which is held in a centralized repository.

### Augmented Reality

AR offers opportunities for use within construction. At the higher Technology Readiness Level (TRL) end, as part of the Advanced Manufacturing Supply Chain Initiative and Laing O'Rourke programme for assisted assembly methods, AMRC used optical projection and created several digital applications to integrate systems and technology that are embedded within an advanced visualisation solution. At the lower TRL end, the AMRC partnered with the AFRC, and SMEs Soluis, Carbon Dynamic and Pinnacle Solutions on the Augmented Worker (AWE); creating a platform for the utilisation of a suite of VR and AR-based tools. Applications are being developed for use throughout the construction life-cycle and include assembly instructions, process monitoring, remote support, and through life maintenance. This activity is supported by Laing O'Rourke, Doosan Babcock, Autodesk, Microsoft and AECOM.

### Additive Layer Manufacturing (ALM)

ALM, or 3D printing, may allow faster and more accurate construction of complex or bespoke items as well as lowering labour costs and producing less waste. It might also enable construction to be undertaken in harsh or dangerous environments not suitable for a human workforce such as in space. The technology can be used to 'print' construction components or even entire buildings. In the UK, the recent emergence of BIM in particular may facilitate greater use of 3D printing.



Utilising process expertise from Loughborough University, Skanska formed a collaborative team to develop 3D printing in concrete and after 12 months we were grinding to a halt in terms of process development. Construction people were trying to develop manufacturing processes and it just wasn't working. One of the partners backed out and we were in danger of giving up and falling into the innovation valley of death. I approached the HVM Catapult who helped us locate our robot in an appropriate facility and they supported us with manufacturing process development. With the team's help, we also secured further support funding and access to 3D printing expertise.

**Rob Francis**  
Director, Innovation and Business Improvement  
Skanska

# Addressing the skills shortage



265,000

skilled entrants required annually to meet demand from industry through to 2024

186,000

of them will be needed in engineering occupations to meet demand

101,000

of them will need to have level 4+ skills

41,000

of them would historically have been UK nationals

40,000

are currently EU and international graduates (pre-Brexit data)

20,000

annual shortfall (pre-Brexit) of engineering graduates

\*Engineering UK report: (The state of engineering)



## The challenge

Shortages in key engineering skills are consistently cited by manufacturers as the biggest threat to success in key expanding engineering sectors such as manufacturing, construction and ICT. Employers predict a growing need for new recruits with high level skills, alongside a growing concern about their ability to find such recruits. This concern is further exacerbated by current uncertainty about the impact of Brexit on the free movement of labour within the EU. At the same time, new technologies and the advancing digitisation of manufacturing requires on-going development and re-training of the current manufacturing workforce to increase productivity and to remain competitive.

Research by Engineering UK found an additional 1.8 million engineers and technically qualified people will be needed by 2025. Currently there is a 20,000-a-year shortfall in the number of these people emerging from Britain's education system.

A recent study by IMECHE and Tata found that the two biggest barriers holding people back from pursuing careers in the sector are a poor image of engineering and manufacturing, as well as a lack of understanding of what a career in these fields actually entails.

## Our response: training the technicians for tomorrow's technology

Over the past 12 months, the HVM Catapult centres have collectively trained over 860 engineering apprentices and offered many specialist short courses. These combine the very best in practical and academic training, as well as working with specialists who have direct experience of the challenges and needs facing industry. Working with employers, we identify and provide the skills that manufacturing companies need to compete globally, from apprenticeship through to doctorate level. We are able to draw on a wealth of world-class technical and educational resources to create a flexible learning approach, tailored to the needs of employers, delivered both at our centres and by partners.

The University of Sheffield and Sheffield Hallam University have announced a pioneering new degree-level apprenticeship programme which will use the expertise of the University of Sheffield's Advanced Manufacturing Research Centre (AMRC) Training Centre and Sheffield Hallam University's multi-disciplinary Materials and Engineering Research Institute (MERI). Apprentices will study for degrees in integrated, materials and rail engineering, achieving professional accreditation alongside their employment and have the opportunity to progress to study at Masters level.

MTC's Advanced Manufacturing Training Centre (AMTC) has developed its own industry-wide and recognised apprenticeship programme to support talented young engineers. The Lloyds Bank Advanced Manufacturing Apprenticeship Programme is a course that provides unique, flexible career paths into manufacturing engineering where all training and administration for the qualification is managed and delivered by the AMTC.

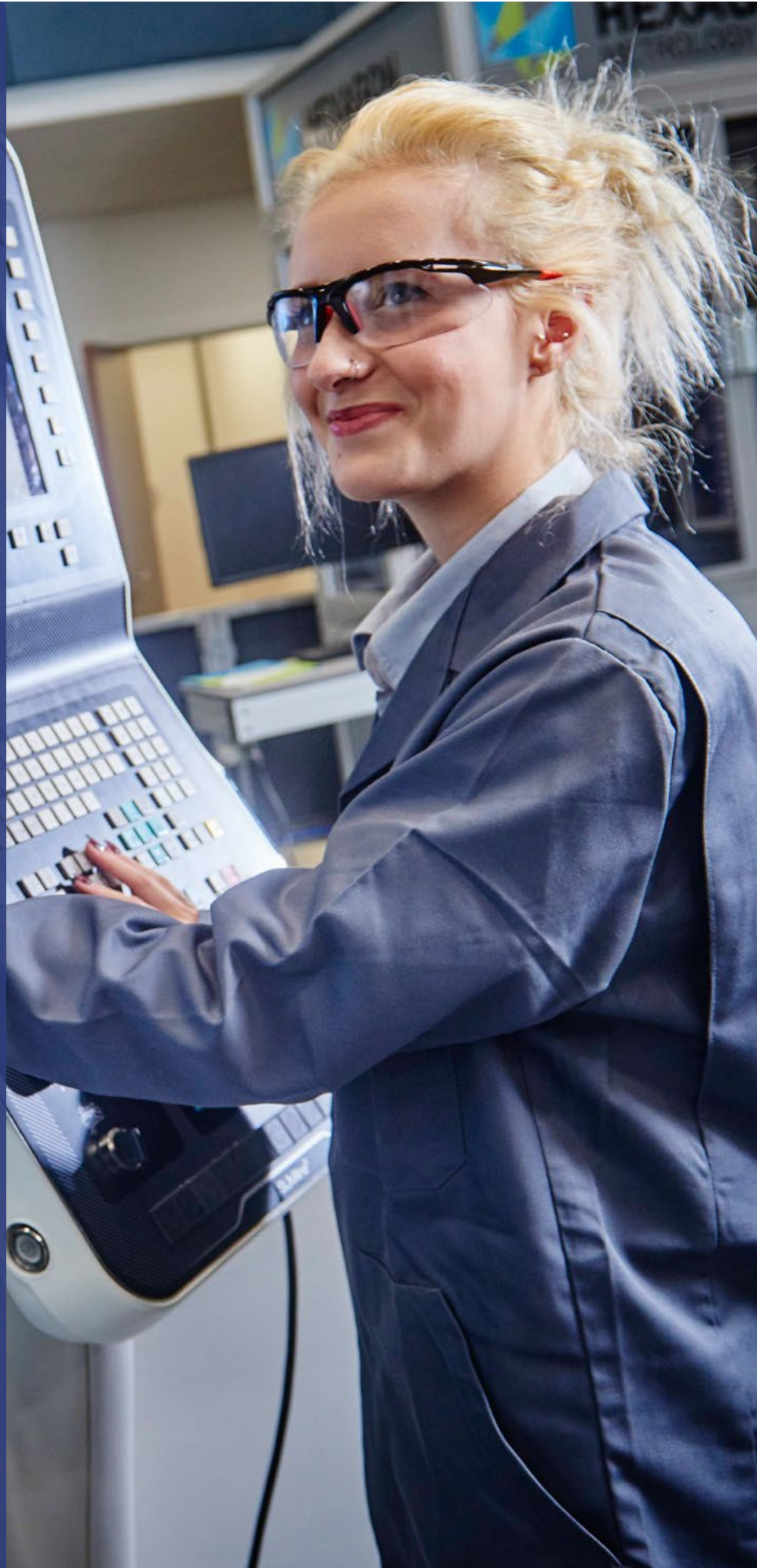
The National Composites Centre has supported the generation of a new Trailblazer Standard for Composites Technicians. The NCC is now assisting 14 Further Education Colleges and Group Training Associations with learning resources, Train the Trainer packages and technical support to enable them to deliver the new qualification to meet their local employers' needs. The first year is likely to include 120 learners who would otherwise not have access to jobs in a growing advanced manufacturing industry.

# Addressing the skills shortage

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## Tilly Brogden Year 2 apprentice at the Advanced Manufacturing Training Centre

Whilst starting her third year studying vehicle maintenance at college, Tilly decided to move into engineering to broaden her knowledge and skillset. In her third year at college, she applied for the MTC apprenticeship programme and was accepted. She says: "At the MTC, there is constant exposure to brand new technologies, and consequently I am excited to be embarking on a career in this dynamic and pioneering industry. Whilst studying CNC CAD/CAM, it was incredibly fulfilling to turn an idea into a design, and then manufacturing something tangible as an outcome, with increasing complexity, as my skills grew. In metrology, I learnt the science and importance of measurement and working to technical drawings and standards. In automation I thoroughly enjoyed fluid power, learning the principles of pneumatics, then constructing circuits and integrating relay logic control. Engineering is so broad and is constantly evolving, which appeals to me massively, as I have a real voracity to learn and develop and I look forward to forging a successful and rewarding career."





Heidi Butterfield

Inspired by her dad's successful engineering career, Heidi Butterfield (19) knew when she left school she wanted to work in the same field.

With a guaranteed job high on her wish-list the talented 19-year-old opted against following in the footsteps of most of her family by going to university and instead secured an apprenticeship.

Now she is studying for a Foundation Degree Apprenticeship in Design Quality Inspection at the AMRC Training Centre and is employed by international manufacturer Kostal UK, based at Goldthorpe.

"An apprenticeship always appealed to me more than university," said Heidi. "I am working and earning a decent wage but also learning skills I need for my career. Most of my friends are at university and my sister is. I think I am the only one doing an apprenticeship but I have made the right decision for me and I hope to continue with my education after completing my foundation degree."



Harry Mayes

After finishing grammar school, Harry Mayes (18) decided to pursue the apprenticeship route. "I'm a very practical person and I don't think I could do something where I would be sat still for long parts of the day" said Harry. "I just knew I wanted an apprenticeship. I approached the AMRC Training Centre and after getting through an assessment I was sent for interviews with several different companies. Each were local to where I lived and offering maintenance apprenticeships and I was fortunate to be offered apprenticeships with two of them. There are lots of incentives during your apprenticeship; you get salary increases for reaching various milestones as you progress. I'm learning skills which are in demand and key to my job role and I am also gaining on the job experience at the same time. I want to get fully qualified and then work my way up the career ladder."



Saad Ahmed

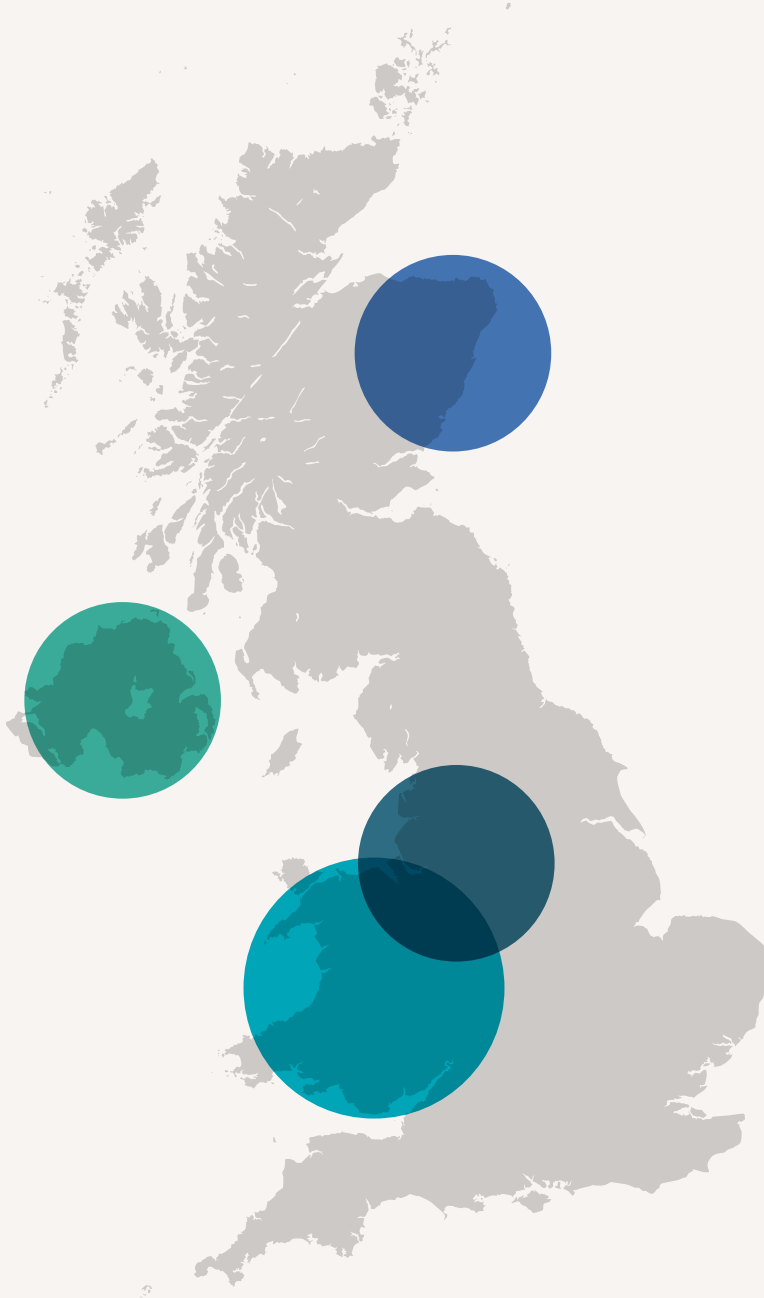
At the age of 18, Saad Ahmed joined the AFRC as a modern apprentice after completing his first year at university. For Saad the decision to make the switch from university to apprenticeship was all about getting as much practical, hands-on experience as early in his career as possible.

Now in the third year of his apprenticeship, Saad is a key part of the centre's successful machining team working on research and development projects for some of the world's most high profile manufacturing companies and operating multi-million pound pieces of state-of-the-art equipment.

# Regional outreach

The HVM Catapult has a national remit and our centres work with companies and universities from all parts of the UK. In response to demand, several of our centres have now specifically developed a presence in regions which do not currently host a physical HVM Catapult facility.

Here is an overview of some of the initiatives that progressed during the course of the past year across such regions.



## North West

The Nuclear AMRC announced that it will be opening a new facility at the site of member company, Cammell Laird, in Birkenhead, on the Mersey. The site is well placed for the nuclear industry hub around Warrington, the decommissioning and new build projects in Cumbria, and the Wylfa new build on Anglesey.

Announced in March, the new facility will be used to develop and industrialise technologies (including modular manufacturing technologies) and know-how to service the nuclear industry.

The facility will provide a base for the Nuclear AMRC to support supplier development in the North West, and in addition the Nuclear AMRC's F4N team has held a series of regional engagement events over the year, including in the North West, West Midlands and south Wales.

AMRC has announced a new facility to be sited alongside BAE Systems on the Samlesbury Aerospace Development Zone. Samlesbury is currently the UK's worst performing economic development zone, yet it has many advantages, such as a large aerospace company on site, and an extensive regional automotive supply chain.

AMRC North West will provide a 2,750m<sup>2</sup> facility worth £10 million and with £5 million worth of equipment and 27 staff, operating initially in machining, assembly and additive layer manufacturing. It will also have a Nuclear AMRC presence on site, directing R&D back to the Nuclear AMRC at Sheffield.

It is anticipated that AMRC North West will be operational by April next year, with the permanent facility opening in June 2019.

The MTC formalised its partnership with Liverpool John Moores University (LJMU) early last year, and throughout the past year has continued to work closely with the university, to support growth and innovation within the region's maritime industry and wider manufacturing sector.

The MTC organises regular trips for SMEs based in the Liverpool area to visit its state-of-the-art facilities in Coventry, to give them an idea of the technology and support available to them through the MTC, the HVM Catapult and other channels.

## Wales

A new AMRC Cymru centre has been confirmed by the Welsh Government as a key component of the £20m, 4,500-m<sup>2</sup> Welsh Government's Advanced Manufacturing Research Institute (AMRI). It is a development of significant importance to the UK aerospace supply chain and the wider manufacturing sector. AMRC Cymru will operate from a new £20 million facility in Broughton at the heart of Airbus wing assembly and supply chain operations and will help ensure the UK plays a full part in the next generation Airbus fleet.

Approximately 30 AMRC staff will be employed in the facility in the first instance, working alongside Airbus and supply chain companies. It will be an open access facility, with a focus on aerospace, automotive, nuclear and the wider manufacturing sector, anticipated to become operational early in 2019.

NCC have also begun discussions with the Welsh Government on the need for composites support for the automotive cluster in South Wales, as well as for the Airbus Wing of the Future programme. The composites activity may take place near the AMRC Cymru facility in Broughton.

The AMRI will operate as a single entity, split between a proposed R&D facility at the Broughton plant of Airbus – the anchor tenant for the new Institute – and a networking, training, business development and advice facility in close proximity to the Deeside Industrial Park.

## Scotland

Four of our HVM Catapult centres (AFRC, Nuclear AMRC, MTC and NCC) joined forces in the 'HVM Catapult Oil and Gas Consortium', which set up a regional access point for the oil and gas sector in Aberdeen, positioning the HVM Catapult as a key strategy, technology and innovation partner for the oil and gas industry. These centres co-sponsor the resource in Aberdeen to act as a point of contact for the HVM Catapult.

Throughout the year the consortium has worked closely with key stakeholders and established the cross-Catapult oil and gas pilot project at AFRC, comprising of two programmes of work involving five oil and gas companies and three trade organisations. It has also won a number of projects in the oil and gas sector utilising a broad selection of its capabilities, all aimed at increasing efficiencies within the sector.

In February of this year the Scottish Government launched 'A manufacturing future for Scotland', its action plan for the development of, and support for, an innovative and diverse manufacturing sector in Scotland.

One of the deliverables is the National Manufacturing Institute for Scotland (NMIS), a manufacturing centre of excellence and skills academy.

The AFRC, alongside the University of Strathclyde, supports the Scottish Government in developing the NMIS as a catalyst to the first manufacturing innovation district in Scotland.

## Northern Ireland

NCC are developing collaborative proposals with the Northern Ireland Advance Composites and Engineering centre (NIACE) in Belfast, and work to support the NIACE SME community has already begun.





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