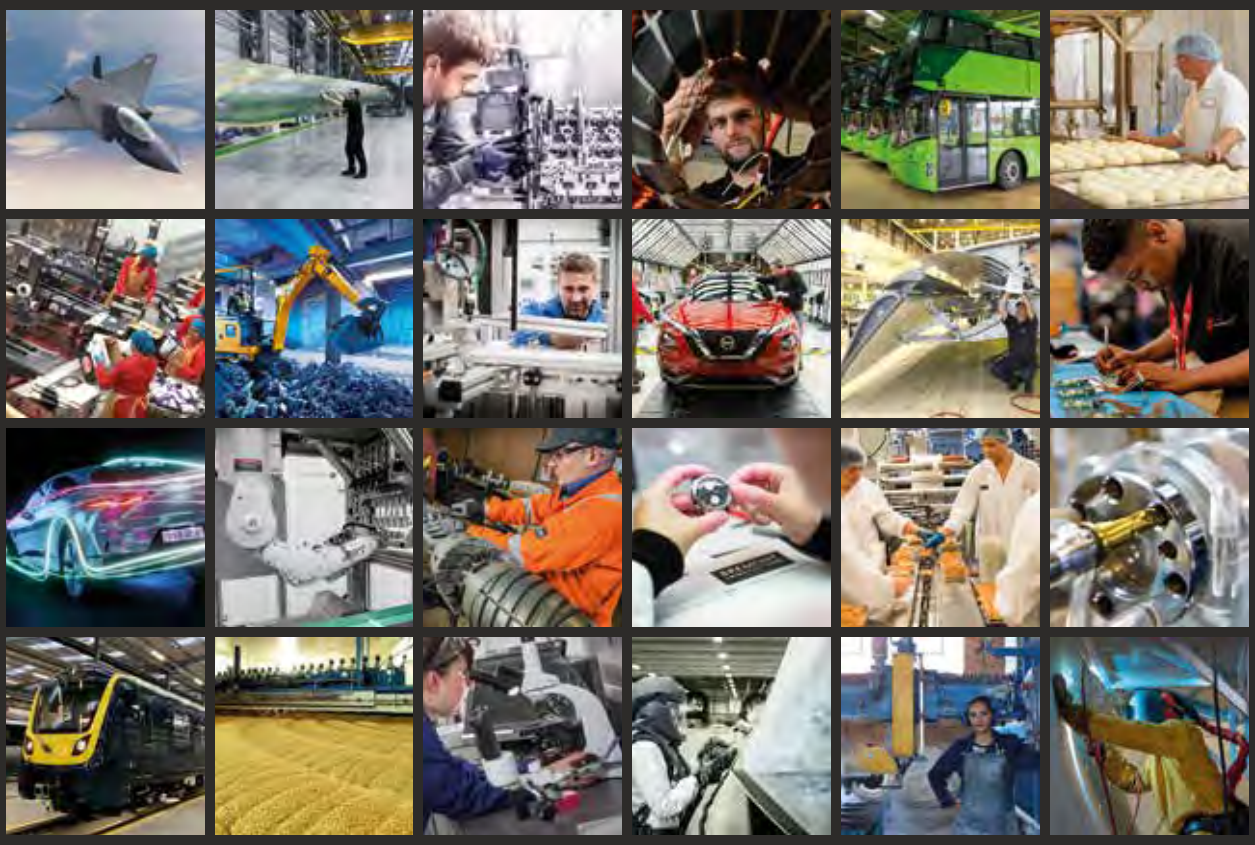
UK MANUFACTURING REVIEW 2019 20

MANUFACTURING SECTORS, REGIONS, TRAILBLAZERS, TECHNOLOGIES



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UK MANUFACTURING REVIEW 19|20

Welcome to the UK Manufacturing Review 2019/20

At the time of writing, Carlos Ghosn is settling in to his new home in Beirut; Angela Merkel says that "Brexit is a wake-up call for the EU", electric van company Arrival is achieving 'unicorn' status with $100m of investment from Kia and Hyundai, and it is reported that UK tech start-ups attracted over £10bn of venture capital in 2019, 44% up on the previous year, at a time when investment in tech companies in the US and China fell, by 20% and nearly two-thirds, respectively.

It has been quite a momentous year for the world at large, and the UK in particular.

The biggest enemy of investment and confidence is uncertainty, which is something this country has suffered from in spades.

I have been writing about manufacturing in one way or another for over 30 years and I have learned that manufacturers in the UK, especially the SMEs in the supply chain, are incredibly resilient. However bad the situation may be, they can adapt to it and overcome it. So long as we have a relatively clear idea of the way forward.

The past three years of navel-gazing self-indulgence by the political classes has been a severe hindrance to Britain's manufacturing base and its companies, of whatever size. Whatever one feels about the outcome of December's General Election, at least we have a Government with a majority big enough and stable enough to get its business through Parliament.

We have seen economic growth generally slow down to sluggishness and the manufacturing sector went backwards in the back end of 2019 but not everything has been down to Brexit introspection and infighting. If that were so then the UK would have been a clear laggard when, in fact, it has outperformed many other countries, including near neighbours.

The global situation has been affected by the re-emergence of punitive tariffs as part of the arguments between China and the USA, the two largest economies in the world. Germany and France have teetered on the brink of recession. Italy – great place for holidays, let's not talk about sovereign debt.

Through it all the UK has emerged better than most. We are not out of the woods but the economy has grown and we have seen investment in new factories, technologies and automation that are putting ambitious companies in nearly all sectors in good shape for the decade to come.

In Aerospace the civil sector has record orders. The luxury and leisure end of Marine has had a record year. In Food & Drink, the biggest manufacturing sector, the big story has been the switch to vegan and non-meat products. How long is it since vegetarianism was regarded as very much a minority pursuit?

Institutions and organisations like the Catapults; initiatives like the Faraday Challenge and public investment into UKRI are all positives in pushing forward. Sharing in Growth is helping SME suppliers up their game. We are delighted to have a 10-page feature on the Future of British Manufacturing Initiative, supported by Autodesk, which highlights and encourages drives to digitisation. A new section – Trailblazers – profiles innovative companies that are building on their expertise and taking the risk to try something new.

Preparing this year's UKMR, the 5th edition, has been quite hard labour, but one of love. I am pleased to publicly offer my thanks, and those of publisher Will Stirling, to everyone who helped produce the book – our sponsors, advertisers, contributors, designers and support staff.

There's plenty to read – we hope you enjoy it!

Ruari McCallion
Editor, UK Manufacturing Review 2019/20

We hope you agree that our front cover montage really shows off the richness and diversity of the manufacturing sector in Britain in 2020, including some of the technologies that are used.

Organisations and people featured on the cover montage include:

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MANUFACTURING SECTORS

UK MANUFACTURING REVIEW 19|20

Published by Stirling Media Ltd
Unit 6, Old Smithy Court
80 Station Road
Hampton
TW12 2AX
Tel: +44 0208 617 9517
Produced by Stirling Media Ltd

First published in the UK in 2015

Publisher and Editor-in-Chief

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Copies & Advertising
Publisher: Will Stirling,

Stirling Media Ltd
will@stirlingmedialtd.com

To order copies:
will@stirlingmedialtd.com or call
+44 (0)208 617 9517

ISBN 978-0-9956954-1-4

Printed in the UK by
Geoff Neal Group, Feltham, Middlesex

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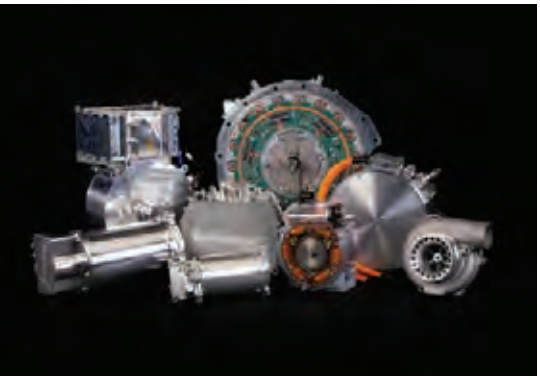
UK Manufacturing Review 2019/20

REGIONS



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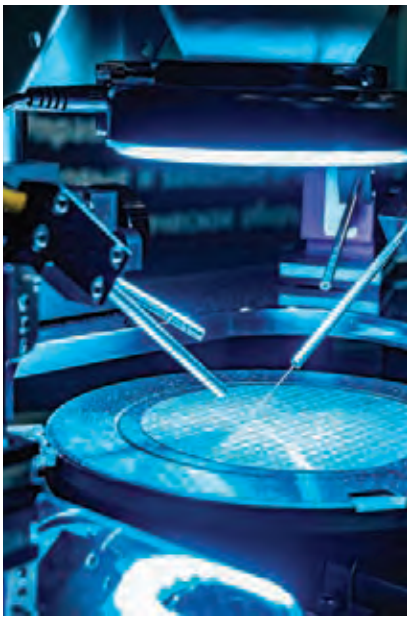

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COLIN ELKINS
GLOBAL INDUSTRY DIRECTOR, MANUFACTURING

Colin is IFS's manufacturing specialist, with over 20 years' experience in ERP software solutions for the sector. He is a key member of the IFS Product Directions Board and plays an instrumental role in the decisions regarding the IFS product strategy.

IFS develops and delivers enterprise software for customers around the world who manufacture and distribute goods, build and maintain assets, and manage service-focused operations.

Technology is driving the manufacturing landscape today. A day doesn't go by without a new angle on digital transformation, robotics, AI, AR, blockchain or IOT being reported or discussed. We are seeing a convergence of technology like never before, connectivity of data and machines creating new and exciting opportunities for the agile manufacturer. Who would have thought that ERP software could remotely orchestrate the activities of robots? Service engineers could be sent to change batteries and empty small remote devices like rodent traps only when required rather than wasted routine service calls? Engineers could be shown how to repair equipment they have never seen before using augmented reality?

Everything in manufacturing must happen faster and differently today, whether that's new products to market, or a faster response to customer requests—technologies like 5G are going to replace the legacy infrastructure in our homes and factories today.

But it's not just technology that's changing, it's also about businesses changing their mindset on how they go to market.

New ways of doing business are developing, business models are changing with servitization, 'coopetition' and 'frenemies' taking centre stage. Who would have thought one year ago that people like Philips would stop selling lightbulbs and start selling light and that Apple, Google and Amazon would join forces to create a single technology standard aimed at smart home products?

And lastly, it's now about the customer, being customer centric, getting closer to understanding their needs and locking them into your brand with a B2B2C strategy. The customer today is also more demanding, wanting proof of sustainability and interrogating your Corporate Social Responsibility before investing or purchasing your products. Who would have thought that CEOs in 5 years would have changed their opinions from 5% of them to 53% of them stating that investing in sustainability is needed for growth, and who could have imagined that we were at a point when the 1862 (celluloid) miracle of plastic would be being questioned and that we would not only consider but actually begin banning single use plastics?

> "IT'S NOT JUST TECHNOLOGY THAT'S CHANGING, IT'S ALSO ABOUT BUSINESSES CHANGING THEIR MINDSET ON HOW THEY GO TO MARKET."

I am pleased that IFS is supporting the 2020 Manufacturing Review and also to be able to share some of the predictions within the market that me and my fellow industry directors have for the year ahead.

Please reach out via email: info@ifs.com if you want to discuss how we could help your business.

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DORRIEN PETERS

Partner and National Head of Manufacturing, Irwin Mitchell

I'm pleased Irwin Mitchell is supporting the 2019/20 UK Manufacturing Review. As a leading UK law firm, we're committed to the manufacturing sector, and although the last 12 months has seen significant disruption, I remain excited about the opportunities that exist.

One of the reasons for this is the huge potential that I believe exists for manufacturers willing to embrace so-called Industry 4.0 technologies.

Our new *'Going Fourth'* study aims to raise understanding about Industry 4.0, and help manufacturers navigate the new data-driven business world to understand the legal issues involved.

The study highlights the different ways Industry 4.0 technologies are being used. Companies have never had so much accurate information about their operations, and have the opportunity to be more productive, efficient, flexible, agile and profitable.

But the report also calls on companies to understand how collecting and having access to more data can increase the risk of breaking the law.

Pooling the experience of a group of in-house experts, specialist lawyers and business leaders from organisations including Siemens and Thales, the report covers a wide range of areas which are explored in greater depth in later sections of the UK Manufacturing Review.

Volume and the cyber threat

According to US tech company DOMO, over 2.5 quintillion bytes of data are created every single day.

Machines in factories are increasingly being connected to and sharing their data with an enterprise systems. But with volume comes risk. There are greater opportunities for cyber criminals to compromise data, and the risk of valuable data leaking or being lost is also rising in proportion to the volume.

Staff monitoring

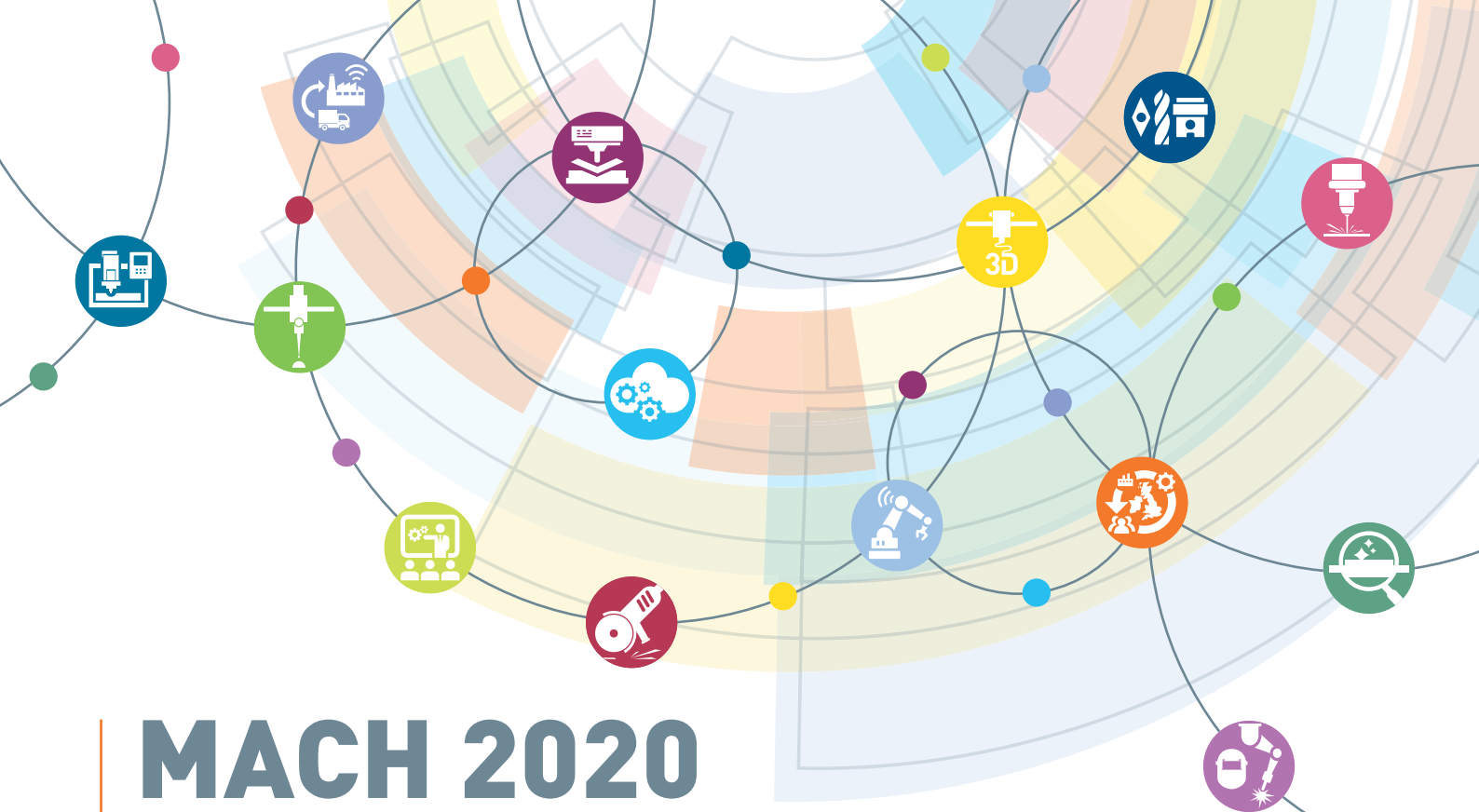
The report also looks at the increasing use of technology to monitor staff and measure productivity. It warns that if this is done without their knowledge to give the employer an advantage, it's a breach of the GDPR. Employers can face huge fines, and must be rigorous in their transparency to avoid this.

Highlighting the increased risk facing manufacturers when it comes to sensitive data and dealing with cyber security threats, the report raises concerns for the sector about the rising trend of cyber attacks on Industrial Control Systems.

Irwin Mitchell's experts also explain how companies that create intellectual property can both capitalise on and be penalised by this change.

Digital transformation is reshaping how organisations do business, driving them to a data-driven world. But there are significant risks and numerous legal issues to be aware of. If the productivity gap is to be bridged, it's imperative that manufacturers get familiar with how data can be used to improve profitability, whilst acknowledging the laws and procedures that will apply as data increasingly dominates how we work.

Hopefully the report will help businesses grappling with these themes. Please feel free take a look at it at irwinmitchell.com, and if you're interested in discussing some of the issues in it, please don't hesitate to get in touch.



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Manufacturing technologies sector prepares for 2020

JAMES SELKA

Chief Executive Officer, MTA

Most manufacturers are unlikely to look back on 2019 with any great fondness, due to uncertainties created by the UK's protracted exit from the EU and tensions in global trade.

James Selka, Chief Executive Officer, MTA

Businesses have been delaying non-essential investment decisions and building cash reserves. At the same time, it is noticeable that manufacturers are paying increasing attention to ensuring they have the skills they need to prosper in future.

So, there is a chequered picture; The market in the UK has held up better than in other parts of Europe. The financial prudence of companies hardly drives their development or the sector's but they may be better prepared for any sharp downturn in business than 12 years ago.

I was struck by the report in June from the Institute for Manufacturing, Inside the Black Box of Manufacturing, commissioned by the Business Department (BEIS). It took forward The True Impact of UK Manufacturing, the landmark report from Oxford Economics, commissioned by the Manufacturing Technologies Association and published 15 months before.

Taken together, these reports make clear the persuasive case for the central role of manufacturing in our economy. This is a key message for the new government and Parliament, especially in an era of technological change, as we seek to ensure that we have the educational system and investment support that will enable industry, and the economy, to thrive.

Also in 2019, the government saw more evidence of the UK's productivity problem.

Manufacturing is a paradox. It's the most innovative sector in both products and processes but the UK lags world leaders in adopting new technology. The Made Smarter North West Pilot this year found that firms themselves want help to improve leadership and management skills.

The pace of innovation is increasing, bringing both challenges and huge opportunities.

2020 sees the return of MACH, the longest-running manufacturing and engineering exhibition in the UK. Despite the current climate, manufacturers have shown unwavering support for the event; nearly all exhibition space has already been taken.

Manufacturing is a paradox. It's the most innovative sector in both products and processes but the UK lags world leaders in adopting new technology.

MACH 2020 will have an unprecedented amount of working machinery on display. Having the latest manufacturing technology solutions available under one roof gives visitors an unrivalled overview of the sector. Manufacturers of whatever size will be able to see how the latest technologies will help improve their productivity and enhance the quality of their products.

Many firms will be looking to invest in themselves, in new machinery, re-tooling, and improving skills levels with new training programmes. As MACH will demonstrate, there is no shortage of options – or sources of finance.

MACH 2020 sponsor Lloyds Bank has pledged additional, fresh funds for the sector. It loaned in excess of £6 billion to manufacturers between 2013 and 2018 and has now committed a further £1 billion per year through to the end of 2020.

The two-year increase in the Annual Investment Allowance from £200,000 to £1 million should also help.

I hope everyone with a stake in the future of the manufacturing industry will take the opportunity to visit MACH 2020 in April and see for themselves what is possible.

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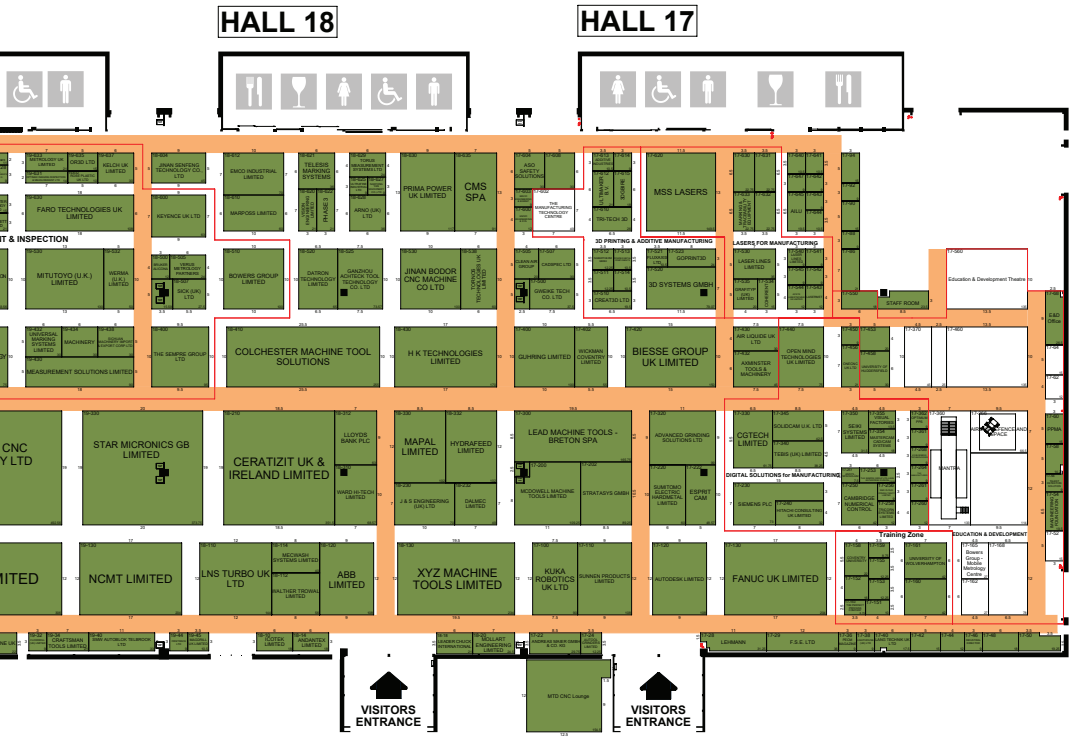

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MANUFACTURERS TAKING THE LEAD ON DIVERSITY

A new survey by the Manufacturing Technologies Association (MTA) and Close Brothers Asset Finance has found manufacturing and engineering firms in the UK are ahead of the curve in embracing diversity in the workplace. *James Selka DL, CEO, Manufacturing Technologies Association*

There have been widespread concerns that manufacturing was lagging the rest of industry when it came to recognising diversity and promoting the benefits of an inclusive workforce. There were fears this was harming the sector's prospects and excluding potential employees, at a time when skills are in short supply.

The new survey dismisses this theory and shows that manufacturing and engineering companies are among the most progressive in the UK when it comes to diversity.

When asked whether they believed that having a diverse workforce - one inclusive of age, faith, ethnicity, gender, sexual orientation and physical ability - was beneficial to a business's financial performance, 77.4% of manufacturing and engineering firms agreed it did. This was higher than the average score (71.3%) of those questioned.

A higher proportion (86.7%) of manufacturing and engineering companies said they did understand what diversity means on a practical level than the average sample score of 81.7%.

When asked if their business was actively working to make its workforce more diverse, 81.9% of manufacturing and engineering companies said yes (average: 71.6%).

When asked whether having a more diverse workforce made a business more attractive to potential employees, 71.9% of manufacturing and engineering companies agreed it did (average: 63.9%).

In spite of the enlightened attitude, the survey shows the sector still has its work cut out attracting new recruits.

- 41.5% of manufacturers and engineering firms said it was difficult to fill existing vacancies, (average: 32.9%)
- 26.7% of manufacturers and engineering firms said they did not get enough interest from minority candidates (ave: 25%).
- 31.9% of manufacturers and engineering companies recruit solely on ability (ave: 42.1%).

The survey responses paint the manufacturing and engineering sector in a very positive light, suggesting companies are adopting enlightened attitudes towards diversity and recruitment.

Evidence suggests that full inclusivity brings economic benefits to a business, boosting the morale of workers, reducing staff turnover and improving productivity.

As the sector looks to reflect society more generally, it is important that no one is ever excluded from the workplace due to age, faith, ethnicity, gender, sexual orientation or physical ability.

WHEN ASKED WHY:		
Reason	Manufacturing & Engineering (%)	Rest of Survey (%)
It is the right thing to do	47.8	43.5
It reflects our customers	23.0	17.0
It reflects our community	11.1	11.1

UK MR SECTORS

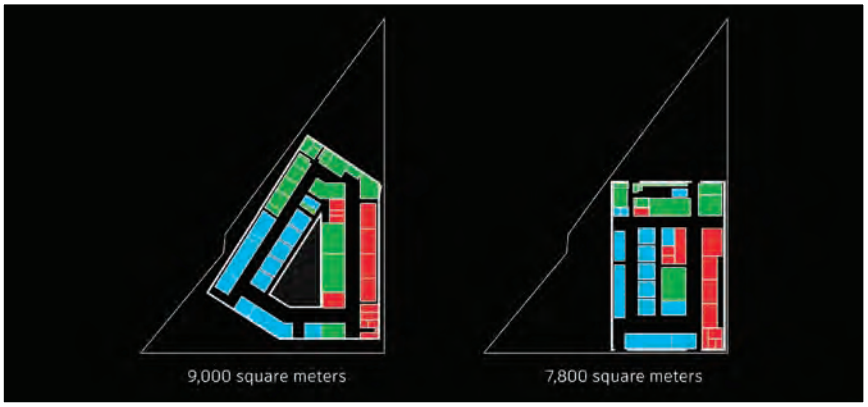
TAKING FLIGHT?

As for many industries, Brexit nervousness hung over the UK aerospace sector for much of 2019.

BY MURDO MORRISON

Early in the year, Tom Enders, the departing chief executive of Airbus, repeated his warning that Europe's biggest aircraft-maker would consider pulling out of the UK – where it designs and builds wings for every Airbus airliner – in the event of a no-deal Brexit. The ADS trade body said uncertainty over Brexit was putting the brakes on investment, including by SMEs, and blamed it for a series of quarterly falls in UK aerospace industrial output starting in 2018.

However, while keeping complex cross-Channel supply chains snaggle-free may be crucial to the prospects of UK aerospace manufacturers, the industry itself remains stubbornly global. Macroeconomic shifts – a reduction in



Left: **Airbus A350 XWB wing assembly at Airbus' Broughton, UK facility. A new design and production hub at Broughton has been preparing carbonfibre wings for trials beginning in 2020.** *Credit: Airbus*

Above: **Computer graphic rendering of Airbus' factory.** *Credit: Autodesk*

China's appetite for airline travel, for instance – together with one-off events, such as the grounding of Boeing's top-selling 737 Max in March after two fatal crashes, and international investment decisions arguably play a much greater role in the fate of UK companies than any Brexit outcome.

Business as usual

The key mergers and acquisitions of 2019 illustrate that borderless nature of the industry. Northern Ireland's biggest industrial employer – the Bombardier aerostructures plant in Belfast – was sold in October to Spirit AeroSystems, a US company that used to be a division of Boeing. The Canadian group had owned the formerly state-owned Shorts for 30 years. The factory's main product is the composite wing for the A220; a small narrowbody airliner designed by Bombardier as the CSeries, now owned and built by Airbus in Quebec and Alabama.

Meanwhile, Cobham, the London-listed aerospace and defence technology firm that bears the name of its founder, pre-war aviation pioneer Sir Alan, and a major supplier to the UK military as well as governments around the world, was cleared for sale to US private equity firm Advent. It follows the purchase of another "crown jewel" of UK aerospace and automotive, GKN, by Melrose Capital in 2018, and a trio of acquisitions in recent years by Chinese investors in UK SMEs in the fast-growing segment of airliner interiors.

EU remains crucial

However, while many of the UK's aerospace and defence assets may be controlled from boardroom tables in Boston or Beijing, that link with Europe remains crucial. Airbus is the UK sector's third-largest employer, after Rolls-Royce and BAE Systems, and one of its biggest direct customers. Its design campus in Bristol and factory in Broughton, North Wales are centres of excellence for wings in a production empire that spans seven countries. And, although it is not Airbus-owned, the soon-to-be Spirit facility in Belfast designed and builds the innovative composite wings for the A220.

Some believe that "right" to remain champion of wing assembly could be threatened by a Brexit that takes the UK

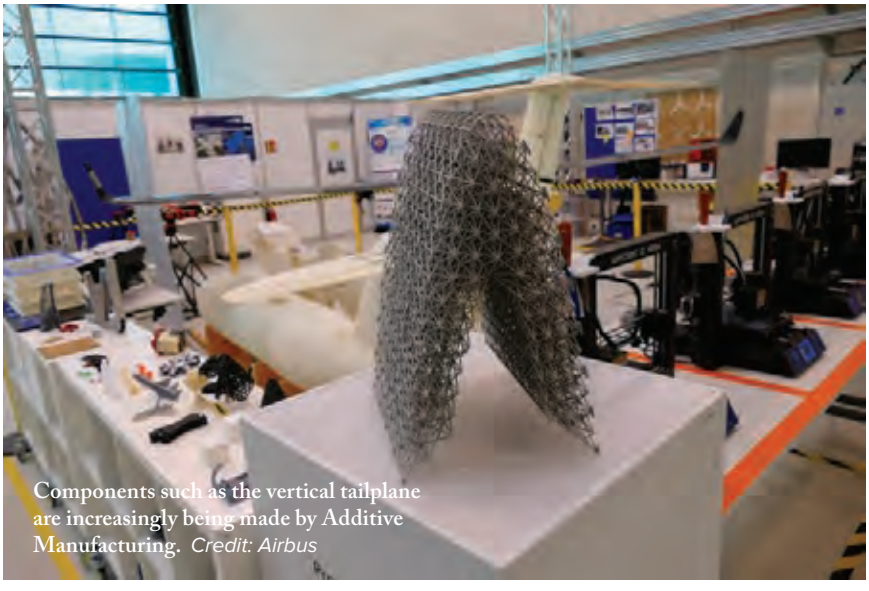
Spirit AeroSystems gained world-leading resin transfer technology and unique status as Airbus' only third-party wing supplier. *Credit: Bombardier*

WING OF TOMORROW

Airbus's facilities in Bristol and Broughton, together with tier one aerostructures players such as GKN and Bombardier Belfast (soon to be Spirit AeroSystems), will be at the forefront of the battle to keep the UK as the aircraft manufacturer's wing centre of excellence. Development work on the Wing of Tomorrow programme stretches down the supply chain. County Down-based Denroy Plastics is taking part in a two-year research agreement with Airbus to design and produce small plastic parts for a prototype composite narrowbody wing.

Chief executive Kevin McNamee says the company (which is also behind a brand of hard-wearing brushes for professional hairdressers) has been a supplier to Airbus for over 20 years.

"Denroy has invested significantly in recent years in developing advanced plastics and composite design and processing capability and we are confident that we can apply this technology to the Wing of Tomorrow programme aimed at creating revolutionary new architectures for carbon wings in order to improve the overall eco-efficiency of Airbus aircraft performance," he says.



Components such as the vertical tailplane are increasingly being made by Additive Manufacturing. *Credit: Airbus*

away from the Customs Union and Single Market. While such an eventuality would be unlikely to impact current programmes, it could be decisive to where the wings are designed and assembled for a future Airbus narrow-body. Such an aircraft – deploying tech-nologies such as new-generation engines, composite wings, and automated production – is likely to be launched in the second half of the 2020s and enter service in the early 2030s, Airbus's new chief executive Guillaume Faury said in November.

Competition: for talent and for production

Airbus units in France, Germany and Spain – and the politicians who lobby for them – are already keen to snatch responsibility for wings from a post-Brexit UK. Bremen designs and builds high-lift systems for all Airbus wings; Stade produces the upper wing shell for the A350 widebody. Plants in Spain have established an expertise in composite structures over several decades. Currently, wing components manufactured in Airbus's facilities on the Continent are shipped to Broughton for final assembly. While Bristol is the centre of expertise for wing design, Airbus itself owns the intellectual property, and bright engineers, generally, are thought of as mobile assets.

Wing of Tomorrow and an Ace in the hole

That is why an Airbus technology demonstrator programme called Wing of Tomorrow is crucial to the UK's chances of remaining in pole position. A new hub at Broughton has been preparing carbonfibre wings for trials beginning in 2020. While composite wings have the benefit of being lighter and more fuel efficient, the challenge will not simply be designing a wing that works, but coming up with a production method able to turn out between 60 and 100 aircraft a month, at a cost comparable with traditional aluminium structures.

An ace up the UK's aerospace sector's sleeve is Belfast. After investing billions of pounds in designing a composite wing for the CSeries and a production hall for it, Bombardier in May announced it was putting the business – with a smaller aerostructures plant in Casablanca – up for sale. The CSeries, a bold attempt to take on the duopoly of Airbus and Boeing, was a gamble that failed for the Canadian company, which was forced to hand the keys (and debts) of the CSeries programme to Airbus for a token sum in 2017. It has been retrenching to its core activities of rail transportation and business jets since.

Raising spirits in Belfast

Spirit will inherit a factory that not only produces the wing for the A220 but owns technology – such as a patented resin transfer-injection process – that could be key to the design of a wing for an all-new larger narrowbody. Belfast is Airbus's only third-party wing shop; it also produces structures for Bombardier corporate jets such as the new, long-range Global 7500 and gives Spirit a direct route into Airbus's first-tier supply base, lessening the Wichita-based company's dependence on former parent Boeing.

Aided by European and UK research funding, the Belfast operation has worked with researchers at Queen's University and local SMEs on resin-injection technologies to create a cluster of competence in composite structures in the province [see box]. Speaking before the sale, Michael Ryan, the Belfast-based chief operating officer of Bombardier's aerostructures business, said that the plant's 40-year know-how in composites puts it in prime position to win a major role in any future Airbus wing programme. "This is an opportunity we need to grab," he noted.

THE END OF THE A380

The quiet, roomy, comfortable A380 is an airliner more loved by passengers than its operators, most of whom have struggled to make the four-engined, 550-seater deliver on its economics on all but a handful of routes. The final delivery of the double-deck "superjumbo" will be in 2021, although the last 845m2 wing will depart Broughton on its long journey by barge and road to Toulouse some time in 2020, ending a 14-year production run for the largest and most complex aircraft wing ever designed. It will leave the A380 wing assembly building redundant, although demand from Airbus for its other programmes means another use will fast be found for the space and staff.

Below: **Airbus' A380 superjumbo jetliner was popular with passengers who flew on them but unfortunately there weren't enough of them. The programme has been cancelled and the last A350 wing will leave Broughton in 2020.** *Credit: Airbus*

"Aided by European and UK research funding, the Belfast operation has worked with researchers at Queen's University and local SMEs on resin-injection technologies to create a cluster of competence in composite structures in the province"

Airbus benefitting from Boeing's ill wind...

The grounding of the 737 Max 9 has been near-catastrophic for Boeing, in terms of lost revenues, potential compensation claims from airlines, and reputation. While this has had an effect on Boeing's global supply chain, including in the UK, a beneficiary has been Airbus. Its rival A320neo overtook the Boeing 737 in terms of total orders in 2019, despite a 20-year head-start for the Americans. The original version of the Boeing narrowbody emerged in the mid-1960s, two decades before its European competitor.

Before the Max crisis, both Airbus and Boeing had been pushing monthly production of their single-aisle families towards "rate 60" by the early 2020s. This unprecedented output has been

Team Tempest Future Combat Aircraft System concept.

Credit: BAE Systems

On the military side, the Tempest, a "sixth generation" fighter study announced by the government in 2018 and intended to be fielded by 2040, is the great hope for UK industry

driven largely by demand by emerging airlines in Asia, but also from carriers keen to replace legacy 737s and A320s with the more modern, fuel-efficient Max and Neo variants, which comes with CFM International LEAP engines in the case of Boeing, or a choice between LEAP and geared-turbofans from Pratt & Whitney in Airbus's.

While Max orders have slowed to a trickle, and production been scaled back with Boeing unable to deliver finished aircraft, Airbus has continued to crank up. It delivered its 1000th example of the Neo in October, although it has been limited in its ability to scale up faster by an already straining supply chain. With Boeing's 777X successor to its successful 777-300ER widebody delayed, Airbus's competing A350 XWB is also benefiting and the A220 has begun to attract more interest than under Bombardier, helped by Airbus's ability to offer deeper discounts.

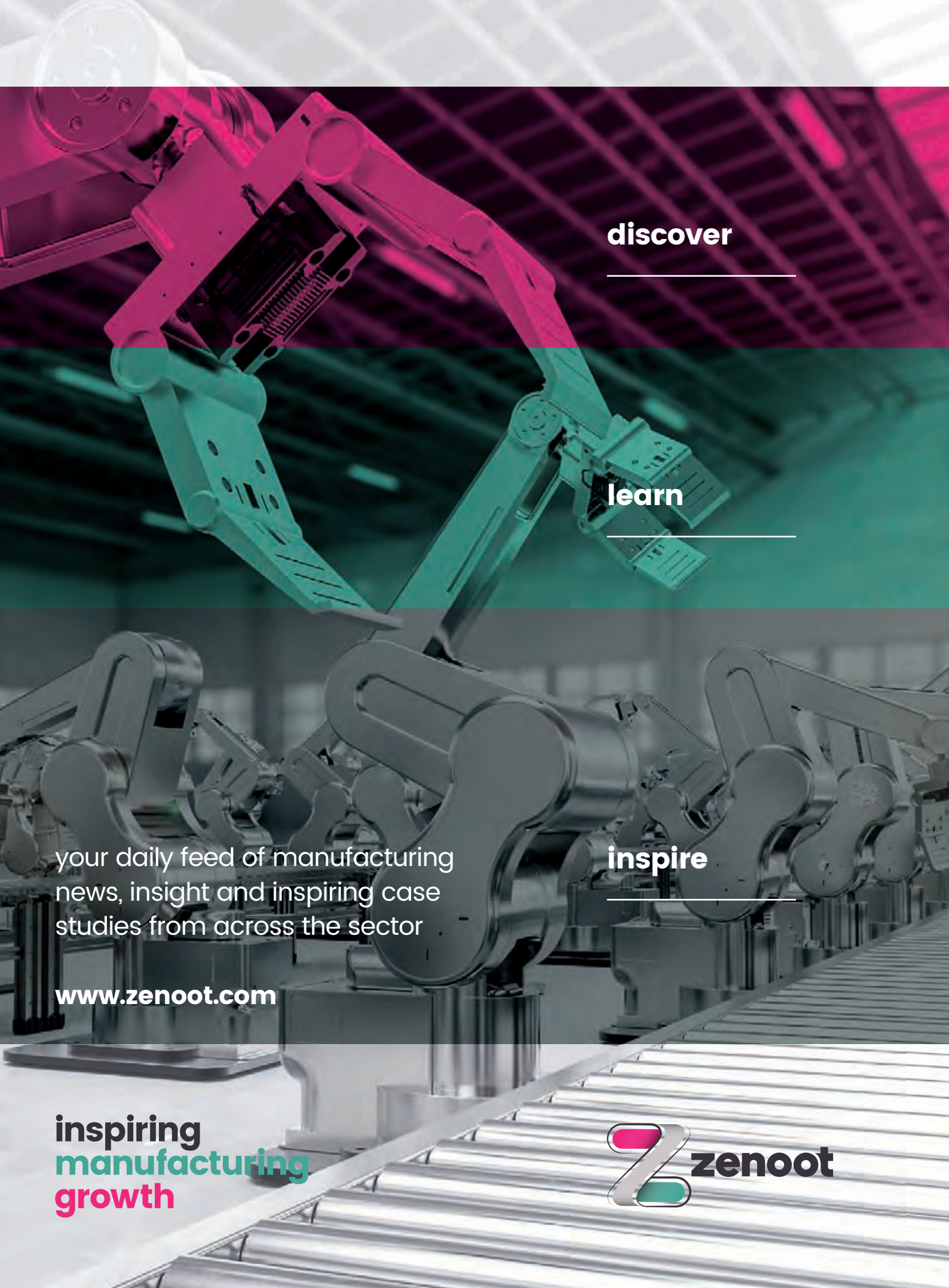
...but challenges remain

The downsides for Airbus have been its slow-selling A330neo (a re-engined version of its small widebody that competes with the popular Boeing 787 Dreamliner) and, of course, the A380. Dubai-based Emirates had been single-handedly keeping production of the world's largest airliner alive after a small flurry of orders in its early years from the likes of Singapore Airlines and Air France dried up but in January the board in Toulouse gave up the fight and cancelled the programme, after Emirates agreed to transfer most of its outstanding orders to the A350.

Tempest fugit

On the military side, the Tempest, a "sixth generation" fighter study announced by the government in 2018 and intended to be fielded by 2040, is the great hope for UK industry as programmes such as the four-nation Eurofighter Typhoon and BAE Systems Hawk jet trainer near the end of their production life. The UK was this year joined as a partner by Italy and its defence industry champions. It followed a decision by France, Germany and Spain to cooperate on a future European fighter to take on the mantle from the Typhoon and France's Dassault Rafale.

Team Tempest – the UK industrial grouping behind the project – will present a business case to the government in 2020 to kick-start the next stage of development. And while 2040 might seem like a long way off, fighter aircraft programmes can sustain a nation's skills base and thousands of highly-paid jobs for a generation or more. Politicans love them not just for domestic security, export, and prestige reasons, but because they are less transferable than their commercial aviation equivalents. While Airbus wing production could be shipped to Germany or even around the world, defence programmes are for keeps, with the IP a jealously-protected national asset.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Sharing in Growth CEO Andy Page

DRIVING THE PRODUCTIVITY OF UK AEROSPACE TO COMPETE GLOBALLY

The UK is enjoying a period of high employment that is, in part, the result of weak productivity. Growing the economy will require greater industrial investment and a growth in higher value jobs.

Aerospace provides a rich stream of opportunity, stimulating research and technology, capital investment, export and highly rewarding employment.

But the UK aerospace supply chain is losing market share to other countries at the rate of about £8 billion every ten years. Primes have long sourced in an international market, selecting from the most competitive and capable suppliers. They have also consolidated their supply chains to work with larger companies, who have the economy of scale and critical mass to invest and absorb risk.

Rocket fuel for receptive leaders

So, when Sharing in Growth (SiG) was established in 2013 as a four year, £250M programme of intensive business transformation, its focus was on creating highly competitive companies to fulfil mid-size aspirations in aerospace and advanced engineering. Rocket fuel for receptive leaders, the programme is delivered on site to maximise context and impact, with the typical activities focusing on leadership, culture, lean operations, manufacturing capability and sales.

An undeniable success, SiG has supported more than 60 companies, with some 10,000 employees, and helped them secure well over £4 billion in contracts, two years ahead of schedule. This is equivalent to over 7,000 jobs so SiG is on target to safeguard 10,000 UK aerospace jobs by 2020. As a result, the government has provided additional funding, bringing the total public funding to £86 million and allowing new companies to join. Furthermore, SiG is now working with the Offshore Wind Growth Partnership to develop the competitiveness of that sector's supply chain.

"The scale and not-for-profit structure of our Sharing in Growth programme has delivered significant value for public money," said CEO Andy Page. "More importantly, it has adopted blue chip approaches from frontier companies like Rolls-Royce and Toyota, and shared and applied them in a wider community of ambitious companies. These practices help increase their profits so they can invest more in people, technology and capital, to move up the value chain and win a larger global market share."

Sharing in Growth lighthouse cell

The programme's 80 business coaches, supplemented by a bank of world-leading experts including Deloitte, IfM and NPL, help companies tackle their individually-diagnosed barriers to growth and, for many, double their turnover and remove 20% of costs.

DEVELOPING HIGHLY VALUED MANUFACTURING FOR THIS GENERATION AND THE NEXT

Companies on the Sharing in Growth programme are growing three times faster than their peers

On target to safeguard 10,000 UK jobs by 2020

What is Sharing in Growth?

- An industry-led supply chain competitiveness programme funded by government.

Who are Sharing in Growth?

- Experts with more than 2,000 years of industry experience
- Part of the Aerospace Growth Partnership and endorsed by Airbus, BAE Systems, Boeing, Bombardier, GE, GKN, Leonardo, Lockheed Martin, MBDA, Rolls-Royce, Safran and Thales
- A not-for-profit organisation specifically created to deliver benefit.
- And chosen to develop a pilot productivity programme for the off-shore wind supply chain

How is SiG Funded?

- SiG has attracted more than £150 million in private investment and £86 million in public funding
- Participating companies are expected to commit time rather than pay for the training costs – the participating companies' commitment comes from their time, not their cash.

Who has benefited?

- More than 60 companies, with a total workforce of around 10,000

How to judge programme success?

- More than £4.4 billion in contracts have been secured by companies on the programme, equivalent to 7400 jobs or around 40,000 man-years' work.

"The sustained support provided by Sharing in Growth is creating an environment in which companies throughout the supply chain can thrive."

Paul Everitt, CEO, ADS Group

What is the scale of the programme?

- More than 3 million training hours have been delivered.
- Raising companies' productivity and competitiveness to compete in an international market.

Is it on target?

- On target to safeguard 10,000 UK jobs by 2020 and to secure more than £6 billion in contracts, securing over 70,000 man-years of work.

What is the return on investment?

- Companies on the Sharing in Growth programme are delivering a growth rate that is over three times their peer group average
- Every £1 of government investment in Sharing in Growth secures £60 of GVA.

How can my company benefit?

- Ambitious aerospace suppliers with at least £10 million in sales turnover should visit: www.sig-uk.org/apply.

SHARING IN GROWTH BENEFICIARY COMPANIES

GOOCH & HOUSEGO LTD - ILMINSTER
SIGMATEX LIMITED
PRODUMAX
ROCKFORD
SOUTHWEST METAL FINISHING
AMPHENOL INVOTEC LTD
MB AEROSPACE NEWTON ABBOT
TMD TECHNOLOGIES
GOOCH & HOUSEGO LTD - GLENROTHES
JJ CHURCHILL LTD
SENIOR AEROSPACE BIRD BELLOWS
GOOCH & HOUSEGO LTD - TORQUAY
POETON INDUSTRIES
WINBRO GROUP TECHNOLOGIES
WALKER PRECISION ENGINEERING LTD
HYDE AERO PRODUCTS - SPECIAL PROCESSES
AEROMET INTERNATIONAL LTD
GENTEX EUROPE
MIDDLESEX GROUP LTD
SENIOR AEROSPACE BWT
CASTLE PRECISION ENGINEERING LTD
SAFRAN HELICOPTER ENGINES UK LTD
STANDARDAERO - ALMONDBANK
FERRANTI TECHNOLOGIES
CARPENTER ADDITIVE - LIVERPOOL
AMFAX
CW FLETCHER & SONS LTD
STANDARDAERO - FLEETLANDS
AEROSPACE TOOLING LTD
OXLEY DEVELOPMENTS CO LTD
SL ENGINEERING LTD
MARTIN AEROSPACE LTD
THOMPSON AERO SEATING
INDEPENDENT FORGINGS & ALLOYS LTD
CRANFIELD AEROSPACE SOLUTIONS
NEMCO LIMITED
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SIGMA COMPONENTS LTD - FARNBOROUGH
ELE ADVANCED TECHNOLOGIES
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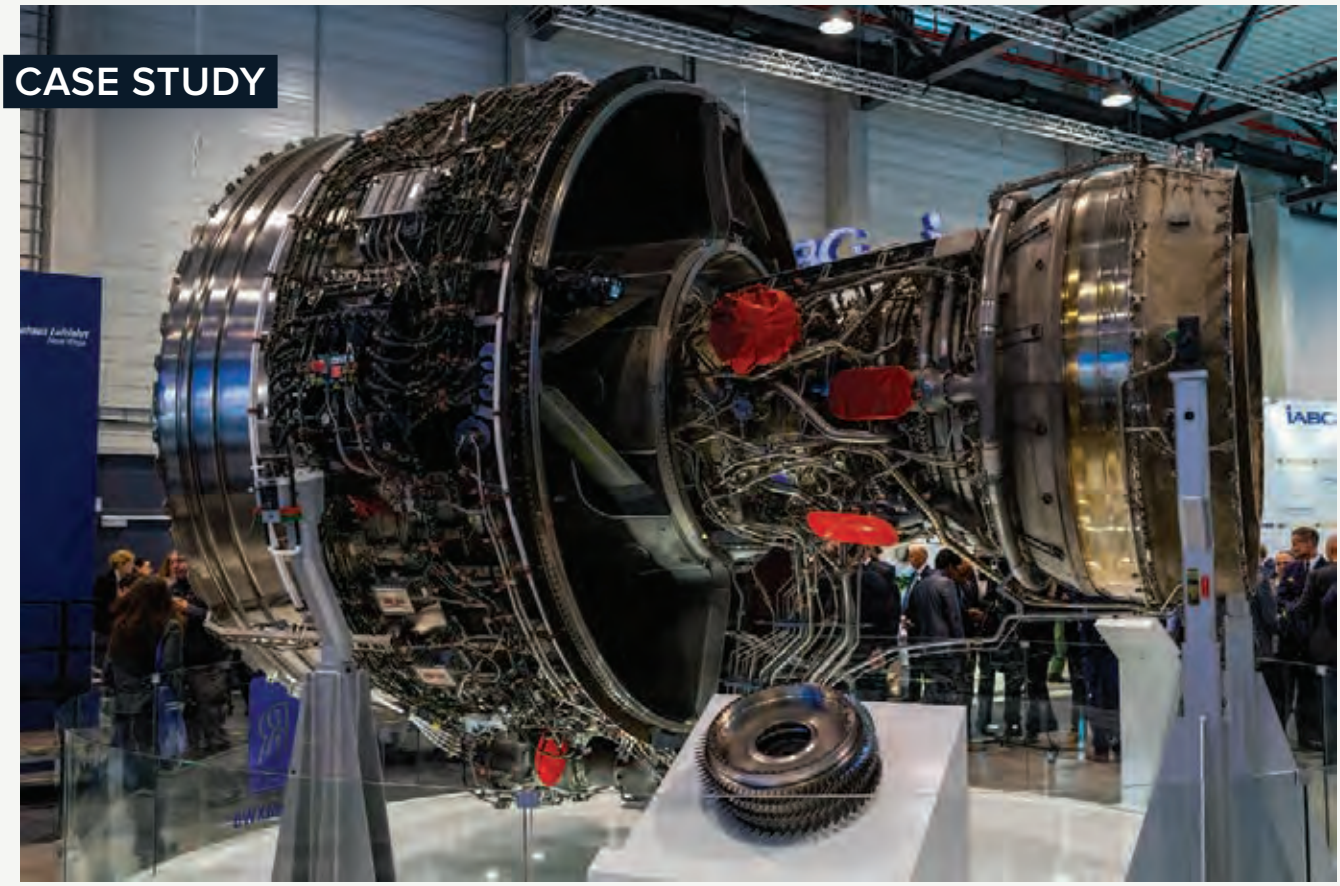
CASE STUDY



FROM CAPABLE MACHINING COMPANY TO INTERNATIONAL STRATEGIC SUPPLY PARTNER

When Castle Precision Engineering secured an £80 million order from Rolls-Royce to supply them with parts for the Trent series engines, this major long-term agreement was a record milestone for the Glasgow-based family firm.

It also marked Castle's successful transition from a capable machining company to an international strategic supply partner of critical rotating parts for aero engines.

Back in 2013, the company was struggling to compete against low-cost sources and remain relevant in an increasingly global marketplace as clients sought newer and cheaper solutions.

So, Castle joined the Sharing in Growth (SiG) productivity and competitiveness programme and has consequently completely revamped its leadership and culture, changed its technical and business processes, reduced costs and fostered strong customer relationships. Through SiG's innovative practices, Castle has developed a sustainable growth strategy and sees an average annual turnover of £20m.

First steps

Starting with a comprehensive business-wide diagnostic, the programme focussed on several key strategic themes including: planning and forecasting, operational excellence and business growth and pipeline. These themes then led to detailed plans to oversee a total business transformation.

One of the most visible impacts is a series of production cells introduced as part of an ambitious major investment. The Castle team streamlined current production and improved performance to create shop-floor space for three significant new projects. A four-year £7 million investment programme is underway, covering building, infrastructure and equipment, to completely transform the factory floor and introduce the latest production technology.

Sharing in Growth operations executive Malcolm James coaching at Castle Engineering STAR Day April 2019

Castle has invested in building, infrastructure and equipment.

One example is a dedicated high-performance production cell for a defence system going into UK and international customers. This major volume project raised huge challenges such as an initial 50% increase in productivity compared with previous operating levels.

"Lighthouse" teams illuminate waste

To make this promise a reality, the company began by breaking down the project's scope, visualising the production process, mapping out resources and ultimately identifying areas that consumed the most labour time. In doing so the company realised that there was significant manual intervention at various stages of the process – interventions that, with the right solutions, could be eliminated.

So, Castle tasked a dedicated cross-functional lighthouse cell team, comprised of manufacturing engineers, quality engineers, production leaders and machine operators, to work the project and optimise the flow in conjunction with the on-site SiG team and the programme training. This 'lighthouse' approach has been successfully implemented in many Sharing in Growth beneficiaries. Employees are trained and supported to tackle a major challenge so that they gain confidence and can apply what they have learned in other areas. This helps create sustainable learning and skills.

Castle's team was given the freedom to dictate the layout of the machines, their positioning, and ultimately how the process was going to function including 'lights out running'. Visual management, lean production system and rate boards have been introduced to manage whether machines are on target and, if not, the company can halt production to escalate and get back on track.

Not to be outdone, on another cell project, Castle managed to deliver a £2.4m cost saving which the company returned to the customer as price reductions, a strategic decision that allowed Castle to increase its position as a key supplier and competitor in the market.

Above Left: Rolls-Royce CEO Warren East congratulates Castle Precision Engineering Managing Director Yan Tiefenbrun.

Above: Sharing in Growth coach Jim Houston with Yan Tiefenbrun

Cross-functional teams deliver

The company has seen its best results when actively involving cross-functional teams in every step of the process; indeed, Castle has seen its employee engagement rise as high as 96% when getting this formula right.

> "Castle managed to deliver a £2.4m cost saving, which the company returned to the customer as price reductions"

The lighthouse cell team delivered the operational improvements that allowed Castle to win the business and save its customers time and money: reducing cycle times by a further 10-15% on top of the original 50% committed and lowering operators required in the cell from ten to six across two shifts. With ideas and deployment coming from the cross-functional team, the senior leadership has been freed up to focus on higher value tasks – like what's next!

Over the next year the business will ramp in three further new production cells, onboarding a further major customer securing business and new jobs for the local area.

Said Castle's managing director Yan Tiefenbrun: "Other countries and their governments are absolutely determined to take a larger market share. They've got their tactics and we've got Sharing in Growth."

PEOPLE FOCUS TO DOUBLE TURNOVER

In order to grow, companies need to invest in their people, technology and capital. Investing in people can be difficult to justify in terms of returns. However, without the commitment and skills of an engaged workforce, there is little point in ploughing money into a new factory or the latest equipment.

Sharing in Growth experts have supported many companies to deliver huge improvements in productivity and competitiveness by ensuring development of people plays a significant role in their growth strategies.

Cumbria-based Oxley Group has a proud 77-year history of family-led innovation and self-sufficiency. Oxley were highly innovative in doing everything in-house – from design to manufacturing and test.

The company had won a strong international customer base, by predominantly providing electronic solutions for the defence and aerospace industry. But, eventually, self-sufficiency led to a silo culture, static turnover and low profit.

Strategy to double and treble turnover

In 2018 Oxley applied to join the Sharing in Growth (SiG) productivity and competitiveness programme and set a target of doubling turnover in five years, and trebling it in ten years.

To deploy its innovative new strategy, the company used Sharing in Growth's X-matrix, underpinned by robust monitoring, a control and reporting system and a complete overhaul of employee engagement.

The company created a vision designed to both deliver for customers and engage staff: Empowering our people to deliver success together. The POW of empowering was used to brand all employee communications with each letter having significance - P: people, productive and performance; O: ownership, optimise and originality; and W: winners, world class and wholehearted.

Engagement and empowerment

Without a huge local talent pool, Oxley needed to engage and develop its team to contribute to Oxley's success. A SiG employee engagement survey found that recognition, communication and personal development were raised as issues, so a communication team was formed to lead changes, the majority of which were delivered within months. The organisation structure was also

Buddy checks in place to create a no fault forward environment

Workstations designed for specific valued added activity

Team activities such as fund raisers and recognition events tackle silo working

reviewed; life insurance, sick pay, holiday hours, and bonus pay were standardised and enhanced; and a new skills matrix and personal development plans were introduced, aligned to the company objectives.

To focus everyone on the customer, Oxley introduced a new customer relationship management system and a business development information centre to help win new business.

Team activities were organised such as fund raisers and recognition events to tackle silo working and, faced with a skills shortage as experienced staff reached retirement, Oxley renewed their apprenticeship scheme and ran community programmes to encourage young people and women into engineering careers.

To help build capacity for volume production and increase continuous improvement skills, a Sharing in Growth 'lighthouse cell' was introduced to implement world-class standards so they could be well-understood before being rolled out across other areas.

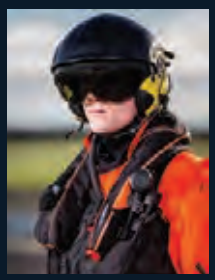
After one year on the Sharing in Growth programme the group has improved turnover by more than £4 million to a record £17.8 million, won recognition in local and electronics industry awards and been awarded a 2019 Sharing in Growth Inspire Award for best practice.

PROFITABLE GROWTH TO INVEST IN PEOPLE

A wholly-owned subsidiary of the US-based Gentex Corporation, Gentex Europe designs, engineers and services specialist helmets, respiratory, hearing and eye protection, and advanced communication products for aerospace, industrial, defence, and emergency services sectors

In 2016, sales and profits had dropped and they were struggling to fulfil requirements, such as on their highly prestigious Joint Strike Fighter helmets.

So Gentex Europe joined the SiG programme. To grow profitably and sustainably, Gentex needed to focus on their people and on creating a talent pipeline. They needed SiG's help to make the productivity and supply chain improvements which could fund investment in their people.



With SIG support, Gentex focused on key areas to enable profitable growth.

Innovation

A New Product Introduction process was defined to allow design concepts for the Pureflo 3000 range of innovative all in-one-respiratory, head, face, eye and hearing protection systems to be brought to market ahead of competitors.

A lighthouse cell was implemented, where the team rigorously applied lean principles to reduce production costs by 20%. Output doubled output to meet growing demand with 98% On Time Delivery. This supported sales by creating reliable supply at short lead-times and competitive product cost.

SiG also supported a new supply chain commodity strategy, where key vendors were selected as strategic partners for each commodity, which cut annual spend by £200k, with reduced transactions and inventory.

The resulting improvements in productivity, turnover and profit allowed Gentex to reinvest significantly in their workforce in 2019 via a package of wage increases, pension enhancements and a pay structure more closely reflecting employees' skills and contribution.

In 2018, Gentex Europe achieved £15.4m turnover – up from £12 million in 2016 and the highest in the company's history – and projects a £17.1m turnover in 2019. Their aim is to double their turnover and profit by 2021.

ELECTRIC DREAMS

After two decades of growth and expansion, the UK's auto industry faced a tough year in 2019. 2020 will see some uncertainties persist and the continued rise of electric and hybrid vehicles.

David Bailey Professor of Business Economics at Birmingham Business School.

It was a turbulent year for UK automotive.

The year started with a slew of bad news. Jaguar Land Rover announced that it would shed up to 4500 workers on top of the 1400 lost in 2018. The news came as a major blow and showed the scale of the challenges that JLR faced.

Like much of auto industry, JLR faced a 'triple whammy' of declining sales in China, as the world's largest car market contracted after 20 years of breakneck growth; a massive shift away from diesels across Europe in the wake of the VW 'Dieselgate' scandal; and Brexit uncertainty slowing the UK market and investment.

Bad news kept rolling in with confirmation that Honda was shutting its Swindon plant and Ford its Bridgend plant, while Nissan reversed its decision to build the XTrail model at Sunderland from 2020.

Both output and sales fell through the year. Sales had fallen by 2.7% through to December and output by 14.4% through to October.

Diesel's decline

Diesels again took a bashing in 2019, with sales down by another 27% through

Ford confirmed that its Bridgend plant, which had only recently started production of the 1.5ltr version of the Dragon engine, would close.

Jaguar's i-Pace ev accounted for more than 10% of Jaguar sales in 2019.

Credit: JaguarLandRover

to November, after hefty falls in 2017 and 2018. By the latter part of the year, diesels accounted for a UK market share below 24%, down from over 50% back in 2015, with a similar ongoing collapse across much of Europe.

There's little sign of this decline coming to an end. Post 'dieselgate', consumers are turned off by tighter regulation in cities, new tax rates on diesels, lower resale values, tighter 'real world' testing and the rising costs of new diesel technology needed to meet regulations.

While the industry has criticised the confused stance of government, the industry itself is still failing to get over a convincing message on which diesels are clean. Consumers have not surprisingly turned away.

Expect the collapse to continue; diesel's share could be below 15% by 2025, especially as electric and hybrid cars take off.

Electrifying news

Alternatively fuelled vehicles are very much on the rise, taking over 10% of the UK new car market in recent months. Plug-in battery electric and hybrid car sales continue to grow rapidly, albeit from a low level; hybrids are increasingly seen as mainstream, as seen in the latest Range Rover Evoque, for example.

Amidst the general gloom prevailing in the industry it was heartening to see JLR's heavy investment at Castle Bromwich to make the new electric XJ model, as well as investment in battery assembly at Hams Hall.

JLR's electric investment came hot on the heels of its successful foray into electric car production with its award winning i-Pace model; it made up over 10% of Jaguar brand sales in recent months.

While EVs are on the up, the UK is lagging in terms of take-up as compared with some other EU countries. Reductions to subsidies for buying EVs and a patchy charging infrastructure haven't helped, although a cut in Benefit-in-Kind tax rates should spur corporate EV take-up in 2020.

A much more holistic policy approach is needed to help the industry, according to Steve Turner, Assistant General Secretary at Unite the Union.

"We need a much more ambitious policy approach to drive electrification and EV take up, covering technology, skills, the supply chain as well as infrastructure and incentives to drive low carbon vehicles," he says. "There needs to be a much clearer destination of travel and a long-term commitment to make the switch. Messing around with tax rates and cutting subsidies for EVs really hasn't helped. That needs to change".

Nissan confirmed that the next-generation X-Trail would not be built at its Sunderland plant. Photo shows the production line in St Petersburg, Russia.

Credit: Nissan Motors

Above: Brunel University's BCAST Advanced Metal Processing Centre is collaborating with a number of auto manufacturers in research & development of sustainable vehicles, using new and upgraded metal alloys.

More collaboration likely

Along with much of the industry, JLR faces higher research and development costs going forward as transport transforms towards autonomous, connected and electric vehicles. The global industry is facing squeezed profits because of these higher costs.

Not surprisingly, JLR announced a long-term collaboration with BMW. The partnership, initially focusing on new electric motor technology, has been extended into combustion engine development, with rumours of platform sharing to develop smaller model. This all makes sense given the heavy investment in new technologies needed as the industry shifts over to EVs.

Indeed, when even giants like VW and Ford are having to team up to develop new electric cars, one wonders for how long JLR can continue to go it alone. Expect more partnerships and tie-ups going forward.

"A greater effort to reduce the carbon footprint of the automotive industry has driven greater innovation in terms of the design, sustainability and manufacture of vehicles. Legislation to help facilitate the roll out of hybrid and electric vehicles has been a key component of this," Stuart Young, Chair of the Automotive Group at Gowling WLG notes.

"While the future is getting harder to predict, the industry's efforts to adapt to fast-changing customer needs, and wider environmental requirements, is a key component of its future survival and ability to weather the storm. Global collaboration, as well as competition, is at the heart of this, as automotive manufacturers focus more heavily on the three pillars of customer satisfaction where automotive is concerned: innovation, digitisation and automation.

DBX production starts

It was a similar story at Aston Martin, where the firm has developed increasingly close links with Daimler to use components and engines, as in Aston's foray into the crossover market with the new DBX, which is now in production. The car is critical for the firm's future and could double Aston's annual output and sales.


Credit: SMMT

Right: The future of Vauxhall's Ellesmere Port plant remains uncertain.

In so doing it may buy the firm more time as an independent player after a disastrous IPO in late 2018 and recent losses. That in turn may encourage new investors to back the firm. Whether the firm can survive longer term remains the big question, though.

Brexit Blues

Investments by JLR and Aston Martin stood out as positive stories while auto industry investment more generally stalled amidst Brexit uncertainty over the nature of the future trading relationship with the EU.

"Brexit uncertainty has had a chilling effect on investment in the sector," reflects Professor Alex De Ruyter at the Centre for Brexit Studies, who has been surveying auto firms in the West Midlands.

It also had an impact on output. Most recently, auto assemblers including Jaguar Land Rover, Toyota and BMW shut down assembly operations in October to avoid disruption around the time of the UK's scheduled departure from the EU. It was the second time in 2019 that car firms in the UK had to shut down for this reason.

Back in April, much of the UK car industry was idled in anticipation of the original end-of-March Brexit deadline. Firms brought forward planned maintenance shutdowns and took extended breaks in an effort to mitigate the cost of disruption. Output fell by 45% in April, compared with a year earlier.

JLR's Chief Exec Ralf Speth said the firm had no choice but to stop production lines at its four UK plants (Solihull, Castle Bromwich, Wolverhampton and Halewood), stating that the firm needed 20 million parts a day; every part had to be available when needed and just in time.


JLR CEO Ralf Speth

"Investments by JLR and Aston Martin stood out as positive stories while auto industry investment more generally stalled amidst Brexit uncertainty over the nature of the future trading relationship with the EU."

The latter point illustrates the vulnerability of automotive manufacturing that relies on 'Just in Time' (JIT) supply chains to customs delays and supply chain disruption. Essentially, customs delays under a No-Deal Brexit would throw a big spanner in the works of JIT systems commonly used across UK and EU manufacturing.

Trade Deal Essential

The Tories' overwhelming General Election win means that the UK will leave the EU on 31st January 2020 and enter into a transition phase. While Johnson campaigned on the slogan 'Get Brexit Done', exactly what form of Brexit he wants remains unclear as a trade deal still needs to be struck with the EU, and quickly.

There is still the risk of a No Deal exit at the end of 2020, if a trade deal hasn't been agreed or the transition phase extended. Peugeot has already stated bluntly that No Deal would mean no investment at Vauxhall at Ellesmere Port (the current Astra model is due to be replaced in 2021).

Ian Henry at AutoAnalysis has crunched the figures in terms of how a No Deal Brexit would impact.

"A hard Brexit, switching to WTO terms, would add around £3bn a year to the vehicle manufacturing sector's costs through tariffs alone, with additional non-tariff barrier costs on top. That is unsustainable in the long run," he said. "It is questionable what the government can do to mitigate these tariffs without falling foul of "level playing field" provisions.

"A hard Brexit would also make the case for long term production in the UK for EU highly questionable for most vehicle plants. I would expect at least 1.5m vehicles would be lost from UK production over a five-year period from when the hard Brexit began."

All of which means that exiting the EU in an orderly way with a trade deal and minimal trade friction beyond the transition period remains vital for the British auto industry. No Deal at the end of 2020 would be damaging to output, jobs and investment, just at a time when the industry is investing heavily in the shift towards electric and - in the longer term - autonomous cars.

AUTOMATION IS THE KEY TO RIGHT FIRST TIME PARTS

MSP's innovative software cuts cycle times and ensures parts are made faster, more accurately, and with less waste.

Manufacturers of complex, expensive and critical components will usually find that their parts are not perfect after they have been machined and taken off the machine tool. MSP strives to help manufacturers get the performance and quality improvements they expect from their existing capital assets, by removing the manual production processes that can affect part quality. Their mission is to identify any errors that will occur when machining, before any metal is cut.

"MSP helps companies collect critical machine and alignment data, analyse it efficiently and understand how to apply the findings to fix any production problems before they start machining," says Peter Hammond, co-founder and Technical Director of MSP. "We provide a guarantee to our customers that their machine tool is capable of making parts within tolerance and that the alignment control in the finishing process will produce 100% accurate parts, 100% of the time".

It's a bold claim, but MSP is prepared to go further and say that its software and expertise helps customers save millions of pounds in costs and material, and days in production time. "Machining parts when the machine is not in a fit state, the part alignment is incorrect or when the condition of supply is unknown is a waste of time and resources and will most certainly result in concessions and scrapped parts," explains Peter. "Our system makes the entire process automated which means that parts can be setup in the same time it takes to run a probing program".

Automation you can trust

MSP delivers and installs automated software and hardware onto customers' machine tools. With MSP's support, customers ultimately trust their machine tools well enough to automatically fixture a part, press 'Cycle Start', and be confident that their part will be machined accurately.

MSP has now extended its expertise into the manufacture of additive parts. Machining problems can lead to significant cost implications, especially when using expensive materials such as titanium or Inconel. Additive manufacturing (AM), also known as 3D printing, of parts rapidly produces 'near net' parts but is also not problem-free. "Machining of preformed parts is very difficult because of the very thing that gives AM its advantage over traditional parts: the absence of excess material," says Hammond. "AM part tolerances are incredibly tight; and perfectly good parts can end up being scrapped because of machine error or a manual misalignment."

"Using our systems, both subtractive and additive manufacturers can be assured of perfect parts, every time".

ACCELERATING F1: MACHINING PARTS IN 93% LESS TIME

A leading Formula 1 team was suffering from long setup times before machining complex aero components, such as the nose cone or front wing.

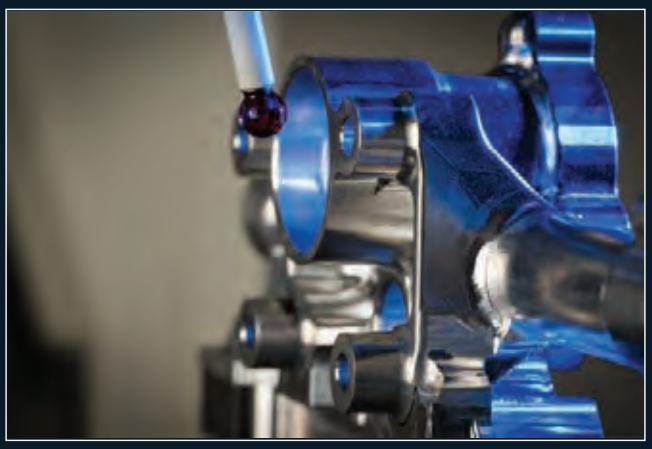
The existing probing process was manual and time-consuming, with handwritten results collated and emailed to the designer for approval, before any machining took place.

MSP's NC-Checker enabled operators to identify and remove errors on the machine to boost accuracy. The software's benchmark reports keep track of machine capability allowing them to schedule maintenance only when necessary.

NC-PerfectPart automated their part setup by automatically aligning the machine to the part and, in turn, completely eliminated the need to move the part around to the correct position. This reduced the setup time from 10 hours to only 38 minutes.

The software's Pre-Machining Verification report was also able to confirm the alignment was valid and the part would be machined within tolerance, making it impossible to machine a bad part.

In such a fast-paced sport where every second is vital and chassis production is restricted, right first time accuracy is crucial.



Right: **MSP's NC-PerfectPart automated part setup and cut setup time from 10 hours to just 38 minutes.**

100% PRODUCTIVITY IMPROVEMENT FOR INDUSTRIAL GAS TURBINES

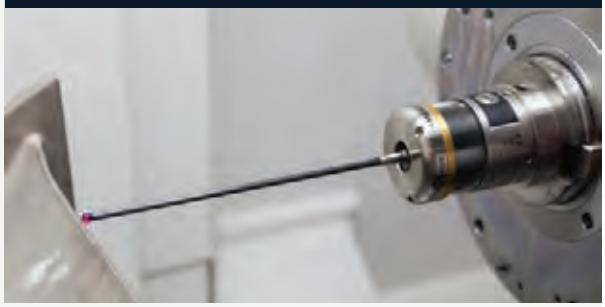
Doncasters Precision Castings – Deritend manufactures investment cast and machined industrial gas turbine airfoils, which are made from nickel and cobalt-based superalloys.

The company sought to improve right-first-time machining rates, eliminate errors, cut costly hard fixturing and reduce setup time.

An Applications Engineer from MSP's associate company Renishaw PLC, recommended MSP's NC-PerfectPart and NC-Checker Software, combined with a Renishaw RMP600 probe to automate part alignment and machine assessments. Setting and machining a typical industrial gas turbine nozzle originally took four hours but with these solutions the part can now be probed, machined and checked in under two hours.

More complex components, which had required up to eight hours' machining time and continuous operator oversight, are now produced in the same two-hour cycle, generating further savings.

MSP halved Doncaster's part setup cycle from four hours to just two with their NC-Checker and NC-PerfectPart software.



SAVINGS OF £21 MILLION FOR BAE SYSTEMS

F-35 in flight

BAE Systems PLC had a major supply contract for F-35 Lightning II rear fuselage assemblies to Lockheed Martin. The Samlesbury Engineering team were challenged with increasing F-35 production rate to one plane set per day.

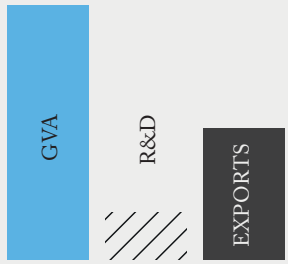
Facilitating machining to tight tolerances, despite the complex shape, of the Nozzle Bay Doors for the F-35 Short Take Off/ Vertical Landing variant, while shortening setup times, reducing production costs and increasing part quality, was critical.

Using NC-PerfectPart, the BAE Systems team developed "sticky fixturing", a setup technique that holds a component in its free-state while it is machined. BAE Systems and MSP developed adaptive machining utilising MSP's automated parts set up, reducing part setup time from days to minutes, saving £21m over the life of the programme.

For more information about MSP, visit metsoftpro.com; call +44 (0)1665 608193 or email info@metsoftpro.com

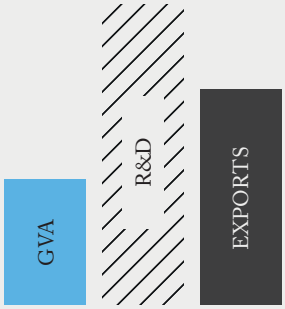
UK MANUFACTURING BY SECTOR 2019/20

FOOD & DRINK



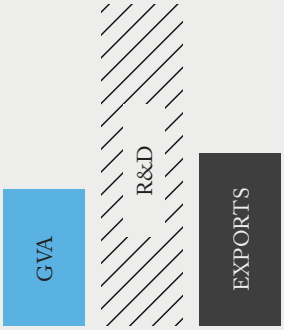
15.1% 2.8% 7.8%

TRANSPORT
(including autos and aerospace)



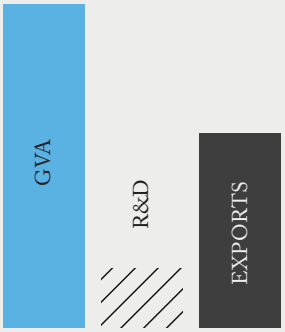
14.9% 35.6% 25.5%

CHEMICALS AND PHARMACEUTICALS



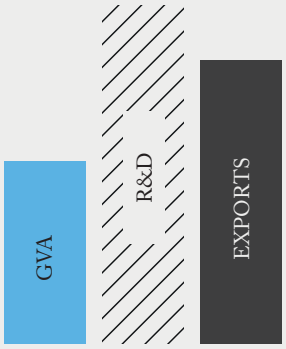
14.2% 33.3% 17.9%

METALS



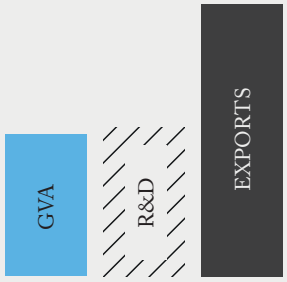
11.5% 2.1% 6.9%

ELECTRONICS & ELECTRICAL EQUIPMENT



8.1% 15% 12.6%

MACHINERY

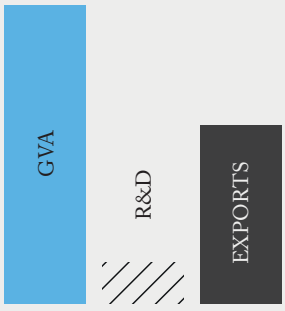


6.3% 6.6% 12.1%

RUBBER, PLASTICS AND NON-METALLIC MINERALS

7.8% 1.5% 4.1%

OTHER MANUFACTURING



22.1% 3.0% 13.2%

GVA = Gross Value Add
R&D = Research & Development

Source: Office of National Statistics (ONS)

A BETTER PILL

BY MARC BEISHON

Pharmaceuticals, one of the top performing sectors in Europe, has a substantial positive trade balance of more than EU100 billion with the rest of the world on a total export value of more than EU400bn, according to the European Federation of Pharmaceutical Industries and Associations (EFPIA).

Jonathan Gawthorpe Copyright @jpimedia

Credit: Accord

"Emerging economies such as Brazil, China and India are ramping up economic and research activity. North America still dominates; Europe, as in so many other aspects, is a fragmented market that suffers from "parallel trade" in medicines"

But all is not well; emerging economies such as Brazil, China and India are ramping up economic and research activity. North America still dominates; Europe, as in so many other aspects, is a fragmented market that suffers from "parallel trade" in medicines, which deprives the industry of resources to fund R&D.

Amid these trends the UK is lagging behind the top performing European countries. Bryan Deane, director of new medicines and health policy at the Association of the British Pharmaceutical Industry (ABPI), observed that the Department for International Trade reported that in 2018 the UK exported about £24.7 billion (45% to the EU) of medicines, but imported the same – £24.7 billion (but 77% from the EU). The UK used to have an export surplus.

"We are also not growing like some countries – we are already behind Germany and Switzerland, and Belgium, Ireland and the Netherlands are focusing on attracting manufacturing facilities. We have to express some concern," he says.

In 2017, medicines comprised 6.7% of UK trade, with European markets being key targets. While tariffs do not apply to pharmaceuticals under World Trade Organisation (WTO) rules, the UK government has called for the WTO's list of products and components to be updated and notes supply chain factors in Brexit that may put pressure on trade. Another spanner in the works may be the loss of EU research funds.

Credit: Oxford Biomedica

Left: UK Pharmaceutical companies range from giants like GSK and Pfizer to very small, specialised producers of early-stage materials.

Above: Accord's new site at Fawdon, Northumberland, is set to employ 500 people by the end of 2020.

Three-legged stool

Deane says there are about 190 medicine manufacturing plants in the UK, although many are small and designed purely for producing early stage materials. In Manufacturing Vision for UK Pharma, the ABPI identifies three main segments in the market:

- Established medicines – including small molecule drugs, monoclonal antibodies, traditional vaccines and therapeutic proteins
- Complex medicines, such as antibody drug conjugates, oligonucleotides, viral vectors
- Future treatments, such as cell and gene therapies, and new vaccines.

There are opportunities to develop new and improved manufacturing processes and capacity in all segments, and to develop value in advanced technologies especially.

The vast majority of drugs prescribed in the UK are generics (off patent). Their use doubled between 2005 and 2017 to 75% of total prescriptions. But they account for only 28% of NHS spending on drugs, according to a 2019 report by consultancy, Oxera. Many are made by giant generics firms such as Sandoz, Sun and Teva in overseas facilities but there is UK investment, notably by Indian firm Accord (a subsidiary of Intas), which has opened a 22 acre manufacturing site in Fawdon, Northumberland, which is set to employ 500 people by 2020.

Life Sciences Industrial Strategy

This investment is by no means isolated. The most encouraging aspect of medicines manufacturing here is the implementation of the government's life sciences industrial strategy, which is starting to bear fruits by developing platforms that can be used by firms especially at the pre-competitive phases of the drug production process. Nick Medcalf, who is deputy challenge director for the ISCF Medicines Manufacturing programme at UK Research and Innovation (UKRI), which manages the government's Industrial Strategy Challenge Fund (ISCF), says it's part of an overall drive to address challenges such as the ageing population, which is not just about diseases of older age but addressing conditions earlier in life that can affect long term ill health, such as genetic disorders, for which treatments are likely to have high ticket prices.

It also aims to tap a major UK strength, which is academic research in fields such as biology and chemical and bio-engineering, but the challenge is to foster the translational stepping stones to not only develop new drugs but also to keep innovative manufacturing processes on home soil and thereby capture maximum value.

Medcalf notes that once medicines development scales up beyond the highly skilled, small batch environment commonly seen in an academic setting to manufacturing, capital costs can be great, especially when new technology is needed. This is where new facilities such as the Medicines Manufacturing Innovation Centre (MMIC) in Scotland come in: by providing access to process platforms based on latest technologies, companies move from this pre-competitive environment to their own in-house systems. Previously, say Medcalf, new manufacturing technologies could take years to be validated for use.

"Now we are helping companies to access important new manufacturing platforms more quickly. We are addressing an issue that the market will not solve as we de-risk process development."


Credit: Oxford Biomedica

"Another major player with the same authorisation is Oxford Biomedica, which is expanding capacity at its OxBox facility"

The two UK giants, AstraZeneca and GlaxoSmithKline, are among the funders of the MMIC, which is led by the Centre for Process Innovation (CPI), part of the High Value Manufacturing Catapult. Other UKRI initiatives, which are also promoted by the Medicines Manufacturing Industry Partnership (MMIP), hosted by the ABPI, are aimed at more complex agents (see box).

An eyecatching major announcement in 2019 was of further investment by Pfizer at its Sandwich, Kent, operation, to develop novel manufacturing technology to make paediatric medicines more suitable for children. There are substantial manufacturing investments like this around the country by commercial players, but a race is on to capture "end to end" value in new technologies and processes. As Deane says, science is international and once a company heads to, say, the facility-rich Boston area in the US, they could be gone for good.

This is a sector where no country can go it alone, given the wide range of new technologies. Medcalf notes that interest in the UK's expertise results in approaches even from countries that excel in advanced medicines manufacture, including Canada, Germany and Japan. Some of these lead to international collaboration. The key is to keep minds focused on the right infrastructure and industrial culture that will attract developers to the UK in line with its strengths.

Trends and movers for 2020

Scope not scale: Nick Medcalf says that, in future, the industry will need to de-emphasise economy of scale (big batches from big facilities) and build more economy of scope (access at reasonable cost to adaptable plant at smaller scale) to meet demand for personalised medicines. there is also a need for a paradigm shift to approaches that minimise waste and allow agile supply, commonly applied in other industries, such as continuous manufacturing, Six Sigma and quality by design. The MMIC is being set up as a model for this as a digital "factory of the future".

The Cell and Gene Therapy Catapult's manufacturing centre in Stevenage, supported by Innovate UK, helps companies develop processes and is authorised for commercial manufacturing of licensed medicines. Another major player with the same authorisation is Oxford Biomedica, which is expanding capacity at its OxBox facility. Also in Oxfordshire will be the Vaccines Manufacturing Innovation Centre, scheduled for opening in 2022, funded by the ISCF. The National Biologics Manufacturing Centre in Darlington, a part of CPI, is developing new processes for biologic medicines; the Future Targeted Healthcare Manufacturing Hub at University College London is addressing manufacturing challenges in precision medicine.

Outsourcing – specialist contract development and manufacturing organisations (CDMOs) are a growing sector for gaining rapid expertise to trends such as continuous manufacturing and new platforms. Two firms to watch in the UK are Arcinova, in Alnwick, Northumberland, and Cobra Biologics in Keele.

Close to home – the NHS is a world powerhouse in integrated healthcare provision and is ideally placed to foster regional groups that offer personalised, high-value, low-volume manufacturing expertise for agents that don't travel well. A network of three Advanced Therapy Treatment Centres is building expertise among businesses, clinicians and academics to make and deliver advanced treatments and is coordinated by the Cell and Gene Therapy Catapult. The rollout of successful products and processes to other parts of the NHS should be announced over the next few years.

Special delivery – "specials" are unlicensed medicines. They account for only 1% of prescriptions but more than 75,000 formulations, and British firms specialising in advanced high value products are ones to watch in 2020, according to Medcalf, such as Bath ASU, a University of Bath spin-off that specialises in cancer therapies on a named-patient basis.

Training up – UK capacity depends on a skilled workforce and an Advanced Therapies Apprenticeship Community (ATAC) has been established to develop the first apprenticeship programme to train and upskill individuals in developing, manufacturing and delivering innovative therapies at scale.

Pfizer committed further investment in its Sandwich, Kent site, for the development of novel manufacturing technology for paediatric medicines.


Credit: Pfizer


Credit: Oxford Biomedica

DATA AND EMPLOYMENT LAW

As digitalisation increases and enhances the analysis of people and processes, two branches of the law are being brought into conflict: employment law and data protection law.

"With more data being captured at the point of the machine or the workstation, it's logical for companies looking to make cost reductions, to use this data in redundancy selection and performance management exercises," says Glenn Hayes, partner and employment law expert at Irwin Mitchell.

Workstation performance data is just one of the criteria companies will consider; others include attendance and length of service. But machine performance data is objective and not subjective, making it compelling to use in court or tribunal.

Glenn Hayes, Irwin Mitchell partner and employment law expert

Data alone won't account for mitigating reasons for sub-optimal performance.

Objective assessments

"Particularly when grading your performance for a redundancy selection exercise, the more objective I can be, the more likely any outcome or dismissal will be fair," says Glenn.

Data protection rights protect the employee by placing restrictions on how employers use this data. Taking data that relates to an employee, such as their productivity, without their knowledge and using it in an unexpected way to give the employer an advantage is a breach of GDPR. Employers can face huge fines; they must be rigorous in their risk assessments and transparency to avoid this.

"Companies can use data to monitor staff performance but it has to be transparent to people that you're using it for that purpose," says Joanne Bone, partner and data protection expert at Irwin Mitchell. The measurement must be legal, proportionate and transparent (via a privacy notice and monitoring policy) to comply with GDPR.

While data alone provides useful evidence to parties in a dispute, human interaction is required to understand the full context of what it is showing. Data alone won't account for a disability, age, machine defects, or other mitigating reasons for sub-optimal performance.

"If an employee is 65 and is recorded with slower productivity, are they operating the machine slower because of their age, or their ability, or some defect with that machine?" says Glenn. "It's unlawful to treat someone unfavourably because of a characteristic protected by discrimination laws. Employers have a duty to make reason-

Joanne Bone, partner and data protection expert at Irwin Mitchell.

able adjustments for disabled employees, so employers need to ask 'is that discriminatory, and will the company have to make adjustments?'"

A wide selection of hardware and software technology is now available to monitor personnel performance, including CCTV, telematics for drivers, workstation monitoring, and recordings. None of these are barred from use in companies; rather it's the necessary signposting that's easy to miss.

"It's a question of proportionality, risk assessment and transparency rather than being unable to use this type of technology," says Joanne. "Many manufacturers miss the fact there are preliminary steps, rush ahead and install screen monitoring, CCTV, tracking telematics etc. without working through the issues to ensure that it's legal."

If a company is collecting data about a person at work, from a data protection point of view it must tell them what it's collating the evidence for and stick to that.

Covert recording and filming employees

Knowledge of GDPR is empowering the workforce. There's a rise in the number of cases where employees provide covertly recorded discussions as mitigating evidence in employment tribunals.

A recent Irwin Mitchell case tested whether the act of concealing the recording was an example of gross misconduct. The case ruled that it wasn't automatically deemed an act of gross misconduct but, if people are covertly recording private conversations, it could be judged as such in specific cases.

Filming people in the workplace with their knowledge is becoming more common, as companies trying to improve process flow and record staff movements between workstations. They can then redesign the factory more efficiently.

CCTV could also flag inadvertent or deliberate time-wasting or other misconduct. This poses the question of whether it could lead to dismissal. Would that be fair?

Litigation trend

Data protection issues are being brought into employment claims more and more. "Employees are leveraging their data protection rights to force a settlement – they know that dealing with a subject access request is potentially time consuming and expensive, and use this fact to try and get a settlement," says Joanne.

It's not just employment cases. In one matter where Irwin Mitchell acted for a consumer business, a buyer was unhappy with the product. When the business said it wasn't at fault, the customer made a subject access request as it'd be expensive to deal with, and threatened to complain to the Information Commissioner's Office, as well to trying to force a settlement.

This performance monitoring could help to accelerate falling employment in manufacturing, as data identifies the weakest piece in the production system.

BEST PRACTICE GUIDE TO DATA COLLECTION NOTIFICATION

Irwin Mitchell recommends that you:

1. Complete a Data Protection Impact Assessment, a form of risk assessment, to make sure you're recording the data proportionately
2. When you're satisfied this is proportionate, assess if the information is transparent enough. Draw up an Employee Monitoring Policy
3. Provide a privacy notice, explaining to the staff again what you intend to do and how the data is collected.

BURSTING WITH INNOVATIVE GOODNESS

BY CHARLES ORTON-JONES

Maybe Roald Dahl is the inspiration. The children's author seduced a generation of British children with Charlie and the Chocolate Factory and his sweets, like Wonka's Whipple-Scrumptious Fudgemallow Delight and the Everlasting Gobstopper. Not to mention George's Marvellous Medicine.

Now those kids are adults and turning into Willy Wonkas of the food and drink industry. The breakout products of 2019 were definitely Dahl-esque: both wacky and wonderful.

Nim's Teas, a brand of air-dried crisps, made from tomato and cucumber, brussels sprouts, and watermelon, represents the latest move is into "edible teas". The tea bags contain dried fried and veg, with which you make tea. Then later, rather than dispose of the bag, you open it and eat the rehydrated food inside. Flavours include Beetroot & Parsnip tea, and Pineapple & Kiwi.

"There's no doubt the British are more receptive to unusual ideas," says founder Nimisha Raja. "We tried exporting our crisps to Spain and Belgium, but they weren't quite ready for us!" She says the rest of the world is waking up to British ingenuity in the food and drink market: "I go to trade shows and visitors want to find out what the Brits are doing. We are the innovators now."

Authentic canned water

The winner of the World Beverage Innovation Awards in the premium category was Larkfire, a canned water for diluting whisky with. It's niche, for sure.

Credit: Shutterstock

Tea is not just for drinking. Nim's Teas contain ingredients designed to be eaten after infusion.

Right: Larkfire canned water is specially extracted from multi-billion-year-old rocks in the Outer Hebrides to perfectly complement premium Scotch whisky.

Bottom Right: Gregg's scored a PR and market hit with the introduction of its vegan sausage roll in 2019. Credit: Gregg's.

Below: Nim's Teas tea bags contain dried fruit and veg, which are designed to be eaten after use in infusions.

Credit: Nim's Teas

"If you are going to drink a special single malt, or blended whisky, you don't want to add chlorinated tap water," says co-founder and CEO James McIntosh. "We took a journey across Scotland to find the best water, amongst metamorphic insoluble rock. And we found it in the Outer Hebrides, where the rocks are 3.5 billion years old. The water is incredibly pure."

Larkfire cans are recyclable (important) and lighter than bottles (great for export). The export potential is there. Whisky is the UK's largest food or drink export by a distance. At £2.2bn, the value of whisky exports is five times greater than salmon,

"In additional to the fad for wild new products, one big trend overshadowed all others: the rise of veganism. Veganism has been increasing for a while in the UK."

the second most valuable. McIntosh sees a prosperous market for his water in markets like China and India. "These are countries where you don't want to drink tap water." And is Britain truly an innovator in food and drink?

"It appears so. Look at Fever Tree in tonics, the craft breweries, and the number of new distilleries. It's in our psyche."

Veganism

In additional to the fad for wild new products, one big trend overshadowed all others: the rise of veganism. Veganism has been increasing for a while in the

UK WINE: FIZZING OR FIZZLING?

Above: British sparkling wine has gone from also-ran to prize winning, even against the finest French champagnes

Who'd be a wine maker? The UK industry is plagued by volatility. In 2012 the rains came and washed away any profits for English wine makers. Nyetimber, the biggest English brand, announced it would produce no sparkling wine at all that year.

By contrast, 2018 was a bumper year. Production rose 130 per cent on 2017. Sales of English and Welsh wine doubled, and exports doubled.

In theory the sector is full of promise. The area under vine in the UK increased by 160% in the past decade to 7,000 acres. A further 2 million vines will be planted this year. Makers are improving their viticulture: Chardonnay, Pinot Noir, Pinot Meunier and Bacchus account for 76% of all plantings in Britain. And the makers are tapping a popular niche: almost three-quarters of UK wine is sparkling.

The Wines of Great Britain association believes up to 30,000 new jobs could be created by 2040, up from 2,000 today. Vineyards are also great for tourism. The association estimates tourism could generate £658m in revenue a year by 2040.

Chapel Down in Kent is a believer in the future of English wine: it is expanding vineyards, targeting 2.2m bottles a year by 2020. Bank borrowings rose from nothing to £6.5m in the last reported period.

The prosperity of the UK wine industry depends, of course, on fine weather. 2018 was a hit. 2019 was "back to normal". A bad year can hammer the industry.

The quality is there. Buyers are enthusiastic. And investment is pouring in. But the unpredictability of the climate makes British wine a bet for hardy investors.

A different kind of factory floor. Nyetimber's vineyard in West Sussex

FOOD & DRINK: EXPORTS HITS OF THE YEAR	
Exports	+5%
Exports to the EU	+9.8%
Salmon exports	+24.7%
Gin exports up	+16.1%
Pork	+9.6%
Wine	-11.4%
Exports to Japan	+24.4%
Exports to China	+16.2%

Source: Food & Drink Federation, H1 2019 compared to H1 2018

UK. Vegan Society surveys by Ipsos Mori suggest numbers have quadrupled since 2014 to 600,000, with many more "flexitarians". A YouGov poll showed the over 55s were the keenest. Converts such as Lewis Hamilton, boxer David Haye and Arsenal vice-captain Hector Bellerin caught the mood of the nation. Hamilton opened a vegan restaurant in August, generating the sort of publicity you'd expect from a serial world champion.

The start-up of the year, awarded by The Grocer magazine, was Freaks of Nature, a dairy-free dessert brand. Founder Pete Ahye rode the vegan boom to launch chocolate mousse, sticky toffee pudding, and cherry bakewell, all dairy-free and gluten-free. Freaks of Nature is now stocked by all major supermarket brands.

The environmental merits of meat-free diets gained traction, taking the issue beyond mere animal welfare. Goldsmiths College voted to ban beef from the university cafe for eco reasons. The University of Cambridge, which removed lamb and beef from menus in 2016, announced removing meat from menus had cut carbon emissions by a

DATA BOX

- **Food & drink contributes £31.1bn to the economy**
- The food & drink industry is the biggest manufacturing sector in the country, accounting for 19% of total UK manufacturing and larger than automotive & aerospace combined
- **The food supply chain employs 4 million people & generates over £121 bn of added value each year**
- 97% of food & drink businesses are SMEs
- **Over 450,000 people directly employed**
- Exports in 2018 were worth more than £23bn
- **Exports of branded food and non-alcoholic drink grew by a third to reach £6bn by 2020**
- The food supply chain employs 4 million people & generates over £121bn of added value for the economy each year

Freaks of Nature, Grocer magazine's Start-up of the Year, specialises in 'free from' desserts.

third per kilo of food purchased. Even the National Farmers' Union unveiled plans to go carbon neutral by 2040.

Bakery chain Greggs scored the PR success of the year with a vegan sausage roll. Shares rose 50 per cent on the back of several weeks of glowing publicity. The CEO later announced he was going on a vegan diet. Even pro-Brexit entrepreneur Tim Wetherspoon endorsed the shift to veganism. His JD Wetherspoon chain signed a deal with Leeds-based The Meatless Farm Co following a successful trial. Meatless Farm will provide plant-based burgers to nearly 900 Wetherspoons nationwide. In December, Meatless Farms appointed former Lidl boss Jesper Højer as chairman - a sign of the momentum in the sector.

Another British plant-based burger producer, Moving Mountains, continued international expansion in 2019. It launched in Hard Rock Cafes across Europe, moved into Australia via 850 Woolworths stores, and Spain in the Carl's Jr chain.

Greggs announced in January 2020 that it is to distribute £7 million to its staff after an 'exceptional' year.

The end of meat as we know it?

2019 was the year artificial meat entered popular consciousness. This is lab-grown meat, supposed to look indistinguishable from the real thing. The United States leads the field, with companies Impossible Foods and Beyond Meat gathering serious investment – the latter being valued at $9 billion. But the UK is in the race too. Higher Steaks is a London-based startup founded by chemical engineer Benjamina Bollag and Dr Stephanie Wallis, a cell regeneration expert. Scientific director David Hay is chair of tissue engineering at the University of Edinburgh. Higher Steaks plans to bring lab-grown pork to markets in 2021. The advantages are plentiful. No cruelty to animals. Higher Steaks needs no anti-

Credit: Freaks of Nature

Left: **Trends away from meat and towards vegan and novel blends like mushroom burgers and rose jam tarte tatin are increasing demand for technically-qualified food production operatives.**

biotics, and the sterile lab conditions eliminate food-borne diseases. The method is eco-friendly too: cell-based meat has the potential to cut down on carbon dioxide emissions, methane, and water usage associated with animal husbandry.

Scientists at the University of Bath announced in March success in fostering pig cells on an edible "grass scaffold" - inspired by the natural diet of pigs. The goal is lab-grown bacon.

Money moves in

Investors are backing the trend. The FAIRR network of investors brings together a group including Invesco, Legal & General, Aegon Asset Management and others, totalling $2 trillion in assets. The goal is to raise awareness of the risks caused by intensive livestock production. FAIRR likens modern animal rearing to the use of coal in the energy industry: unsustainable. Antibiotic resistance alone poses an existential threat to the farming industry, it argues.

In tandem with the move to sustainability is the resurgence in "buy local". A survey by Made in Britain, a lobby group for British agriculture, found 63 per cent of the public believed buying British could help combat climate change. Eight in ten are prepared to pay a little more for something made in Great Britain.

Naturally, some of the biggest success stories of the UK food and drink industry fused these trends together. For example, The Wheatsheaf pub in Chilton Foliat, near Hungerford, Berkshire, won business of the year at the Sustainable Food Awards. It combines low carbon thinking, local sourcing, meat alternatives, and true imagination on the menu. Owner and chef Ollie Hunter cut down on meat the menu – you may find mushroom burgers. The pub grows its own herbs and fruit on-site. Roses are turned into rose jam and pears into a tarte tatin. The honey is from the local park. Even the electricity is sustainably sourced from Ecotricity, which uses wind turbines and carbon neutral gas mills. It's a vision of the future.

CATCHING THE BUG

Credit: Shutterstock

Recipes using insects helped The Bug Farm to become an award-winning restaurant, attraction and academic centre of excellence.

Husband and wife team entomologist (insect scientist) Dr Sarah Beynon and chef (food wizard) Andy Holcroft established Dr Beynon's Bug Farm (or 'The Bug Farm') in 2014. Sarah is an academic, ecologist and farmer, with a doctorate from the University Oxford. Andy is an award-winning chef of 25 years. The Bug Farm is a research centre, working farm and visitor attraction showcasing their passion for sustainable agriculture and delicious food. Sarah's research inspired Andy to invent recipes using insects which evolved into dishes in the 'Grub Kitchen' restaurant, the first full-time entomophagy restaurant in the UK. The Bug Farm has evolved into an award-winning attraction and academic centre of excellence, winning the Best Start-Up Business of the Year in 2016 and the Sustainable/CSR/Green Business of the Year in Wales in 2017.

FOOD & DRINK: NEWS IN BRIEF

Coca-Cola European Partners invests £20m

A new production line at CCEP's Edmonton Factory line will make Bag-in-Box products, which contain concentrate for food service and licensed operators to mix with carbonated water to dispense draught soft drinks. The format saves 48,400 tonnes of CO_2.

Princes £80m investment

Princes has completed the first phase of a planned £80m investment in its Long Sutton site in Lincolnshire with the opening of a new pea plant at the facility, and a £5m investment plan to modernise pack designs and formats across all its product categories.

Britvic boosts rPET packaging

Britvic has announced a long-term agreement with Esterform Packaging for the supply of recycled plastic (rPET). Esterform will become Britvic's preferred supplier of rPET in Great Britain and Ireland and receive a £5m invesment from Britvic towards the construction of new manufacturing facilities at its North Yorkshire site.

Avara Foods' £6.5m investment

Avara Foods has invested £6.5m in its Hereford site, including the installation of a suite of new technology, boosting production capacity by 100,000 chickens per week. The facility supplies chicken, turkey and duck to retailers, food service and food manufacturers.

Kellogg UK drives to reduce organic waste

By 2030, Manchester-headquartered Kellogg UK has announced that intends to cut organic waste by 50%, as part of its global 'Better Days' corporate commitment. Company initiatives to reuse 'imperfect' but edible product

include supplying Salford-based brewery Seven Bro7hers with 'less-than-perfect' Kellogg's Rice Krispies, Coco Pops and Corn Flakes for use in making beer.

Wensleydale Creamery £17.9m investment

Following a £17.9m deal with HSBC UK and £800,000 EU productivity grant, North Yorkshire's Wensleydale Creamery is to purchase new vats, working tables and cheese-making and curd-handling equipment. Almost £1m will go towards a more efficient cheese blending and waxing facility. A new cheese smoking plant, along with water recycling and increased milk storage capacity, are also planned.

Taylors of Harrogate investing £14m

Yorkshire-based Taylors of Harrogate has recently completed the installation of a new tea blending area as part of a £14m investment, which increased production capacity by 50%. Taylors has moved to 24/7 production for the first time in its 130-year history, to accommodate growing demand in the UK and internationally.

Müller completes £50m expansion

Muller's project to build a chilled yogurt manufacturing facility capable of producing 500 million pots each year at its site in Telford, has been completed. The £50m project doubled the size of the site, increased its capacity to make products in a range of formats and created 65 new jobs.

Wrights Food Group invests £7m at Crewe factory

A year-long, £7m investment project at Wrights Food Group's Crewe factory, backed by a £3million funding package from Lloyds Bank Commercial Banking, included the introduction of a new savoury production line, ovens and cold storage facilities. Wrights, which has an annual turnover of £60m, supplies pies and other savoury food products to more than a third of clubs in the English Football League.

Family-run HECK has invested £600,000 in equipment to produce a new range of frozen, plant-based sausages at its dedicated vegan facility in Leeming Bar, North Yorkshire. The range will be available at over 600 Holland & Barrett stores.

GOVERNMENT MUST PULL ALL THE LEVERS IT CAN TO GIVE UK STEEL A FIGHTING CHANCE

Steelmakers face a horror show list of pressures, from global overcapacity and uncompetitive energy prices to Brexit. Little wonder Tata Steel's pan-European job cull last year included its UK plants. UK Steels' *Richard Warren* says that while long term global demand forecasts for steel are positive, the government must act, and now, to keep steel real in this country.

Richard Warren

It is deeply dismaying, but unfortunately not unexpected, to see the gloomy trend set for the steel industry last year continue into 2020. The 9 January announcement from Liberty Steel regarding plans to reduce staff in the face of difficult market conditions came just weeks after Tata Steel announced 3000 job cuts across its European plants. These restructuring plans from Tata and Liberty Steel of course sit alongside the sale process for British Steel, ongoing since May last year when the business went into liquidation and the government's official receiver took over the management of it.

Last year's difficulties, and what will clearly be another challenging year for the sector, are the result of several negative factors; some global, some UK specific, which have aligned to create uniquely challenging circumstances in which UK steel makers are inevitably struggling to operate.

"Steel producers in the UK are paying approximately 60 and 80% more for their power than their German and French counterparts respectively, costing the sector some £50 million each year."

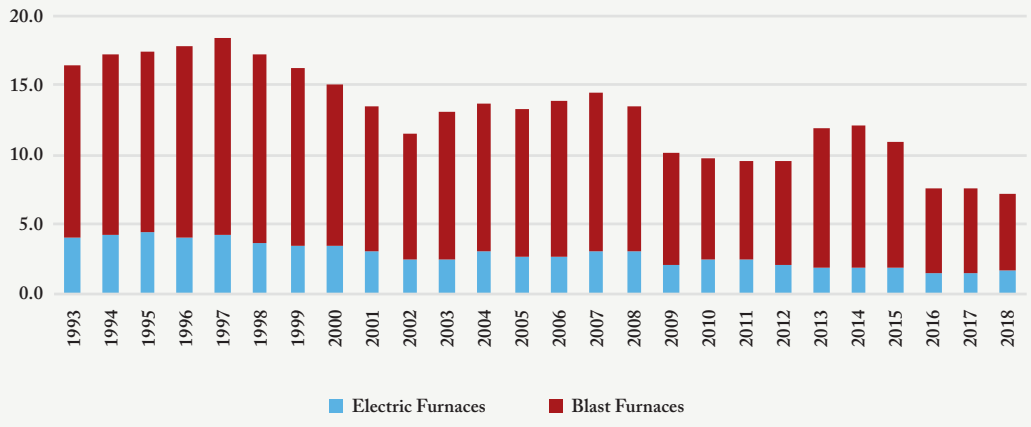
Falling Demand, Falling Prices, Rising Costs

While demand for steel globally remained positive in 2019 this masks a stark contrast between different regions. Chinese demand grew by nearly 7% to 806 million tonnes, but steel markets elsewhere experienced a first recession since the doldrums of 2015, shrinking by 1.5% to 776 million tonnes.

Much of this fall was driven by a huge 3% reduction in EU consumption, forcing EU producers to reduce steelmaking capacity by 8 million tonnes. UK steel demand followed a similar trajectory, weighed down further by Brexit uncertainty which pushed the whole of the UK manufacturing sector into a recession in the latter half of the year.

Falling demand in the EU has naturally led to downward pressure on prices. European hot rolled coil and wire rod prices, both key products in the UK steel manufacturing sector, tumbled 20% and 25% respectively last year. These contractions in steel demand and prices have been compounded by rising raw

UK CRUDE STEEL PRODUCTION 1993-2019



material costs, squeezing steel makers' margins even further. This differs markedly from the last downturn [for steel] in 2015 when both iron ore and coking coal prices were less than half of those in 2019.

Global overcapacity

The issue of overcapacity is one the global steel industry has struggled with for many years.

Despite some modest reductions in the overall levels of overcapacity from the peak of 400 million tonnes in 2016, capacity utilisation remains around 70%-75%, sitting well below the 80-85% levels seen in the late 2010s. Well over two thirds of this overcapacity sits in China and despite vague assurances that measures would be taken to redress the situation, China broke new records in 2018 with output of 928 million tonnes (53% of global production) and this is expected to have grown by a further 3-4% last year.

Discussions must continue at a multi-lateral level through the G-20 and OECD to find a long term solution to this problem but, in the meantime, the EU and UK Governments must be prepared to use the trade defence measures at their disposal far more robustly in order to protect the sustainability of Britain's steel markets and production.

As Britain prepares to leave the EU and it regains control of these levers, it is more important than ever that the UK Government drops its traditional aversion to these tools and embraces them as part of a new more interventionist industrial strategy.

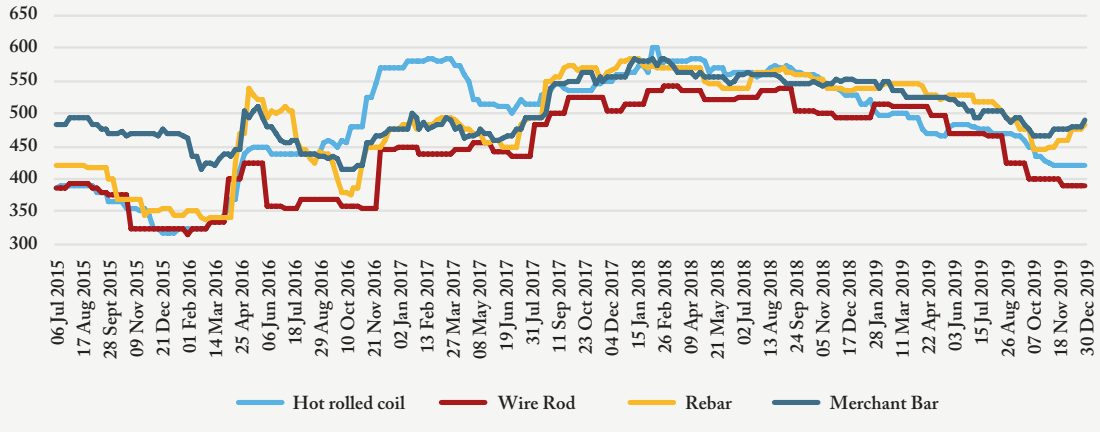
Global trade wars

Driven by the US steel sector's frustrations with the lack of practical action on global overcapacity and President Trump's own aversion to supranational decision making, the US introduced a blanket 25% tariff on all steel imports in March 2018. Since then UK exports to the US have plummeted by almost 30%, with long products (rods, bars, rails, construction materials) having been hit particular hard, falling by 60%.

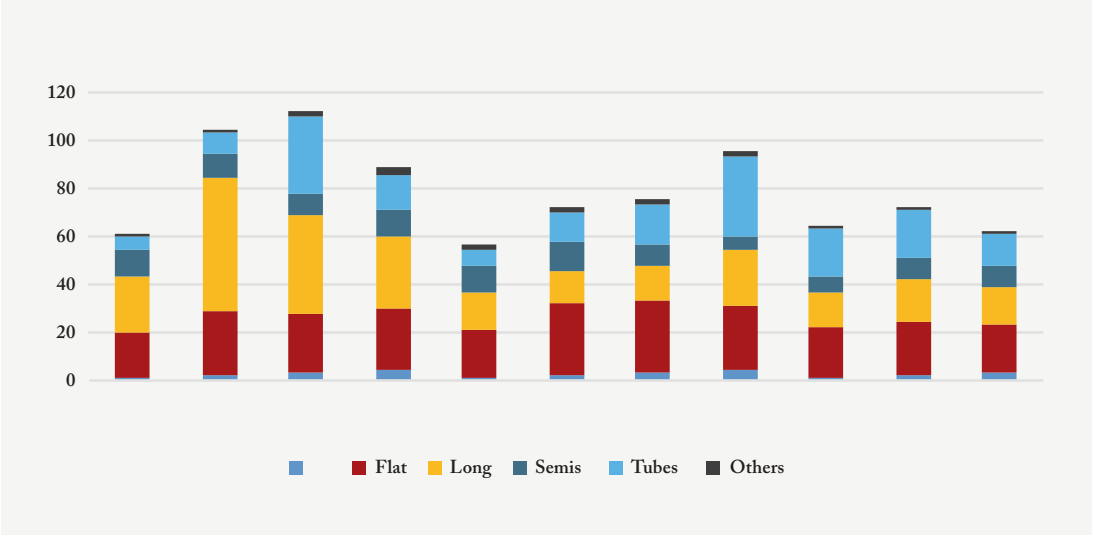
Above: **British Steel's blast furnaces at Scunthorpe, known as the 'Queens', are under threat since the company went into administration**

At the same time as falling UK exports, other exporting countries hit by these tariffs have looked for alternative markets, making the EU a prime target. Despite demand falling by 3%-4% in 2019, imports have remained broadly high, forcing EU

STEEL PRICE DATA



UK STEEL EXPORTS TO USA - 2017 - 2019



and UK producers to reduce output by as much as 6%. It is to the EU Commission's credit that it acted decisively to introduce safeguarding measures across the board, but with the tariff free quotas increasing year-on-year and demand continuing to contract they are not having the desired effect.

With US tariffs unlikely to disappear soon, the pressure is on for the UK Government to use its post-Brexit trade policy to both secure an exemption from the US steel tariffs for UK industry (as Australia has already done), as well as ensuring the UK introduces sufficiently robust safeguarding measures of its own.

"The massive 3% reduction in EU consumption in 2018-19 forced EU steel producers to reduce steelmaking capacity by 8 million tonnes."

US tariffs and declining demand have impacted steelmaking across the EU as well, including Thyssen Krupp's plant in Duisberg

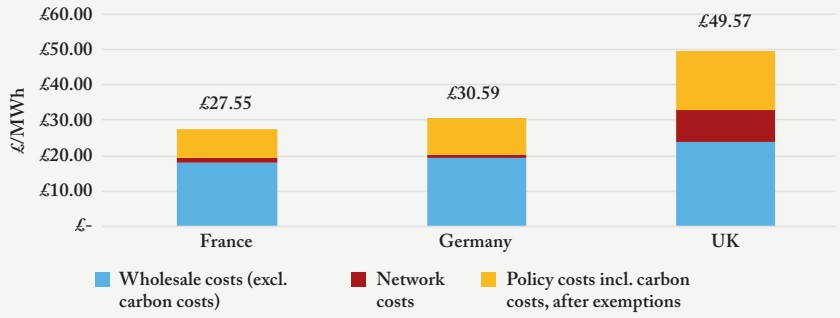
Brexit – uncertainty pervades

On top of these global and European challenges, the UK sector is due to exit the European Union on 31 January and the disruption of its trading relationship with its largest market. The UK steel sector exports around 40% of everything it produces (3.5 million tonnes), and 70% of this goes to the EU.

Over the last 12 months, the sector has had to deal with the looming prospect of a no-deal Brexit and the imposition of the EU's safeguarding measures against UK exports at an estimated cost of £60 million a quarter. The passing of the Withdrawal Agreement in January 2020 largely rules out this prospect, but the chronic uncertainty has already undermined EU customer confidence and hit order books. British Steel noted as much as it went into liquidation, and so too did Liberty Steel when announcing job cuts this month.

Furthermore, the Withdrawal Agreement provides little to no certainty about the future UK/EU trading relationship and indeed what access UK exporters will have to those markets with which the EU currently has free trade agreements. A bare bones trade agreement at the end of 2020 seems to be the government's aim, and the steel sector knows this will mean the introduc-

ELECTRICITY PRICES FOR STEEL PRODUCERS IN FRANCE, GERMANY AND THE UK (2019/20)



"Since President Trump imposed the 25% tariff on steel imports [March 2018] UK exports to the US have plummeted by almost 30%, with long products particular hard hit – falling by 60%."

SUSTAIN, a £35m Future Manufacturing Hub based at Swansea University under the auspices of UKRI, is designed to make steelmaking more sustainable. It was launched in April 2019

tion of significant friction at the border and with it delays, additional costs and customer concern.

A government shift towards a comprehensive UK/EU trade agreement, based on the alignment of regulations and standards, would be by far the best thing for the UK steel sector this year. If this is not the direction the Government takes, then it has no choice but to use its new-found regulatory and political freedom to make drastic improvements to the business environment in the UK and best mitigate the damage done to our EU trading relationship.

UK business environment

While all European steel companies are suffering right now, and did in the last downturn in 2015, one has to ask the question why the UK sector seems particularly badly hit at these times. Brexit is partly, but not exclusively to blame; the UK's business environment is one of the most challenging for steel makers in Europe.

The UK has the most expensive electricity prices in the whole of the EU for large industrial users. Steel producers in the UK are paying approximately 60 and 80% more for their power than their German and French counterparts respectively, costing the sector some £50 million each year. That's £50 million in foregone investment every year, money that has already been committed to UK investment by steelmakers should the UK Government take action to level the playing field.

Equally, when it comes to business rates the UK is an outlier.

Business rates for steel companies are 5%-10% higher than in France, Germany and The Netherlands, costing an additional £40m-50m a year – they also increase as companies invest in plant and machinery to modernise and become more efficient. The government has committed to a review of the regime and this cannot happen soon enough.

There are also critically important actions the government must take in areas such as innovation, public procurement, climate change, and infrastructure to support industry. Three years of discussions under the May administration delivered too little for the sector; it is vital that the new government does better.

2020 and beyond

Make UK has projected a 4% contraction for the metals sector this year, following a similar sized reduction in 2019. We are clearly hopeful that steelmakers can buck the overall trend, but with all the challenges facing the sector, the best we can hope for is some green shoots on the back of greater UK political certainty and a return to growth for key sectors like automotive and construction. Promisingly, some steel prices appear to have bottomed out and were rising again at the end of 2019, and we hope this is indicative of a wider trend.

We should see a conclusion in the sale process for British Steel to Chinese firm Jingye in the next two months and with it large investment and a return to more normal operations. And while the restructuring decisions at Tata and Liberty Steel have come as a last resort, they have both been taken with an aim to return to profitability and ensure the sustainability of the businesses. We hope to see these decisions start to bear fruit.

The long term projections for steel demand both globally and in the UK remain positive, but what happens during the course of 2020, and critically what decisions the UK Government makes in the coming months on Brexit and domestic policy, will be paramount in determining the fortunes of the steel sector and its ability to weather the current downturn and be in a position to exploit the next market upturn when it arrives.

INNOVATE OR DIE

Electronics and electrical equipment manufacturing continues to grow but hesitantly, as political and fiscal uncertainty maintains its restraining grip on the economy.

As the decade draws to its end, three years of expectation and uncertainty surrounding the UK's withdrawal from Europe is continuing to hold UK manufacturing industry back by the reins as foreign investment stalls and decision makers hedge their bets.

Despite this, output in the electronics and electrical equipment segments has remained stable, with a small amount of growth. The UK continues to be seen as a hotbed of innovation, particularly in automotive, aerospace and test & measurement markets. With high levels of innovative churn in these industries, both established and start-ups are showing their competitive strengths.

Industry is also supported by strong academic alliances as well as Government programmes designed to provide investment, assistance in taking concepts through to production and support for reaching new markets.

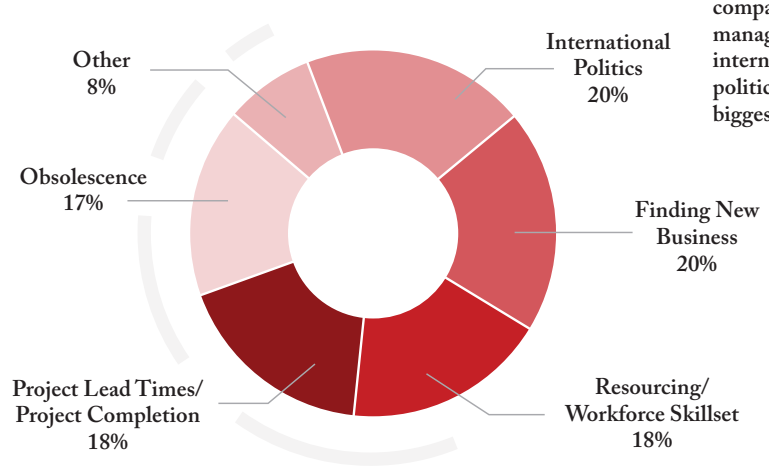
On this landscape, current performance is expected to

Innovation, embedded systems and cross-industry cooperation will be the signature to growth for UK electronics.

Credit: Micro-Epsilon UK

Left: One of the large industrial RF Interference filter cabinets produced by MPE, particularly suitable for the needs of electro-magnetic compatibility testing chambers being used in the commercial sector.

BIGGEST CHALLENGES CURRENTLY FACING ELECTRONIC DESIGN BUSINESSES



A fifth of electronics manufacturing company senior managers see international politics as their biggest challenge.

continue through the forthcoming period of political uncertainty, placing it in a strong position for growth once trade agreements, tariffs and customs procedures have been set in place.

Innovation provides key to growth

All sectors of UK manufacturing have long realised that box-shifting or high volume cost-focused manufacturing is not a national strength and it's hard to compete against nations that are more aligned towards fast moving output.

The country has been a pioneer in many areas of technology throughout its industrial history in aerospace, railways, automotive and electronics as well as manufacturing process technology. All of these areas are still subject to high levels of innovative growth and British scientists and engineers are continuing to prove they're at the cutting edge.

During the past 12 months, both start-ups and established manufacturers have seen a growth in activities relating to product innovation, prototyping and advanced manufacturing for niche sectors.

Electronics technology cuts across all industrial sectors and is at the heart of the changes that are taking place in Industry 4.0, Connected Autonomous Vehicles, Collaborative Robots and Test & Measurement Systems, to name but a few.

Markets on the move

Collaborating with other technology suppliers such as these is a key theme in the current electronics and electrical manufacturing landscape.

At a press briefing held in early 2019 at the Millbrook proving grounds, Bedfordshire, the automotive testing organisation of the same name was showcasing its connected smart city test site equipped with 5G wireless and electronics communication technology. Addressing journalists, Millbrook's CEO Alex Burns was highly optimistic about the level of collaboration between the electronics and automotive industries for the future of British enterprise.

"This is a superb opportunity which we're very excited about. Millbrook has never in its history been host to as many specialists from outside the automotive sector as we have today," he said.

WHAT TO EXPECT IN 2020

New technology and innovation feature highly in predictions for the industry over the next 12 months with a rise in demand for embedded systems. One UK manufacturer, JJM Manufacturing, sees investment in technology as the key to its success and believes that developing sectors will provide the opportunity for growth.

Analysts at Infosys Consulting reflect that view, predicting that 5G, smart factories and emerging technologies in innovative markets such as automotive will drive growth in electronics.

There are nonetheless still fears around political uncertainty and the obsolescence caused by rapid innovation. Embedded Systems consultancy, ByteSnap Design, surveyed electronics company executives at the 2019 Engineering Design show with 20% citing Brexit as their biggest challenge along with meeting skills requirements and coping with obsolescence.

At the Advanced Engineering Show 2019, Tim Figures of Make UK (formerly the Engineering Employers' Federation) told delegates in a packed open forum that uncertainties surrounding the Brexit debate are likely to persist for some time. "Even if a deal is concluded, it will take months or even longer to regain stability," he said.

TABLE 1 – VOLUME HISTORY FOR KEY ELECTRONIC PRODUCTS (£ MILLION)

Products produced	2013	2014	2015	2016	2017	2018
Populated electronic boards	1017	886	766	763	744	821
Computers & peripherals	1403	No data	1167	1275	1659	1428
Communication Equipment	1362	1258	1255	1187	1189	1136
Consumer Electronics	355	397	408	429	441	422
Measuring & Test Instruments	5668	5866	5762	5385	5560	6084

(Source: ONS)

TABLE 2 – VOLUME HISTORY FOR KEY ELECTRICAL EQUIPMENT PRODUCTS (£ MILLION)

Products produced	2013	2014	2015	2016	2017	2018
Motors, Generators & transformers	2763	2578	1986	1773	1845	1573
Batteries & Accumulators	No Data	274	257	226	229	361
Wiring Devices	590	556	590	580	709	759
Lighting Equipment	1352	1557	1579	1335	1288	1359
Domestic Appliances	1186	897	909	832	884	963

(Source: ONS)

Aerospace, defence and the railway sectors are also benefiting from large scale cooperation with electronics too, beyond their traditional connections for component supply. The trend now is for simulation, digital twinning, Hardware-in-the-Loop (HIL) testing, "train zero" connected prototyping and monitoring. All of these require test equipment, sensors, data acquisition systems, advanced electronics design skills and a high degree of connectivity.

Technology Transfer

There are also current examples of technology applications that are seeing growth in commercial sectors that originate in the defence industry, creating opportunities for growth. A very high profile example is the growth in the commercial use of aerial drones but this is also the case for electrical equipment in other segments.

Electronics for test and measurement systems grew strongly last year. The segment is expected to maintain its growth

Credit: Micro-Epsilon UK

One example is RFI (Radio Frequency Interference) equipment. With the growth of connected systems in the home, on the road and on the factory floor, there is a growing problem of electro-magnetic compatibility (EMC). Under current European standards, anything with an antenna in it needs to conform to stringent EMC requirements, so the level of testing has increased dramatically. EMC test house capacity is stretched and more companies are opting for in-house facilities.

One company that specialises in RFI filters for the defence industry, MPE in Liverpool, has recently expanded to meet the needs of the commercial market and is planning further expansion to cope with expected demand. During a recent visit to MPE, the company's Director, Paul Currie told me,

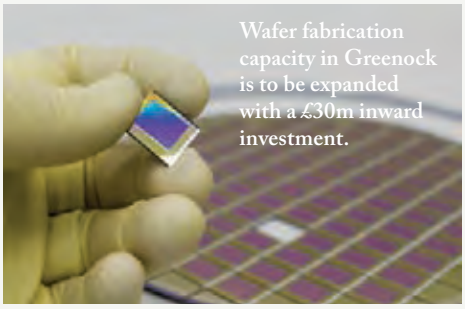
"Our roots are in the defence industry and we've always had a stable business with them but we're now being approached more often by companies in the commercial sector that need our products. We have the space to expand to meet this demand and we're planning that now."

Product Volume Performance

Table 1 shows the financial revenue performance for UK electronics manufacturing. This has been largely flat for most product groups with a small uplift last year in populated electronic boards. However, this still didn't attain the same levels as 2013. In line with the cross-industry collaboration on new product introduction and growth in electronic content, the "measuring and test instruments" product group showed the greatest growth last year and this is expected to continue.

Table 2 shows the same metrics for electrical equipment products with a similarly flat profile except for wiring devices, which leapt in 2017 and has maintained its higher level, and domestic appliances, which crept up last year but still didn't reach 2013 levels.

WAFER FABRICATION INVESTMENT IN SCOTLAND



Wafer fabrication capacity in Greenock is to be expanded with a £30m inward investment.

Greenock near Glasgow has been in the heart of what was once Scotland's emerging silicon valley for decades with one of its core companies being Texas Instruments (TI). The take-over of TI's wafer fabrication plant in February 2019 by Diodes Inc. ended the threat of closure after TI had announced it was withdrawing operations from the town three years earlier.

Now, Diodes is investing £30m into the plant to modernise existing equipment and replace key staff, who had left during the threat of closure.

According to Diodes CEO, Dr Keh-Shew Lu, the re-equipped plant will provide the wafer fabrication capacity needed by the company to meet its automotive electronics expansion initiatives.

"Our technical and operational performance expectations will be met with the excellent wafer fab know-how and engineering skills that exist at the plant," he said.

The company's other UK facility in Oldham, Lancashire won an electronics industry TechWorks award for its performance and innovation.

CHALLENGES AND PROMISES

2019 has been a challenging year for UK textile manufacturing, but the outlook is promising, provided that some key issues can be addressed.

BY KATE HILLS

Following a significant decline in textile manufacturing in the UK since the late 1980s, the sector has experienced a period of slow but steady growth over the last decade. This has been driven by a number of factors, including the International appeal of a 'made in UK' label and the lower carbon footprint of sourcing locally, as well as the more rapid delivery of product required to fulfil the demand for 'fast fashion'. The latest UK Fashion & Textile Association figures show that the value of UK fashion and textile exports reached almost £10bn, representing an increase of 66% in a decade.

> More than 80% of manufacturers had unfilled machinist vacancies in 2019, accounting for an average of 65% of existing positions.
>
> *Source: All-Party Parliamentary Group for Textiles and Fashion*

But despite the continued growth, 2019 has been a difficult year for many UK textile manufacturers, caused by the uncertainty surrounding Brexit, the continuing closure of retailers on the High Street, and the ongoing issue of the lack of skilled staff. This combination of factors has caused many manufacturers to be cautious about investing too heavily or taking unnecessary riskvs, and has seen some closing all UK manufacturing operations altogether.

NEWS IN BRIEF

Lower CO_2 from local manufacturing
A research project by clothing manufacturer David Nieper, in conjunction with the University of Nottingham, found that carbon emissions are 47% lower for clothes manufactured in Britain, rather than overseas.

Dr Marten's
Footwear manufacturer Dr Marten's plans to invest £2m in its Northampton factory, doubling UK production to 165,000 pairs of shoes a year.

Future Fashion Factory
Sustainability within textile manufacturing is a key area of focus for Future Fashion Factory, a £5.4 million Research and Development partnership exploring and developing new digital and advanced textile technologies, particularly those that reduce waste in the design and manufacturing process.

Abraham Moon & Son
Leeds-based textile firm Abraham Moon & Son, is receiving funding from Future Fashion Factory which in developing a colour measurement system to ensure cloth consistently maintains specified colour throughout the production process, thereby reducing waste.

AW Hainsworth
Weaver AW Hainsworth has introduced a new designer-led short production run service for bespoke fabrics, allowing brands to manufacture cloth in smaller quantities.

Skills shortages: sewing and reaping
By far the biggest challenge that is facing UK textile manufacturing looking into the next decade is the lack of skilled talent in the UK, particularly in the sewing and garment construction side of the sector. Many manufacturers report that local staff are difficult to attract into an industry that is still seen by many as on the decline and apprenticeship schemes are not producing the required amount of new talent quickly enough to keep up with demand.

At the end of 2019 The All-Party Parliamentary Group (APPG) for Textiles and Fashion surveyed manufacturers across the UK and found that more than half employed EEA citizens for machinist roles, and the UK's exit from the EU would pose significant risk to the growth of the sector because manufacturers would be unable to meet the current demand for staffing. The APPG has proposed to add several textile worker roles, including garment machinist and garment technologist, onto the Shortage Occupation List to facilitate employment after Brexit, in order to stem the loss of workers that has been happening since the referendum.

To address the issue of skilled staff within the industry, training initiatives are being put in place to address specific gaps in knowledge, including a tailoring academy based at Fashion Enter factory in North London and a centre for artisan accessory and leather makers in Kent. The UK Fashion and Textiles Association, which is the sector skills body for the UK, is working with manufacturers to develop new vocational and academic routes into the industry.

Manufacturers are also looking to use augmented reality to train new employees and cut down time-consuming and labour-intensive training which can take a minimum of six to eight months. Yarn spinners Laxtons are working on a project using AR techniques to develop immersive training packages for its staff, allowing them to gain virtual 'hands-on' experience of complex production processes.

> "UK fashion and textile exports have reached almost £10bn, representing an increase of 66% in a decade."

Sustainability
2019 was the year that sustainability came to the fore in textiles. The Environmental Audit Committee launched an enquiry into the sustainability of the UK fashion industry, which included concern over pay at UK garment factories in Leicester. The result of the enquiry was the Fixing Fashion Report, which was presented to Government in February 2019, but the recommendations were later rejected. Despite this, many brands and retailers are now choosing to make textiles locally because of the much lower carbon footprint that it affords.

Whatever the future decade holds for the UK textile industry, one thing for sure is that sustainability will be high on the agenda. Manufacturers that do not find ways to lower their carbon footprint, create less waste and provide ethical working conditions for its staff, will fall by the wayside over the coming years. On the other side of the coin, those that do will continue to be in much demand and will help to see the UK textile industry thrive again.

Make it British

The Make it British Exhibition 2019 was held at the Business Design Centre in Islington, North London, 29 & 30 May 2019. Thousands of British-based manufacturers, retailers, designers and academics gathered to showcase the creativity and diversity of UK manufacturing and to share their stories. The next event is scheduled for 17 & 18 March 2020, at the same venue.

FOR FURTHER INFORMATION AND TICKETS VISIT HTTPS://MAKEITBRITISHLIVE.COM/

MACH 2020

MACH 2020 promises the perfect showcase for manufacturing technology

"The Manufacturing Technologies Association (MTA), were able to announce in March that Lloyds Bank had agreed to be the headline sponsor for MACH, for the fifth consecutive time."

"It is integral to the success of MACH that our exhibitors and visitors can have proper access to finance, from a bank that understands manufacturers' needs."

MACH is the longest-running manufacturing and engineering exhibition in the UK, showcasing the largest variety of manufacturing technology solutions in the country, all under one roof. Taking place at the NEC in Birmingham between 20th – 24th April, and with 95% of exhibition space now sold, MACH 2020 is set to be an unmissable event for the UK manufacturing and engineering community and one of the best exhibitions in the event's long history.

It will offer offers major benefits to both exhibitors and visitors alike; not least, in the sheer scope of the event.

Mills CNC has been a frequent exhibitor at the show and is returning in 2020 because MACH offers it the perfect platform on which to showcase its products and delivers on customer expectations.

"MACH is the UK's largest manufacturing technology exhibition and it allows us to have a large stand where we can display our full range of machines," said Tony Dale, Technical Director, Mills CNC. "We view it as an essential part of a larger, two-year promotional strategy.

"You can read all the brochures you like but there's no substitute to seeing a live demonstration. Exhibiting at MACH allows us to demonstrate all our machines; customers can see them in action and gauge them against competing products."

Sponsorship

The exhibition's organisers, the Manufacturing Technologies Association (MTA), were able to announce in March that Lloyds Bank had agreed to be the headline sponsor for MACH, for the fifth consecutive time.

The Bank has recently reaffirmed its support for manufacturing by increasing its lending to the sector. Having originally pledged in excess of £6 billion between 2013 and 2018, it has pledged a further £1 billion per year of new lending, through to the end of 2020.

James Selka DL, CEO of the MTA said: "With Lloyds Bank's pledge to lend a further £1 billion per year to the UK manufacturing sector until 2020 and the expansion of the Annual Investment Allowance from £200,000 to £1,000,000, MACH 2020 will be the perfect platform to stimulate investment.

"A lot of changes have taken place within the manufacturing technologies sector during one of the most turbulent political and economic periods in UK history. It is remarkable for one institution to remain loyal to an event and we are very grateful to the bank for its unwavering support."

"It is integral to the success of MACH that our exhibitors and visitors can have

proper access to finance, from a bank that understands manufacturers' needs."

Tooling Technologies

Constant improvements in tooling technology continued to push the boundaries of machining productivity and quality during 2019.

MACH 2020 will be the perfect platform on which to showcase these developments. The event will offer visitors an in-depth look at the work being pioneered by the likes of leading tooling manufacturers such as Ceratizit, Guhring and Horn.

Cobots

The application of robots and automation in manufacturing will continue to shape the sector in 2020 and beyond as Industry 4.0's impact continues to grow, offering major opportunities for even the smallest of companies.

Many SMEs believe that traditional robots are unsuitable for them; many staff simply lack the skills to operate them. Installation can be costly and the initial investment can be hard to justify if volumes are relatively small.

However, advances in robot technology mean that machines are becoming more affordable and many companies are keen to explore the benefits of using automated processes to bridge the productivity gap and overcome the difficulty of finding skilled labour.

Supply Chains

With the UK's future trading relationship with the EU still unclear, British OEMs and higher tier manufacturers are looking to strengthen ties with local suppliers, many of which are, in turn, looking to build stronger bonds with UK-based customers.

Many SMEs have taken the decision to reshore production. By bringing everything in-house, companies can more effectively regulate batch quality and dramatically decrease lead times, a process which could take up to six months in places like China.

"With the UK's future trading relationship with the EU still unclear, British OEMs and higher tier manufacturers are looking to strengthen ties with local suppliers, many of which are, in turn, looking to build stronger bonds with UK-based customers."

The advantages of such a strategy are many, especially as producing goods in China and other emerging economies is no longer as viable as it once was, due to rising labour costs.

The UK Supply Chain Zone at MACH 2020 will be an ideal opportunity for manufacturers and suppliers, exhibitors and visitors to build new relationships and to network with industry experts.

Digitalisation will also be a key theme of MACH 2020 and it is an area with which MACH organiser MTA is very familiar, having been a key participant in the Made Smarter Industrial Strategy Review. Manufacturing SMEs consistently recognise that MACH is the place where they can access the innovative manufacturing technology vital for a digitally integrated, productive UK supply chain.

Additive Manufacturing

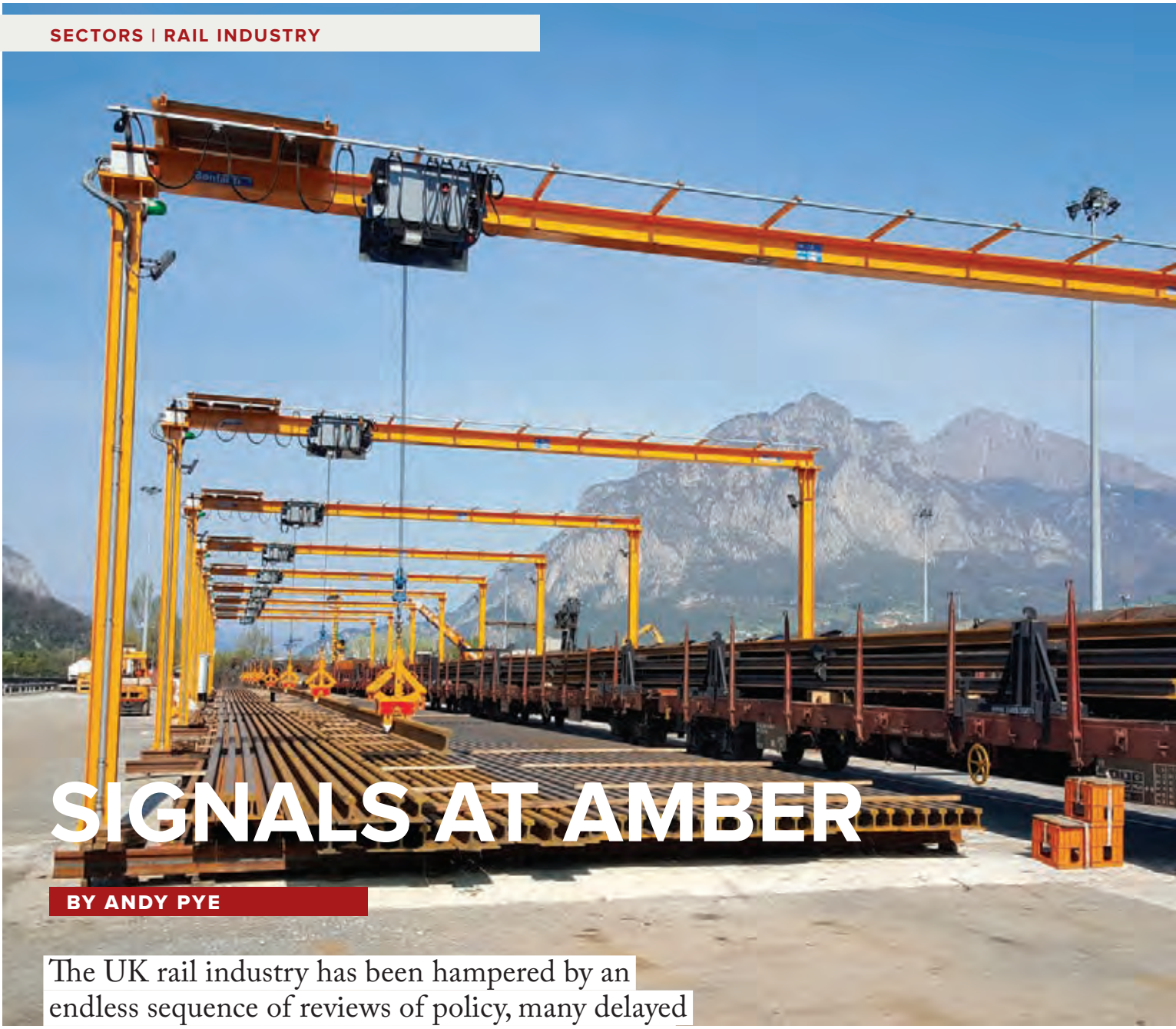
The enhanced role of additive manufacturing is recognised at MACH 2020. No longer just for prototyping, 3D printing is now a production tool in its own right. The use of new materials, new applications, improved processes and the production benefits offered by additive manufacturing will all be key themes at the show.

Connecting Manufacturing

Industry 4.0 is about the importance of creating a truly connected manufacturing environment and offers game-changing possibilities for manufacturers. As such, connectivity will once again be one of the key themes for MACH 2020.

The event will give visitors the chance to evaluate these technologies and better understand the potential for their businesses.

For information on this and more, visit www.machexhibition.com



SIGNALS AT AMBER

BY ANDY PYE

The UK rail industry has been hampered by an endless sequence of reviews of policy, many delayed or refocused by the political landscape, dominated by Brexit issues and political stagnation.

As we come to the end of 2019, facing a General Election and an on-going review of the HS2 in prospect. Such uncertainties curtail investment and future planning.

In January 2009, government examined the case for the new high-speed HS2 line between London and the West Midlands. The decision to proceed came in January 2012, with the planned line opening in 2023. The plans were approved by government in November 2016. A new review was set in train in August 2019 by the new Secretary of State for Transport Grant Shapps to provide clear advice on the project's future.

"It is only fitting for the government to celebrate the 10th year anniversary of the project by commissioning a review to determine whether HS2 is a good idea and whether it should be cut back or abandoned!" jibes Ian Brown, Policy Director of Railfuture, a leading UK voluntary organisation campaigning for better rail services for passengers and freight.

The decision was postponed until after the election on 12 December. However, it is reported that the team have now leaked the report conclusion, saying that the HS2 project should go ahead in full, and circulated it widely to stakeholders who have very publicly welcomed it.

Stress-free heat-treated rail from British Steel.


Credit: Bombardier Transportation

LOOKING DOWN THE TRACK

- Train building: Hitachi Rail announced 250 redundancies at its Newton Aycliffe factory in January. Last year it missed a contract to build trains for Tyne and Wear Metro. Hitachi said the workforce would be "resized to a team of skilled, core full-time employees".
- Network Rail will invest £245m in R&D over the next budgeting period, Control Period 6 (CP6), which runs from 2019-24.
- HS2 report expected to confirm that the project will go ahead in full.
- Conversely, Crossrail will not open in 2020 and its cost has increased again by up to £650 million. The bill for the scheme could reach £18.25 billion, an increase of between £400 million and £650 million on the latest funding commitment made in December 2018.
- A Brexit effect likely in the rail industry, from a paucity of skills required to deliver the major infrastructure programmes like HS2 and Crossrail; increased costs for manufacturers having customers paying in Euros; and some reduction in demand for travel from more stringent immigration controls.
- $30 billion to be spent in the next 12 years on IoT projects in the rail sector, to bring about radical improvements in services and information for passengers and in manufacturing techniques and predictive maintenance.
- Progressive eradication of diesel engines, with freight being the major challenge.


Credit: Bombardier Transportation

The UK Government has called for diesel-only trains to be phased out by 2040.

Brown observes that, although the Department for Transport (DfT) is the project sponsor of HS2, it is the Prime Minister and the Treasury who will decide and there is no evidence that they will automatically follow any recommendation.

More generally, according to the Office of Rail and Road, the future for rail appears bright. Rail passenger journeys in Great Britain in 2019-20 Q1 increased to 439 million (2.4% rise compared to 2018-19 Q1). And it is technology that leads the future of the rail industry.

Green transportation

Backed by new regulations and environmental groups, the global trend towards greener forms of transport is affecting the rail industry. In response to a Government call for the use of diesel-only trains to be eradicated by 2040, the Rail Safety and Standards Board (RSSB) has set up a Decarbonisation Task Force.

"Freight is very challenging to decarbonise because you need a lot of power. Currently, only diesel engines and overhead electrification can provide those levels of power within the confines of our Victorian infrastructure," says Professor Paul Allen, Assistant Director of the University of Huddersfield's Institute of Railway Research.

The Digital Displacement for Non-Passenger Rail project features a consortium of Artemis Intelligent Power, the University of Huddersfield and Direct Rail Services, with support from Freightliner and Voith Turbo. It is using Artemis' digital displacement technology to develop a more efficient alternative to conventional hydraulic pumps for providing traction and auxiliary power for freight locomotives, shunters and on-track plant.

"A conventional hydraulic pump that operates constantly is inefficient. But with an electronic control, you can effectively switch idle cylinders on and off," says Allen.

Digitalisation

Cisco suggests that around $30 billion will be spent in the next 12 years on IoT projects in the rail sector. Potential applications range from advanced passenger information systems to real-time incident alarms and better manufacturing and maintenance procedures. Train travellers now want to surf or use the compartment as a mobile workstation. Operators are investing in robust Wi-Fi access that is bandwidth-friendly and stable throughout the trip. With Ethernet through Single Twisted Pair (SPE), trains can be equipped with future-ready Gigabit Ethernet.

Industry 4.0: the "Railway Internet of Things", like its industrial counterpart, is

£3.5M PANTOGRAPH TEST RIG

There is a vital need for research that will improve the technology, especially the pantographs that collect current from overhead catenary wires. When they fail, schedules are disrupted and there can be safety risks.

Now, the University of Huddersfield's Institute of Railway Research (IRR) is to be the site for a world-class, £3.5 million pantograph testing rig, expected to be commissioned in 2020.

Specific to the UK, which was an early adopter of electrification, is the low level of investment in system renewal. Also, the large number of Victorian tunnels with limited levels of clearance pose problems.

"We aim to improve pantograph and catenary technologies, to get better current collection," said João Pombo, Professor of Railway Technology.

TRB: MANUFACTURING DOORS FOR WEST MIDLANDS RAILWAY PROJECT

TRB Lightweight Structures is working with CAF to design and produce gangway doors for 17 new trains for West Midlands Railway. The doors section the cab off from passengers in driving mode, or are used to create additional corridor space, allowing passengers to move between coupled sections. The lightweight doors have an aluminium external skin with a honeycomb core

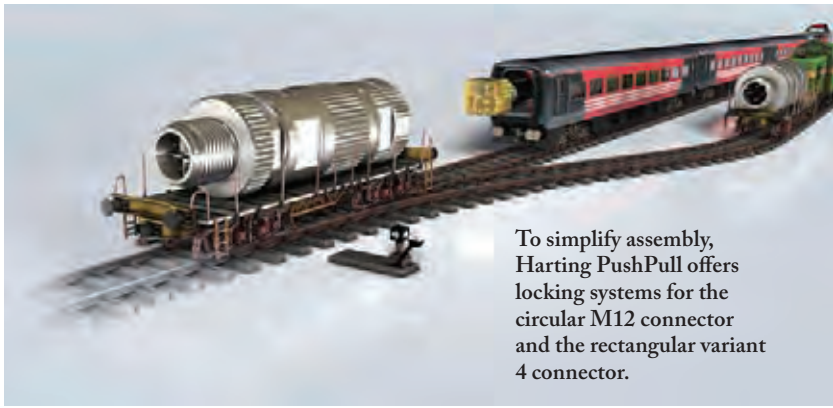
"The 136 doors – four per cab and overall eight per train – have been designed to meet GM/RT 2100 Rev 5 regulations, and will be impact tested to BS EN15152 standards to meet the stringent safety requirements of the UK rail sector.," said Lyndon Newman, Lead Engineer of Rail at TRB."

UK LEDS LAST MORE THAN 100,000 HOURS

The LED bulkhead lamps on the buffers at the end of railway lines are designed and manufactured by Marl in Ulverston in Cumbria, and known for outstanding reliability, lasting a minimum of 100,000 hours, equating to almost 11.5 years of continuous use.

Now Marl is to expand into other rail networks across Europe, Australia and Asia. The white lights are also ideal for lighting walkways, paths and subways around towns and cities. Red, orange and green illuminators can also be used in big warehouses for marking out different stages of a distribution process.

"The 084 series has been an unsung hero of the UK rail network for years," said Graham Round, Marl's Sales & Marketing Manager. "When it comes to construction sites, for example, the bulkheads can be removed when the project is finished and moved and reused on another site, as they will last for years."



To simplify assembly, Harting PushPull offers locking systems for the circular M12 connector and the rectangular variant 4 connector.

opening up opportunities in vital areas: services and information for passengers and more effective manufacturing and predictive maintenance.

Cyber Security: with increased connectivity comes increased vulnerability, as previously closed systems are now open to the public Internet. The rail industry is becoming proactive in taking steps to protect their networks.

All the cyber security techniques applied in the factory are relevant — separating zones with firewalls, monitoring network activity and updating firmware and patches on all assets, keeping up to the minute on known vulnerabilities.

Virtual Reality: the production of expensive advance models can be greatly improved by using virtual test runs. Augmented and Virtual Reality (AR/VR) are enhancing training sessions for rail personnel and can assist remote asset management routines, reducing the dependency on needing experts available on the ground physical.

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MIXED SHIPPING

While UK shipbuilding continues to descend into the doldrums, production and profits remain on a strong upward trajectory for British yards designing and building small craft and luxury superyachts. *Dennis O'Neill*

For centuries the United Kingdom has enjoyed enormous economic benefits from the global success of its diverse and innovative maritime sectors. Today, though, its boat builders and commercial shipyards face contrasting fortunes. While the shipbuilding sector sinks to its knees, crippled by a gloomy and uncertain future, the leisure boat sector is booming.

Naval problems

In 2019 three leading commercial shipyards fell into severe financial difficulties – two hundred jobs were lost at Appledore shipyard in Devon after Babcock International chose not to renew its lease; the Ferguson Marine shipyard in Glasgow had to be taken into public ownership, with £50m of taxpayer loans written off after it failed to deliver a ferry contract; and in Belfast, Harland and Wolff, famous for building Titanic, was saved from closure at the last minute after a London-based energy company stepped in with a £6m rescue deal.

The MOD's tender process to build support ships for the Royal Navy's two new Queen Elizabeth-class aircraft carriers has been abandoned. Credit: MOD]

The precarious outlook for British shipyards has been blamed on the UK government's flawed National Shipbuilding Strategy, launched in 2016, which has now floundered dramatically. Central to the problems has been a tendering procedure set out by the Ministry of Defence for £1.5bn in major naval contracts – including ships needed to support and supply the Royal Navy's two new Queen Elizabeth-class aircraft carriers – that proved so unsuccessful it was suspended in December 2019, leaving most of the UK shipbuilding industry with no idea of how to view future prospects.

The Superyacht sector has recorded its 7th successive year of growth.
Credit: Sunseeker

Superyacht success

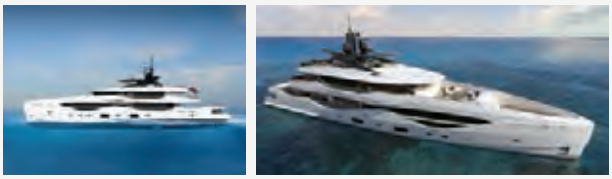
Meanwhile, figures released in September 2019 by British Marine reveal that the UK's superyacht sector had recorded its seventh successive year of growth. In 2018 45 yachts, combined value over £24m, were produced in the UK, including three sailing yachts; as 2019 drew to a close 109 yachts were on order or under construction. In terms of volume, the UK is now the world's third largest builder of superyachts. Two-thirds (66%) are exported, mainly to the US and Eurozone; important growth regions for new sales include emerging markets in Southeast Asia and the Middle East.

Sailboat sector

At the other end of the size scale, the UK continues to be an important player in the global sailing dinghy market. After a post-recession decline, UK production is once again posting strong figures, having grown 6.7% from 2013 to 2016. The sector is dominated by a handful of manufacturers, led by Topper International and Laser Performance Europe,

SUNSEEKER

Credit: Sunseeker



Sunseeker's new 161 Yacht will be built in aluminium

Sunseeker has become the iconic British superyacht brand. It has delivered 137 yachts over 30m since 2000 and, in 2020 it plans to double the number of models it has on offer, to 22. While the majority of these will be built conventionally in GRP, its largest superyachts – including the new 161 Yacht – will be constructed in aluminium. Sunseeker's new CEO, Andrea Frabetti, has initiated a substantial product development programme, which will see the company invest £60m over the next three years.

Credit: Princess Yachts

At 130ft the tri-deck 40M is Princess Yacht's flagship superyacht.

Plymouth-based **Princess Yachts** employs more than 3000 people across seven plants. In 2019 it built more than 250 vessels, marking six consecutive years of strong growth, and returning an annual profit of £29.8m.

The company designs and fabricates all of its components in-house, builds its own plugs using a pair of five-axis cutting machines, and uses resin infusion to create decks and superstructures.

"None of our components is sourced off the shelf or from third-party firms," explains technical manager, Paul Bailey. "Everything is designed and built by our own craftsmen to ensure a much more artisan and bespoke finish than you would you get from any other boatbuilder."

Each new Princess model is initially built, in exhaustive detail, full-size out of plywood, enabling the designers to step on board and examine it thoroughly first-hand and explore head heights, door openings and spatial arrangements. Any snags can then be tweaked before production begins.

A key driver behind Princess's success is the manufacturing approach of chairman, Anthony Sheriff. After arriving from the automotive sector, he invested heavily in a 'No Fault Forward' quality management system, which identifies any faults early in the build process, so they can be remedied before being passed to subsequent production stages.

RIBS ON THE RISE

Scorpion twin-outboard RIB

Credit: Scorpion RIBs

RIB manufacturing is one of the UK's great boatbuilding success stories, with large volumes produced for the leisure market as yacht tenders and high-speed pleasure craft. After a prolonged decline between 2008 and 2012 it has finally returned to pre-recession levels, with 1060 units built and sold in 2018. Production volume is led by Williams Jet Tenders, which builds a range of waterjet RIBs under 7.5m, followed by a number of highly respected brands including Ribeye, Ribcraft, Cobra, Rib-X, Scorpion, Pascoe and Redbay, which produce 7.5m to 12m craft.

POLAR PUSH

Sir David Attenborough is the world's most advanced polar research vessel.

Credit: British Antarctic Survey

Officially launched by the Duchess of Cambridge in September 2019, RRS Sir David Attenborough is the most advanced polar research vessel in the world. Representing a UK government investment of £200m, it will be operated by British Antarctic Survey, spending northern summers supporting Arctic research and during southern summers in Antarctica.

Sir David Attenborough was constructed at Cammell Laird using a modular system that bolted together several individually fabricated blocks. The129m ship will collect deep-ocean data using a fleet of robotic and remotely operated devices, including Boaty McBoatface, its famous 3.6m autonomous long-range submersible, which can be deployed to depths of 6,000m.

CANAL BOAT PRODUCTION

Credit: Aintree Boats

The UK builds around 200 new canal boats each year.

Canal boat production in the UK fell by a third between 2008 and 2009, and since then annual unit output has hovered around the 200 mark. Construction of new build narrowboats and Dutch barges is dominated by a small number of specialist bespoke builders such as Piper Boats, Colecraft Boats, Aintree Boats, Fernwood Boats, MGM Boats and JD Narrowboats.

MARINE DATA

£5bn	541	4.9%	25,616
TOTAL REVENUE UK SHIPBUILDING IN 2019	SHIPBUILDING BUSINESSES IN THE UK	UK SHIPBUILDING ANNUAL GROWTH 2014-2019	UK SHIPBUILDING EMPLOYEES
£777bn	9,477	1,288	1,060
UK BOATBUILDING REVENUE	UK BOATBUILDING UNIT PRODUCTION	UK MOTORBOATS BUILT IN 2018	UK RIBS BUILT IN 2018
7,050	580	466	43	204
UK DINGHIES BUILT IN 2018	UK MOTORBOATS (UNDER 12M) BUILT IN 2018	UK MOTOR YACHTS (12 TO 24M) BUILT IN 2018	SUPERYACHTS BUILT IN 2018	CANAL BOATS BUILT IN 2018

Credit: Credit: BAE Systems.

LOOKING AHEAD

One UK shipyard that is managing to look forward to the future is Cammell Laird. In 2018 the Merseyside yard won two 10-year contracts, worth £619m, to support the Royal Fleet Auxiliary and was awarded a £160m contract to upgrade and modernise the propulsion systems on the Royal Navy's Type 45 destroyers. It also agreed a long-term deal with BAE Systems to support the construction of the Royal Navy's next generation of Astute-class nuclear submarines. Its participation has been aided by investment in a new nuclear research and development hub, in partnership with the Nuclear Advanced Manufacturing Research Centre (NAMRC).

Left: **Discovery Yachts builds a range of monohulls and catamarans from 42ft-74ft.**
Credit: Discovery Yachts

who each produce thousands of units annually.

A number of smaller companies specialised in producing larger cruising sail yachts, with a handful of significantly sized manufacturers, such as Oyster, Discovery, Rustler and Spirit. In 2018, Oyster almost went under; with reduced output from that company, overall UK sailing yacht production was down 7% year-on-year to 79 units in 2018.

The latest Seaward Nelson 35 E18 twin-screw all-weather motor cruiser at speed in the Solent.

Credit: Seaward

Motorboating

With almost 600 units produced annually, a key component of British boatbuilding is production of motorboats under 12m. The sector includes small motor launches and speedboats to cabin motorboats and larger cruisers and, like sailboats, is served by numerous small-scale producers and a handful of significantly sized manufacturers, such as Orkney, Hardy, and Seaward. After a serious decline between 2008 and 2009, motorboat production has remained relatively consistent for most years since. With a slow domestic market, builders in this sector are increasingly looking towards overseas markets, especially Scandinavia and northern Europe, where smaller motor-cruisers are a fixture of family life.

Production of mid-sized motor yachts (12-24m) declined heavily after 2008 and now accounts for less than a third of its pre-recession output. Production volumes also reduced as some UK motorboat builders shifted focus towards the production of superyachts.

A WIND OF CHANGE

BY BRIAN DAVIS

Faced with a shrinking market in the mostly mature oil and gas fields of the UK Continental Shelf, manufacturers of everything from compressors, valves and well tools to remotely operated vehicles (ROVs) are looking to new field developments in export markets, while also diversifying in the fast-growing offshore wind market.

A wind of change is blowing through offshore energy equipment suppliers.

The transition from oil and gas towards renewable sources including wind, solar and tidal, is a key area of focus. To some extent, oil and gas related supply chains are adapting to serve the offshore renewables sector in terms of maintenance and repair and production of structural elements.

Decommissioning

There are also new opportunities with the decommissioning of old oil and gas platforms and pipelines here and abroad. UK expenditure on decommissioning is expected to be about £1.5 billion per year over the next decade according to the Oil and Gas Authority (OGA). Looking globally, Wood Mackenzie forecasts that $82 billion will be spent worldwide on decommissioning over this period.

Challenging times

Revenues in the UK offshore oil and gas supply chain have shrunk by about one-third, from almost £40 billion in 2014 to £27 billion in 2017 (according to last available data from EY OFS Report 2019). The industry has seen lower investment levels, reduced contract rates together with significant optimisation. The OGA is working with the industry to reduce costs of UKCS projects by 35% by 2022. Oil & Gas UK (OGUK) Economic Report maintains there has been some growth and improvement in investment levels during 2018/9.

Many supply-chain companies have diversified into other energy sectors, though the oil and gas business remains the primary source of income for more than half of OGUK members. The OGUK Roadmap to 2035 estimates that the UK government drive to achieve net zero greenhouse gas emissions by 2050 could create £10 billion in value through new technology and innovation.

With eyes on building new export markets after decades of North Sea development, those suppliers that have survived volatile oil prices, slashed costs and highly competitive markets are for the most part feeling positive.

EVENTS AROUND THE ENERGY SECTOR

Expansion

Expansion of the Baker Hughes Montrose Subsea Centre of Excellence benefited from a £31 million investment by the GE-owned company, supported by £4.9 million through Scottish Enterprise. The campus provides a 'one stop shop' with advanced manufacturing technologies serving global activities and the energy transition.

Leaner operations

Unique Group's Buoyancy and Ballast Division provides Water Weights and Seaflex products for over 100 countries, manufactured at various facilities including plants on the Isle of Wight and in Aberdeen. Mid-2019, Unique Group made a multi-million investment in assets, technology and people, including an upgrade of its Aberdeen premises. Seaflex recently invested in three Forsstrom high frequency welding machines.

'The investment has facilitated manufacture of 110 tonne water weight bags and removed a large degree of manual handling,' says Graham Brading, Unique Group's Buoyancy and Ballast Group Director. 'The company has also adopted lean initiatives throughout its global manufacturing facilities, to increase productivity and quality.'

Storm of activity

Today, over a third of UK electricity comes from renewable sources, with wind farms providing half the clean power. The UK is a global leader in offshore wind, with more capacity installed than any other country and has outstanding export opportunities.

The Offshore Wind Sector Deal announced by the Government and industry in March 2019 ensures that by 2030 the UK will be generating over one third of electricity from offshore wind alone – trebling capacity to 30GW. Under the sector deal, the value of exports of offshore wind goods and services is set to increase from about £500 million, to £2.6 billion a year by 2030, according to the Office for National Statistics. The third auction for wind licence contracts to generate power (Contracts for Difference) saw a record amount of new offshore wind capacity procured at record low prices, notes RenewableUK.

WELL CLEAN UP

Well-bore drilling, plug and abandonment tool makers **Coretrax**, based in Aberdeen, recently acquired Churchill Drilling Tools. 'This acquisition increased our downhole product portfolio and manufacturing capability, while we progress with plans to broaden our well construction and intervention offering,' says Kenny Murray, CEO, Coretrax. 'We are forming a group structure which will also include Mohawk Energy, North America and Asia Pacific. These are target markets in the year ahead.' Coretrax has experienced sustained growth this year with new contracts and project renewals in the UK, Middle East and South East Asia.

BIGGER BLADES

Siemens Gamesa took the plunge in 2016 to invest £310 million with Associated British Ports in a massive factory in Hull and execution port, making wind turbine blades up to 75 metres long initially. In 2019, the company invested a second tranche and has begun manufacture of 81.5m blades.

'Producing wind turbines is a bit like an arms race – there's always demand for bigger!' remarks Ray Thompson, Head of Business Development in the UK. 'The market is amazingly positive, particularly with the new UK Government sector deal commitment. Offshore wind has made the transition from being very expensive technology to a cheap, accessible source of green electricity production.'

Blades are cast in a single construction with three raw materials, fibre glass matting, fibre glass resin and balsa wood. Fibre glass is layered into a mould, with a former in the centre and strips of balsa wood to give it strength. Resin is drawn in under vacuum and the blade dry cast as a single piece. 'The lay-up process is very labour intensive and cutting the fibre glass matting requires "almost fabric and tailoring skills" to handle complex patterns,' explains Thompson.

Siemens Gamesa has supplied blades for several UK windfarms including Hornsea 1, the biggest offshore windfarm in the world, and will be targeting markets across Europe, the US and Asia.

PLOUGHING AHEAD

Northumberland-based **Osbit** designs and manufactures offshore equipment for well intervention in oil and gas operations. The company also provides back deck and subsea systems for the fast-growing wind sector. A recent example is a boulder clearance and pre-lay plough for Global Marine, to be used on the Kriegers Flak wind farm for Vattenfall. Osbit is also currently producing a monopile gripper system, for Malaysian offshore contractor, Sapura Energy.

Osbit has produced equipment for offshore wind farms in the UK, Belgium, The Netherlands, Japan, Taiwan and China.

'We design and manufacture bespoke equipment for offshore activities and see particular growth in offshore wind cable and foundation installation. To meet these requirements, we are continuing to design and manufacture systems in the UK, but are also looking at production in locations more local to our clients' projects, such as our project for Sapura which will be primarily fabricated, assembled and commissioned in Singapore,' says Ben Webster, Sales and Tendering Manager.

Future prospects

Given UK supplier's five decades of experience developing North Sea oil and gas platforms, prospects for winning business in rapidly evolving markets in South East Asia, China, India and Africa and elsewhere look hopeful. Many initiatives will be driven by new collaborative partnerships. Decommissioning, field automation and digitalisation will be key driving forces for UK manufacturers and software service providers.

The success of offshore wind development in UK waters signals the potential for significant opportunities in a host of export markets also.

NEW RENEWABLES FOCUS

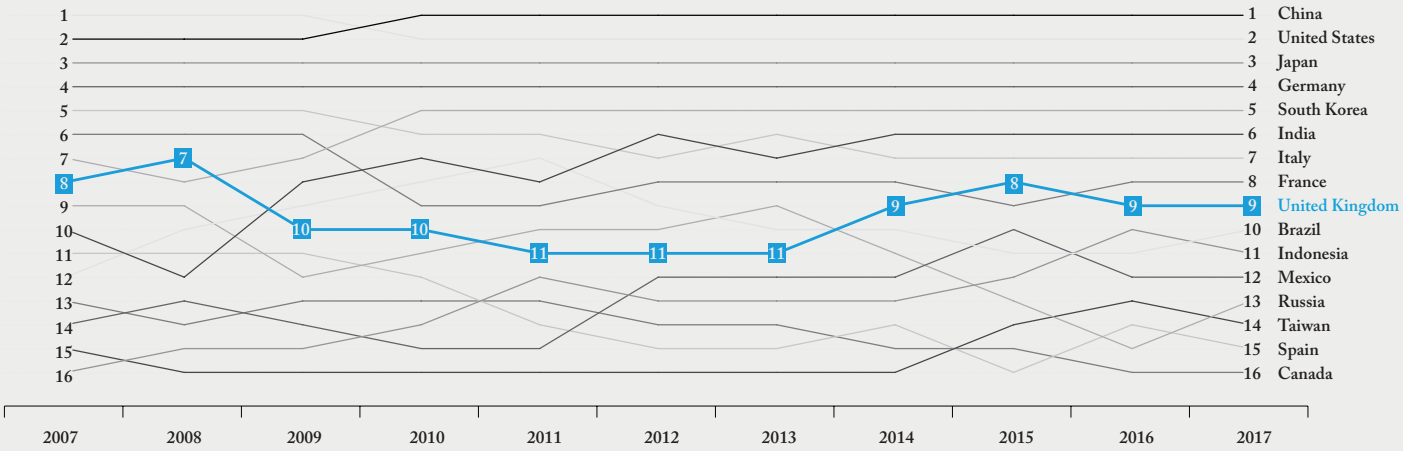
Cheshire-based steel designer and fabricator **Hutchinson Engineering** made the switch from the oil and gas sector to focus primarily on the offshore wind farm market four years ago, as well as serving the telecom and rail business. The company supplies bespoke access platforms, ladders and other large plant support structures.

Hutchinson Engineering has doubled in size to over £20 million turnover since the new focus on renewables, with exports of about £5 million and employs 165. 'The new Sector Deal on wind contracts has been a big boost for us,' says Neal Scrivener, Business Development Manager, Hutchinson Engineering.

The plant has modern machinery including a Ficep Gemini, 4kW Amada laser profile machine and HGG pipe cutter. Plate rolling, using newly acquired Sertom 35/50 4RV Bull rollers for large plate and Davi MCB 3028 rollers for smaller tower sections. In 2017, Hutchinson invested in a blast and paint facility at the port of Garston, to handle structures up to 32 metres long. Work is underway on internal platforms and decking for transition systems on the Hornsea 2 wind farm.

Credit: Hurchinson Engineering

AS OF 2017, THE UK WAS NO 9 IN THE WORLD BY MANUFACTURING OUTPUT



Source: UNCTAD (2017), current USD

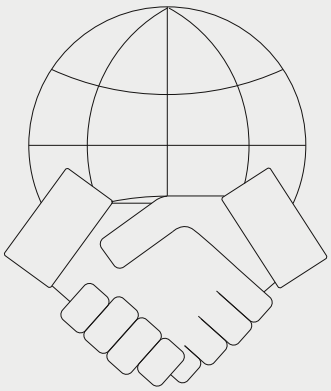
THE UK IS...

Number 9 in total Manufacturing GDP

The world's Number 10 exporter…

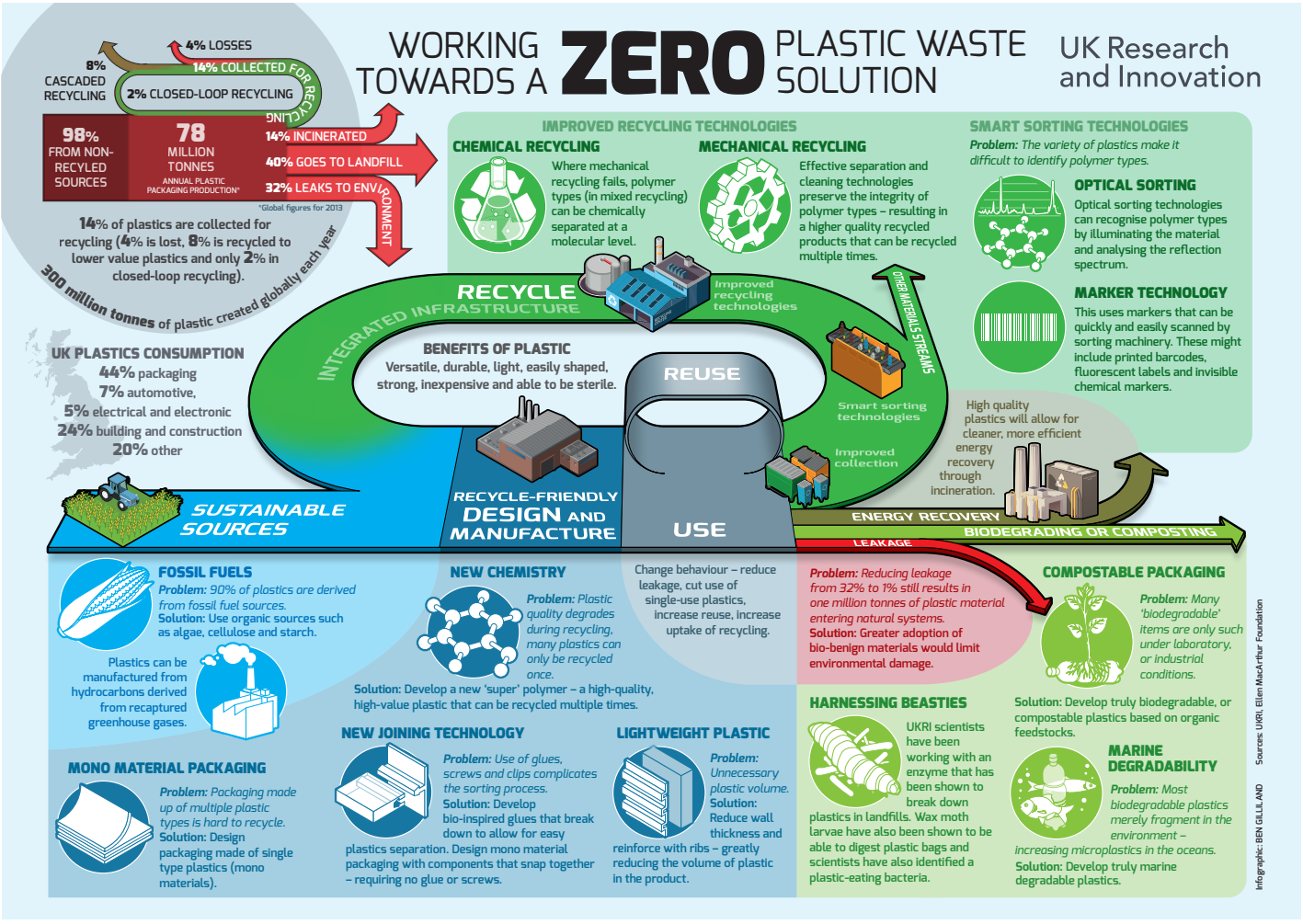
Number 27 for GDP per capita

Number 7 in total trade (imports + exports)



Source: World Trade Organization and World Bank

INNOVATIONS IN PLASTIC PACKAGING



BY Nick Cliffe, Head of Advanced Materials, Innovate UK

During 2019, the entire plastics family of materials and its most common usage, packaging, has been the subject of many miles of column inches, campaigns, tweets and even a television series or two. Entire communities have made public pledges to give up plastics; consumers have been bringing bags of plastic packaging back to retailers to demand they do something; and legislation in the form of bans on items like microbeads and plastics straws has been debated and, in some cases, implemented.

The reason is the challenge of plastic pollution, particularly in the marine environment. As our understanding of the impacts of plastic grows, we are finding it in more and more places, including our own bodies.

A range of materials, uses and relationship issues

Plastics are a diverse range of materials and their properties make them ideal for the manufacture of a wide range of products. They are cheap, strong, lightweight and can be transparent. Their natural barrier properties can be enhanced though use of additives or the construction of multilayer and multi-material structures. The extension of product life that plastic packaging can provide, for everything from fresh produce to pharmaceuticals, underpins the logistics of global supply chains. This diversity and complexity, coupled with the relative low cost of the raw material is, unfortunately, a key component of the issue. As a society we do not value plastics at the end of their first use cycle sufficiently; plastic itself is not the problem – it is our relationship with it.

The solution lies in developing a more circular economy for plastics. Through

UK PLASTICS INDUSTRY AT A GLANCE

£27bn	6200	3rd
ANNUAL TURNOVER	COMPANIES	LARGEST UK MANUFACTURING EMPLOYER

500,000	3.3	1.8
EMPLOYEES	MILLION TONNES OF PLASTICS MATERIALS PROCESSED ANNUALLY	MILLION TONNES OF PLASTICS PRODUCED ANNUALLY

The challenge of plastic pollution, particularly in the marine environment, has become impossible to ignore.

Supermarkets and retailers including Sainsbury's, Morrison's and Waitrose have committed to using less plastic packaging, including allowing customers to bring in their own packaging for products being sold loose.

innovation across the supply chain to reduce, replace, reuse and recycle, greater value can be derived from the material and the likelihood of it ending up as a pollutant decreased. There is growing appetite across the UK supply chain to make this shift, evidenced by the success of the UK Plastics Pact, an industry-wide agreement, managed by WRAP (Waste Resources and Action Programme). Pact signatories commit to four key targets:

- 100% of plastic packaging to be reusable, recyclable or compostable.
- 70% of plastic packaging effectively recycled or composted.
- 30% average recycled content across all plastic packaging.
- Take actions to eliminate problematic or unnecessary single-use packaging items through redesign, innovation or alternative (reuse) delivery models.

As well as signing up to the Pact targets many UK retailers and brands are making their own separate commitments to making their packaging more circular. Sainsbury's has pledged to substantially reduce the overall quantity of plastic it uses; Waitrose and Morrisons are trialling 'unpackaged' approaches, offering more categories of products for sale loose and even allowing customers to bring their own reusable packaging to store.

RECYCLING: A QUESTION OF CAPACITY AND WILL

Gill Jakes, Director of Bosworth Plastics, deplores the lack of recycling capacity in the UK – along with the historic lack of will to build it.

Gill Jakes, Director, Bosworth Plastics

Bosworth Plastics, which designs and manufactures injection moulded engineering components at its base in Hinkley, Leicestershire, has been putting increasing efforts into investigating better ways of making plastics. It has looked at the practicality of dissolvable, compostable and otherwise less damaging polymers but the biggest challenge is now the lack of recycling capacity in the UK.

"We have been trying to close the circle in our own factory and we have a system whereby robots automatically collect waste material from our own processes, put it straight into a granulator and we re-use it," says Gill Jakes, company director.

"But as a country, we haven't invested in our own recycling facilities. We don't have the infrastructure and we don't have the capacity."

The blame for this extends to successive governments, she maintains. Making it financially more attractive to send waste overseas has led to whatever domestic capacity there was being shut down. With China and other recipient countries now refusing to take any more waste, it has nowhere to go and is piling up on docksides and in whatever storage is available. Aluminium cans effectively have a closed loop; PET is easy to recycle and should be. The same effort being put into developing batteries and gigafactories should go into cleaning up the plastics industry.

Bosworth Plastics ensures that waste from production is robotically connected and resubmitted to the manufacturing process

Supporting change: The Smart Sustainable Plastic Packaging Challenge

Innovate UK has developed the Smart Sustainable Plastic Packaging Challenge, part of the Industrial Strategy Challenge Fund, a £60M investment in R&D that runs over the next 5 years. The Challenge will deliver a core programme to support networking and collaboration; it will invest in fundamental research to deliver greater understanding in areas such as the impact of plastic pollution on the environment and consumer behaviour; and it will co-invest with industry across a series of funding competitions, ranging from early-stage research to first-of-a-kind demonstrator projects.

Materials innovation, including improving 'compatibilisation', is about making it easier to use recycled content in the manufacture of new products. This can be challenging for manufacturers who have optimised processes for virgin polymer, particularly if the recycled feedstock is varied in both quality and availability. Approaches being explored include the use of additives to improve the blending of virgin and recycled feedstocks; dynamic monitoring of products with data being used to adjust the rate of inclusion in real-time; and even changes (such as increased inline filtering) to physical handling to optimise the use of recycled material.

Biopolymers, plastics made directly from organic material rather than fossil fuels, and often created to be biodegradable, also have challenges, ranging from developing materials that are 'drop-in' compatible to existing manufacturing processes, through to finding appropriate end-of-life solutions. Although many packaging items made of these materials are tested to composting standards they are not widely accepted in organic waste streams across the UK. (See MarinaTex box-out)

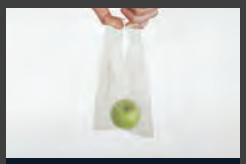
Alternatives to plastics for packaging applications are also being explored, such as mycelium-based materials to replace expanded polystyrene, and insulating packaging made with paper, rather than plastic film.

Advancing recycling

Another focus area will be support for the development of processes and technologies that can deliver high-quality, high-value and highly consistent recycled plastic.

UK STUDENT'S FISH-WASTE BIOPLASTIC WINS DYSON AWARD

British designer Lucy Hughes, a product design student at the University of Sussex, won the annual £30,000 James Dyson International Award with the development of a plastic based on fish skin and scales, which she has named MarinaTex.



Award-winning MarinaTex uses waste from fish processing as raw material

Ms Hughes approached the challenge from the waste stream, rather than virgin materials. She says that 172,207 tonnes of fish waste is produced annually. Her bioplastic composts naturally within six to eight weeks and is light enough to be used in plastic bags. One Atlantic cod may produce sufficient material for 1400 MarinaTex carriers.

LUCIDEON: ALTERNATIVES TO MICROBEADS IN COSMETICS MANUFACTURE

The UK issued a ban on microbeads in rinse-off products such as scrubs in June 2018; the ban is expected imminently to be extended to creams, liquids, and anything else containing microplastics, which can become a dangerous pollutant, damaging the health of marine animals and even altering their behaviour.

With funding from Innovate UK, Lucideon launched a feasibility study to assess whether polymers in microbeads can be replaced by inorganic alternatives such as glass and ceramics, which are environmentally friendly and already present in sand, soil and the ocean.

Engineering challenges include problems beyond creating the right size and shape, cost is also an issue, as current alternatives are about 2000% more expensive than microplastics, according to Dr Gasparini, Senior Chemical Engineer at Lucideon.

Although natural alternatives could be dug out from the sand and soil naturally, this would not provide a very sustainable solution. Lucideon is exploring how to manufacture the materials synthetically in an environmentally friendly way and without using high temperature processes, that may produce an environmentally-friendly material but are energy-intensive.

The team at Lucideon Ltd

As Dr Gasparini explains that Lucideon's project goal is to deliver the industry's size, shape and cost requirements from an environmentally-friendly, low-temperature approach to produce a non-pollutant material.

Lucideon is hoping to produce at least 80 tonnes of microbeads by the time it goes to market. Dr Gasparini hopes that there will be "about a 30% lower cost for industry, compared to microplastics."

Among the priorities of the Smart Sustainable Plastic Packaging Challenge is the development of improved sorting technologies to better identify packaging by material type and colour

New sorting technologies using advanced photonics, such as redesigned near-infrared cameras to identify packaging by material type and colour, can facilitate high-speed and accurate sorting. Invisible markers are being developed that can be applied to packaging to provide additional information, which sorting systems can detect but don't impact on packaging appearance or branding. Such systems can allow packaging to be sorted by its original contents; important for very exacting specifications such as food-contact grade recycled polymer.

Increasing yield for recyclers is important for improving economic viability. New approaches to shredding, using cryogenic techniques or enhanced sorting systems based on differing densities of plastics, help to reduce losses.

Chemical recycling

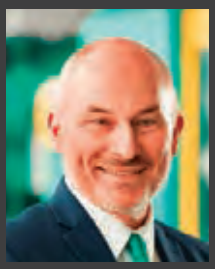
The commercialisation of chemical recycling technologies is a very significant development. The majority of packaging recycling currently is 'mechanical', in which the plastic itself is preserved in polymeric form. Output can be very pure and high quality but it will never be quite the same as virgin polymer.

In chemical recycling the polymer chains are broken back down to the monomers from which they were made; these can then be remade into what is effectively virgin polymer. A number of systems, ranging from pyrolysis techniques to solvent-based, are being developed and trialled. In some cases, these technologies are being deployed at recycling sites; in others, they are being integrated into polymer manufacturing facilities.

Looking further into the future, the next great leap could be biological recycling, where microbes, recently discovered in landfill sites, and their enzymes, carry out a similar process of breaking down waste plastic into simple molecules and stitching them back together into high value products.

Innovation and investment to deliver a more circular economy for plastic packaging has never had so much attention focused on it. Any company working in the supply chain needs to be looking at this area or risk being left behind.

LEADING IMM PROVIDER ADDRESSES PLASTICS AND THE ENVIRONMENT



By Colin Tirel, Managing Director, ARBURG Ltd

As global player in the injection moulding machine market, ARBURG is extremely conscious of its responsibilities related to the circular economy involving plastics through every aspect of what we do. This starts from the internal manufacturing processes employed in our ultra-modern manufacturing facility in southern Germany, defining the most suitable and efficient solutions for customers, through to how the customers best utilise our equipment in their mould shops.

Over the last 25-years ARBURG have made quantum leaps in technology advancements, and a big focus has been energy consumption. This is true in many sectors of the plastics industry and is particularly so in the packaging sector where margins can be small and high productivity is absolutely key.

We now offer bespoke machine specifications for the packaging sector which meet the sector's specific requirements. These machines have been developed to work in this sector to give the optimum solution and ensure that production is sustainable and as efficient as it can be. We now offer customers energy-saving options within our machines using servo hydraulics and servo motor technology in our hybrid and electric machines.

These types of technologies can give customers shortened cycle times for higher productivity, improved energy consumption, and in many cases significantly improve the quality and the consistency of the components produced. The increasing demands of packaging mean that our technologies have developed with an eye on the processing of Post Consumable Recyclates (PCRs).

ARBURG approaches the question of the circular economy very seriously and this is underlined with the introduction of arburgxGREENworld, an initiative that seeks to serve three areas: protecting resources, creating cycles and increasing efficiency.

FACTORY-BUILT HOUSING SECTOR MUST PROVE IT HAS FOUR WALLS AND A ROOF

BY DENISE CHEVIN

2020 will be the make or break year for factory-built housing.

Optimism has grown in the past 12-months that housing's Cinderella – offsite building manufacture – is poised to become mainstream, but so far that promise has yet to materialise and deep pockets have been necessary to sustain start-up costs on small turnovers.

There is certainly real momentum to develop modern methods of building construction, which means moving from the traditional brick and block building to various levels of factory fabrication – from the use of light gauge steel frame to the more radical modular or volumetric forms. With the latter, factory-made panel-built units are fully kitted out in the manufacturing plant, shipped to site and assembled and stacked to form houses and flats. This method has been attracting big investment in the UK in 2019 and interest is growing on the back of government policy promoting offsite housing manufacture.

Against a background of construction industry skills shortages, the government is banking on a modernisation of the sector, and a steady stream of new entrants to help increase the production of high quality homes to help meet its 300,000 annual target of new homes. Homes England, the government's housing delivery agency, announced in

Left: **Urban Splash modular housing being installed at its new Islington development. The buildings are made at its SIG factory, which the company bought in 2018**

Right: **Urban Splash modular housing at its Port Loop development in Birmingham**

September that it had invested £30m in Yorkshire-based factory homes start-up company like the agency, as the first step in the development of a new Northern hub, dubbed the "Construction Corridor".

Homes England has also played a part in other headline-making deals including, most significantly, working with Urban Splash and the Japanese housing giant Sekisui House. In this innovative joint venture, Sekisui House will invest £22m of new equity, with £30m of equity and debt funding coming from the Government's Home Building Fund, managed by Homes England.

In addition a £75m investment last September from investment bank Goldman Sachs into manufacturer TopHat , which is building its first development in Chatham, Kent, was another major confidence boost for the sector.

Will the sector grow?

Richard Cawdron, relationship manager at Barclays, specialises in fast growth and disruptive technologies, advising clients how to become 'debt ready'. He is optimistic that modular factory-built housing is a sector that will see very fast growth. "I would expect to see Barclays' engagement growing 10-20 times in the next two or three years, albeit from a very low base," he says. "I don't see modular housing providing the majority of new homes built in the next five to 10 years, but its capacity as a portion of the UK's new homes is expected to increase, and in that five to 10 year period we may even start to see modular construction taking significant share of the value end of the market."

"I would expect to see Barclays' engagement growing 10-20 times in the next two or three years, albeit from a low base"

Richard Cawdron, Barclays

He adds "At the moment the sector is evolving quickly but is at an early stage in maturity. But the quality is so much higher than it was in the past and I think we are getting to the point where people are starting to accept modular. Homes can now be built, from start to finish, in just 40 days. Training people in a factory is so much easier and less time than a tradesperson working on site, and this will be key as we start to see skills shortages post-Brexit."

Another emerging trend is the tie-up of manufacturers with local authorities and housing associations. This helps provide a consistent and predictable pipeline, which has been an Achilles heel for the building sector in the past. Ilke Homes signed a £100m deal in May last year with housing association Places for People to deliver 750 modular homes, for example.

House building is ripe for disruption

One of those playing their part in trying to disrupt the housebuilding market is Joseph Daniels, founder and CEO of

Project Etopia. His company received a £19m investment into its novel panel-building system from investors Reuben Brothers adding to the millions it has already received from hedge fund boss and former Conservative party treasurer Lord Fink.

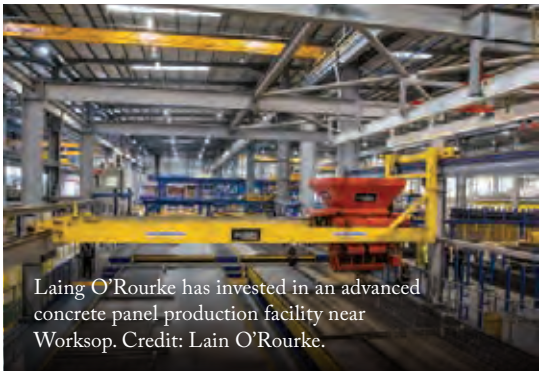
It takes Project Etopia four weeks to construct a home, which it manufactures at either its factory in Tiverton, Devon, which has the capacity for 400 homes a year, or in Ellesmere Port, Cheshire, where there is capacity for 2,000.

"We have ambitions to grow capacity to 6,000 homes a year by adding two more lines and increasing shift working," says Daniels. Two additional regional factories are also on the cards.

The company recently completed the first eco-houses on a 73-home modular commuter village in Corby, Northamptonshire. The houses have been awarded the highest EPC (energy performance certificate) grade possible – Grade A – and they are energy-positive thanks to built-in technology to generate and store energy, enabling the system to surpass the government's new Future Home standard for net zero homes. Several houses have already been sold. Daniels says "The homes appeal to a new generation, people who want quality and want to tackle climate change."

The modular building sector's total current capacity is hard to estimate. Adam Challis, head of residential research at JLL and co-author of an April 2019 report *Industrial-Scale Housing Solutions*, says: "We estimate UK capacity to be the equivalent of circa 20,000 homes. Further, we expect this to grow significantly over the medium term and with continued Homes England and government support for MMC, it could triple in the next five years."

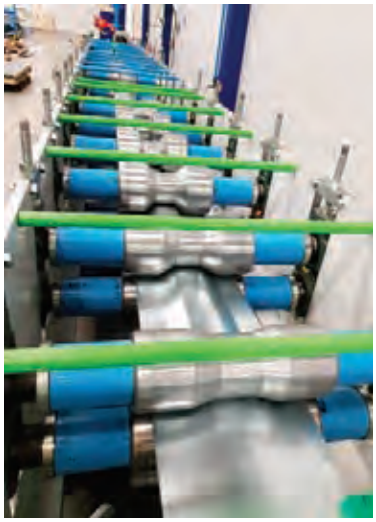
His report says: "Our research shows that 13.5 million square feet of manufacturing space – the equivalent of over 200 football pitches – is needed



Laing O'Rourke has invested in an advanced concrete panel production facility near Worksop. Credit: Lain O'Rourke.

to increase the number of new homes from the current rate of 190,000 to 300,000 per year."

One of those expanding capacity is contractor Laing O'Rourke, which has invested in an advanced



PROJECT ETOPIA

"We have ambitions to grow capacity to 6,000 homes a year by adding two more lines and increasing shift working,"

Joseph Daniels, Project Etopia

Project Etopia's Ellesmere Port factory has the capacity for making 2,000 homes a year, with 400 a year in Tiverton

"[Research shows] 13.5 million square feet of manufacturing space – the equivalent of over 200 football pitches – is needed to increase the number of new homes from the current rate of 190,000 to 300,000 per year."

Adam Challis, Head of Residential Research at JLL

Legal & General Modular Home's huge factory near Leeds. While the company posted losses in 2017 and 2018, the CEO says it expects to be building and selling 3,000 homes per year in the next five years

offsite facility for making concrete panels in Steetley near Worksop. A company spokesperson says: "A decade ago we invested to create Europe's most advanced construction components facility that has enabled the offsite delivery of residential, healthcare, commercial and infrastructure projects. We continue to work with a variety of partners on the plan for an even more advanced facility adjoining the current factory, which would be capable of producing 10,000 homes a year. Such an approach would revolutionise the sector's approach to high quality offsite delivery."

Costs curtail the rush

But despite the general market optimism, overheads and start-up costs still present a big risk. In December Ilke Homes, for example, posted losses of £22.4m in 2018/19 accounts on revenue of just under £2.7m. Its private equity backer TDR Capital has said that it would provide financial support to the company to make sure that has adequate resources to continue operating "for the foreseeable future".

Legal & General, another major investor that established a modular homes business in 2015 with a factory near Leeds, to date has only seen a trickle of homes roll off its production line. Accounts reveal combined losses of more than £66m in 2018 and 2017. Rosie Toogood, CEO, L&G Modular Homes says: "We have made great progress over the last two years, completing the development process and bringing to market our two- and three-bedroom homes."

She also highlights the accreditations and ISO standards that have been awarded and new technology systems that are "enabling us to robustly plan business activities and ramp-up production to scale."

"The onus is on manufacturers to bring their prices down and make the systems affordable, as most are aiming at registered social landlords and housing associations"

Jeff Maxted, BLP Insurance

Rosie adds: "We have a strong pipeline of customers for the next 12 months and beyond, working with partners from local councils to housing associations, we expect to be operating at full capacity – which is 3,000 homes per year – in the next five years."

More stakeholders are acquiring certification for modular housing. Jeff Maxted, head of technical consultancy at BLP Insurance that administers BOPAS, an accreditation scheme to assure mortgage lenders and warranty lenders that the system can last for a minimum of 60 years, says registrations for 2019 were at record levels with more than 50 now accredited and more going through the process. But he adds "In truth, we are still not seeing many homes being built."

In Maxted's view, "the onus is on manufacturers to bring their prices down and make the systems affordable, as most are aiming at registered social landlords and housing associations and a lot of start-ups have proved expensive." JLL found that costs for modular housing are 12 per cent higher than traditional house-building.

BLP Insurance is confident that the market will grow, but Maxted says "there is general nervousness in the market about a number of things that still need to be addressed," including the cost of repair, the impact of flood damage and fire, and poor coordination between building site and factory, which can lead to water ingress and damage to units.

He adds: "There are also on-going issues around lack of standardisation, with manufacturers protecting their IP. That creates nervousness over whether if a company goes out of business another supplier would be able to step and finish the job.

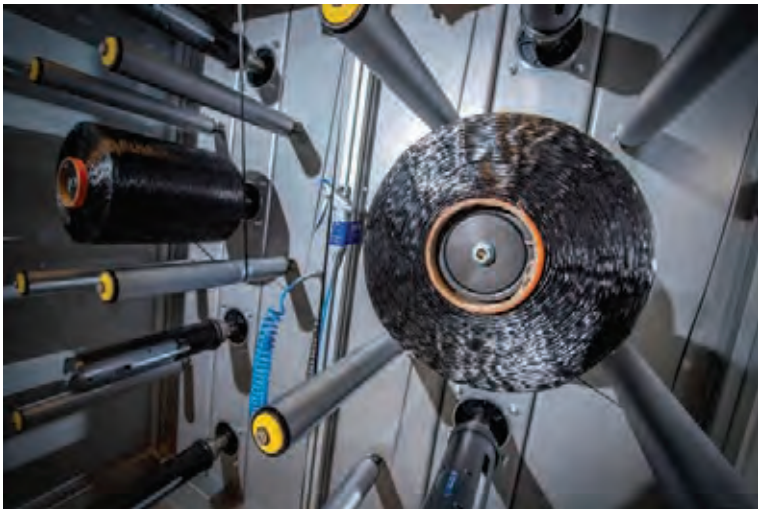
"We are nearing the tipping point where offsite should become a significant contributor to the residential sector but we do not appear to be quite there yet".

SMALLER, HIGHER, FURTHER

BY MALCOLM WHEATLEY

The UK's space industry is the unsung hero of the country's manufacturing. It is a world leader in small satellites and is now driving hard for a share of the low-cost launcher market.

On Scotland's windswept Moray coast, a factory in the town of Forres is building rockets destined to carry small satellites into orbit, with the first commercial flight expected in as little as two years' time. Launched from the UK Space Agency's Sutherland spaceport, the Orbex Prime rocket is designed to be reusable, require just four tonnes of propellant per launch, and leave zero orbital debris in space.



Top: **Orbex' factory in Forres, Scotland, houses one the largest carbon-fibre winding machines in Europe.**

Above: **The Orbex Prime rocket engines are 3D-printed**

Look closely, and several things make that remarkable performance possible. First, the Orbex Prime is designed to be 30% lighter than similarly-sized rockets, thanks to its carbon fibre construction. Inside the Forres factory is one of the largest carbon fibre winding machines in Europe: an 18metre long behemoth that automates the rapid weaving of the intricate mixes of materials that make up the main rocket structures.

The rocket engines are equally innovative, using 3D printing to create what are currently the world's largest singlepiece 3D printed rocket engines. Burning renewably-generated bio-propane, and generating roughly 90% fewer carbon emissions than SpaceX's liquid kerosene engines, the engines can accelerate the Orbex Prime from 0 to 1,330 km/h in just 60 seconds.

Already, Orbex has secured multiple commercial agreements to launch small satellites into orbit. These include agreements with Surrey Satellite Technology (SSTL), the world's leading manufacturer of small satellites, and Astrocast, which is building a planetwide Internet of Things network.

"Our goal is to make smaller, more efficient launch vehicles, with a tiny CO2 footprint and zero orbital debris," says Chris Larmour, Orbex' chief executive. "We want to eliminate waiting time by launching on a regular timetable, with massively reduced costs and a more agile, modular approach. We can only do that by rethinking how we do it, rather than copying the past."

Above left: **Caption: Surrey Satellite Technology's Space Operations Centre.**

Above: **SSTL's Deployable Space Telescope, jointly developed with Surrey Space Centre & University of Oxford, showing the telescope stowed and deployed (L & R respectively)**

Space in context

Britain's space industry is something of an unsung success story. If people think of it at all, they think of companies such as Stevenage-based satellite and space probe manufacturer Airbus Defence and Space, which as well as designing and manufacturing satellites for telecommunications, earth observation, and science programmes, built the European Space Agency's Rosetta deep-space probe, which made a historic rendezvous with comet 67P/Churyumov–Gerasimenko in 2014.

Less well known are companies such as Guildford-based SSTL—originally a spin-off from the University of Surrey, now owned by Airbus—and Chelmsford-based Teledyne e2v. SSTL pioneered the manufacture of small satellites, and has launched over 60 since the company's inception in 1981. For its part, Teledyne e2v built the imaging technology that provides the crucial multi-spectrum 'cameras' on board missions such as NASA's Hubble Space Telescope, the Mars Reconnaissance Rover, and the European Space Agency's Rosetta probe.

But in fact, according to the 2018 edition of the UK Space agency's The Size and Health of the UK Space Industry report, the 948 organisations that make up the UK's space industry contribute almost £16 billion a year to the UK economy, and directly employ 42,000 people, with a further 80,000 jobs in its various supply chains. By 2030, government plans call for the industry to be roughly 10% of the global space economy, which currently stands at US$350bn. Moreover, the government is backing that ambition with hard cash in the form of development capital and assistance, including setting up the UK Space Agency, the Satellite Applications Catapult, and the UK National Satellite Test Facility.

Underpinning that effort are a number of space-centric 'hubs' or clusters. Glasgow, for instance, is at the heart of Scotland's space industry, and homve to firms such as Alba Orbital and CubeSat manufacturer Clyde Space. Remarkably, according to the Scottish Centre of Excellence in Satellite Applications, the city designs and builds more satellites than any other city in Europe.

Further south, Oxfordshire's Harwell Science and Innovation Campus reckons to be the largest space cluster in Europe, home to 94 space industry organisations, including the Satellite Applications Catapult, microsatellite antennae manufacturer Oxford Space Systems, research organisation RAL Space, and—from 2021—the UK National Satellite Test Facility. Close links with the government-funded Local Enterprise Partnership, OxLEP, help to nurture the burgeoning cluster, attracting businesses from across the globe to locate in Oxfordshire. "Five years ago," says Catherine Hamelin of the Satellite Applications Catapult, "there were only five space industry organisations at the Harwell site; now there are over 90."

As with Scotland, local links also underpin the ongoing development of the UK's two spaceports—the site in

THE UK'S SPACE INDUSTRY GOES GLOBAL

A UK-Australia political declaration signed on 24 September 2019 launched a 'Space Bridge' between the UK and Australia—a platform to enable closer and stronger collaboration on space technologies and satellite applications, delivering benefits to the space industries of both countries.

"The goal is to increase innovation, increase the UK space industry's global access and exports, and—potentially—strengthen the post-Brexit UK-Australia Commonwealth relationship," says Catherine Hamelin, Australian Space Venture portfolio director at the UK's Satellite Applications Catapult.

It's not exactly a partnership of equals: the UK's space industry is well-established, while Australia's is relatively new, with its national space agency created as recently as 2018. But the various UK government bodies involved in setting up the Bridge see clear benefits for the UK, says Hamelin.

"It's about global access," she says. "Australia has very good links with other Asia Pacific economies, providing UK companies with a good platform for growth, and lowering the barriers to entry. For its part, Australia is targeting the creation of 20,000 jobs over a 10-year period."

Nanosatellites are as small as smartphones and often intended to operate in 'clusters'. They are light and much cheaper to launch than traditional space communications hardware.

Credit: ESA/NASA

Scotland, and Spaceport Cornwall, which should see satellite-carrying rockets launched horizontally from underneath a Virgin Orbit-owned Boeing 747, operating out of Newquay Airport, which has one of the longest runways in the UK. CloS LEP, the local enterprise partnership, again sees a space industry cluster developing in the county, and is working closely with the nascent spaceport and the nearby Goonhilly Earth Station, reckoned to be the largest satellite-receiving earth station in the world.

FACT FILE:

Number of organisations in the UK's space industry:	948
Value to the UK economy:	£16bn /year
Direct employment:	42,000
Supply chain employment:	80,000
Current value of the global space economy:	US$350bn

Companies in Glasgow, Scotland, design and build more satellites than any other city in Europe.

Harwell Science and Innovation Campus, near Oxford, is home to 94 space industry organisations.

Reach for the skies

Three separate factors are driving the growth of the space sector in the UK. "First," notes Orbex' Larmour, "satellites are rapidly reducing in size, making them easier and cheaper to launch into orbit, and faster and cheaper to build. And when a satellite's weight is measured in just tens of kilos—or even less—it becomes much easier for the private sector to get involved in building and launching them."

So-called nanosatellites —as manufactured by Glasgow's Alba Orbital and Clyde Space—are lightweight and tiny, and often intended to operate in clusters, or 'constellations'. The CubeSat, for instance, is roughly a 10cm cube, weighing no more than 1.33kg. Many such microsatellites can be deployed on a conventional launcher, further reducing the cost of getting into orbit.

"People hold up SpaceX and Blue Origin as examples of private sector space involvement, but they're actually the exception, with an ability to deliver multi-tonne payloads to orbit," he points out. "Look at satellites weighing tens of kilos or less, and there's a huge market for launches."

Secondly, there's the so-called 'New Space' phenomenon. Traditionally, going into space has been the job of central government, and agencies such as America's NASA and the European Space Agency. The private sector built the satellites, launchers, and landers—but the purse strings were held by central government. No longer: pioneered by Elon Musk's SpaceX and Jeff Bezos' Blue Origin, the private sector is now directly going into space on its own account, as amply evidenced by Orbex and Virgin Orbit.

And third, with the passing of the Space Industry Act 2018—described as the most modern piece of space industry legislation in the world—the UK has put in place a regulatory framework underpinning the commercial exploitation of space from UK soil. A significant advance on the previous legislation—the 1967 Outer Space Treaty, to which over a hundred nations are now signatories—it places strict requirements on spaceports, launcher operators, and the bodies carrying out range control, notes Orbex' Larmour.

"The space environment is becoming congested and contested," says Christopher Newman, professor of space law and policy at Northumbria University. "A solid governance framework provides the protections that corporations, government, and investors all require."

Finally, what of Brexit? If Bridgend-based laser wire marking equipment manufacturer Spectrum Technologies—whose equipment was central to NASA's Mars Insight lander, which landed on the Red Planet in November—is anything to go by, Brexit is an irrelevance.

Credit: Lockheed Martin

Artist's impression of the UK's first commercial spaceport at the Sutherland Site in Melness, near Tongue, Scotland, which will conduct the UK's first vertical, orbital rocket launch in the early 2020s. The team developing the spaceport is being led by Highlands & Islands Enterprise, with strategic support from Lockheed Martin.

"There'll be some adjustments to make, but for us, Brexit won't make any real difference at all," says chief executive Peter Dickinson. "Even with worst-case WTO tariffs, the pound has already depreciated much more than that, anyway."

TIME TO DELIVER

STRATEGIC MACHINE TOOL PARTNERSHIP DOUBLES CAPACITY AT WATCHMAKER

British luxury watch manufacturer Bremont made the most of Coromant Capto® and DMG MORI's strategic partnership as it introduced a turnkey manufacturing cell to double capacity at its factory.

Luxury watchmaker Bremont Watch Company is a true British manufacturing success story.

Founded by brothers Nick and Giles English in 2002, the company specialises in making chronometer certified, aviation-themed timepieces that are painstakingly assembled and pressure and quality tested at Bremont's purpose-built headquarters in Henley-on-Thames, Oxfordshire.

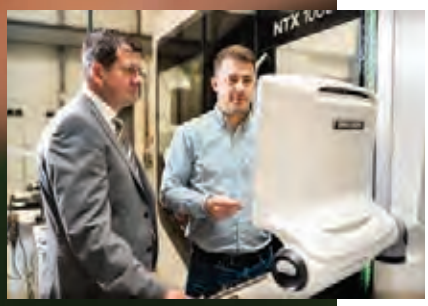
The British military is a key customer, with watches such as the Argonaut finding favour among servicemen and women plus members of the Royal Air Force. Many watches are customised for specific units and regiments, and demand for the company's designs, which retail from around £3,000 to £25,000, is growing.

That means Bremont's dedicated manufacturing facility, located a few minutes' drive from the HQ, is very busy. The factory has recently been able to double production capacity to make stainless steel top bezels, mid-sections and casings for six new watch designs. This is thanks to the introduction of a state-of-the-art 5-axis NTX 1000 machining centre from DMG MORI, using Coromant Capto® tooling.

The project was six months in the making, explains Mathew Bates, a machine tool investment specialist from Coromant Capto®'s UK Machine Tool Solutions team. "From the beginning, the objective was to deliver a 'right first time' solution," explains Bates. "We wanted Bremont to be able to use the new system straight away."

That meant working closely with engineers at machine tool manufacturer DMG MORI to select the appropriate tooling for the job. "We knew we had six new watches to make," says Bates. "Once drawings became available, we met with DMG MORI's application engineers to draw up a list of standard tools to use and decide where non-standard tooling was needed."

Bremont watches feature minute



"Bremont watches feature minute threads and chamfers, which sometimes require specialised tools."

threads and chamfers, which sometimes require specialised tools. For one project, for example, Bates was able to track down the only company in the UK able to supply a particular type of tap. "When you are manufacturing something big, there is a lot more choice in terms of the tooling available," he explains. "With something so small, you are limited in what you can use."

The DMG MORI NTX 1000 was installed containing a carousel of 30 tools specifically chosen for the job, with the option to expand to up to 76 tools. The Coromant Capto® tool holder design was used. The twin-spindle machine is capable of both turning and simultaneous high-speed 5-axis milling. The system now machines from stainless steel bar to finished component without operator intervention, around the clock.

Frederick Shortt, applications manager at DMG MORI, explains that specialised work holding had to be designed and manufactured by a supplier for the NTX 1000 sub-spindle for the Bremont manufacturing processes. His engineering team spent time programming the machine with an offline CAM system and simulating the NC code produced in Vericut. "We spent a lot of time working on this before we went on-site. With Coromant Capto®, we were able to streamline the number of tools required, so Bremont only bought what it needed."

This combined effort has meant teething problems have been kept to a minimum, and a rapid return on Bremont's £500,000 investment is expected. James Rhys-Davies, strategic relations director, north Europe at Coromant Capto®, says that implementing turnkey manufacturing solutions such as this is on the increase. "Although the upfront cost is sometimes higher, the benefits of a rapid ROI and the maximisation of machine uptime make turnkey manufacturing cells a highly attractive option, as the cost per part is typically much lower," he says.

Once the new machine had been installed, Bremont was able to start full production of watch components immediately, exactly as planned.

Malcolm Kent, Bremont manufacturing manager, has been delighted with the results. "We've been surprised with how easy it is to produce components," he says. "We were struggling to keep up with demand from Henley. Now we are asking them for more work, and that is the way it should be."

INDUSTRY HAS NO CHOICE: WE MUST INNOVATE TO SAVE THE PLANET

An overview of Cranfield University's five manufacturing centres, which have solutions to help industry achieve this

Professor Mark Jolly, Professor and Director of Manufacturing, Cranfield University

The imperative to act on climate change and to reduce our impact on the environment has never been greater. Not only do we have a moral duty but as manufacturers our consumers and customers demand it.

Increasingly through innovative technologies and novel practices, we are seeing not just the environmental benefits of a transition to a circular economy but the economic and commercial benefits as well.

By backing innovation we no longer need to see a compromise between being 'more environmentally-friendly' and the quality of products and business growth.

In this year's UK Manufacturing Review, you will see how Cranfield is working alongside our industry partners to be at the forefront of this transition to a more sustainable industrial output.

Whether that is through new materials and composites, reducing the amount used in production or identifying ways to keep product in service for longer, sustainability is at the heart of everything we do.

As we look to the year ahead, a year that the UK hosts COP 26 in Glasgow, my hope is that the sector continues to back innovation and seek out new sustainable ways to embrace the Fourth Industrial Revolution. At Cranfield, you can be sure that we will continue to play our part working with our partners to deliver the cleaner, greener economy that will safeguard the future environment.

WELDING AND LASER PROCESSING CENTRE

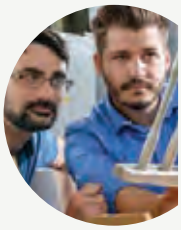
Reducing long lead times for forgings and the massive waste from machining big metal components metal are driving additive manufacturing research at this world-class centre

ENHANCED COMPOSITES CENTRE

Innovations in composite materials and structures are essential for the zero carbon economy

SURFACE ENGINEERING AND PRECISION INSTITUTE

An internationally recognised centre of excellence in thin film deposition techniques, precision device manufacturing and in-situ process metrology in ultra-precision machines



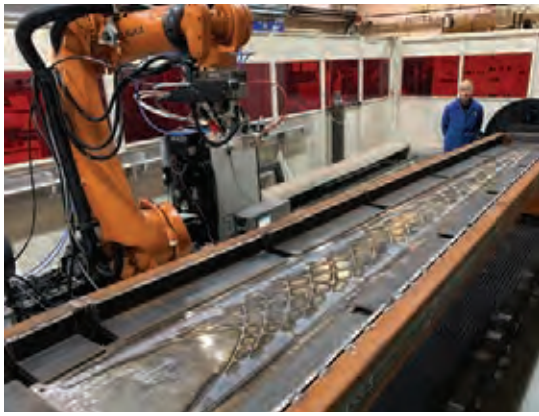
SUSTAINABLE MANUFACTURING SYSTEMS CENTRE

Focused on the energy efficiency of industrial systems, and digitally simulating manufacturing systems to find more efficient ways of manufacturing

THROUGH-LIFE ENGINEERING SERVICES INSTITUTE

Through-life Engineering Services focuses on finding ways to manufacture products with the highest levels of reliability and lowest levels of cost over their entire life cycle.

WELDING ENGINEERING AND LASER PROCESSING CENTRE



Over 13 years, a research centre at Cranfield University has grown into the UK's largest university department focused primarily on large-scale metal additive manufacturing, as well as specialised laser processing, for core research and multiple industrial applications.

Reducing long lead times for forgings and the massive waste from machining big structural components from solid metal are driving additive manufacturing (AM) research at Cranfield University's **Welding Engineering and Laser Processing Centre**. The Centre is a world leader in printing large engineering structures more resource-efficiently and with lower cost than incumbent processes.

Large, load-bearing components are typically forged and then machined to the desired shape; 80% or more of the original forging is often milled away. This uses a lot of electricity, wears cutting tools and machinery and produces tonnes of swarf, often uneconomic to recycle. "Much of our additive (manufacturing) work is focused on replacing expensive forgings," says centre director Prof. Stewart Williams.

Additively manufacturing these components achieves several compelling benefits.

"It reduces material consumption by 80% for many parts; sometimes more," says Stewart. "Typically, these methods deliver 50% cost saving on forgings and reduce the lead time from many months to just a few weeks." Additively-made structures can also be lighter than machined and fabricated parts. Unlike metal sheets or sections that are welded they have no joints, so the structure has higher overall integrity and fewer or no weak spots.

"Currently, we use off-the-shelf but modified welding equipment and wires, in order to make the process accessible to partners," says Stewart. "Our programme is about increasing the TRL – Technology Readiness Level –so it can be used in industry."

Applications and industrial partners

The Centre is providing AM research and industrial case studies for companies including: Airbus, BAE Systems, Northrop Grumman, Safran, Weir, DSTL, Schlumberger and TechnipFMC.

It is also working with global architectural practice Foster+Partners on a five metre construction beam. Construction is a growth industry for AM because the structural properties are improved, the part can be topologically optimised saving weight and material. The AM equipment could be operated directly on a building site or other remote locations.

NEWAM

In 2019 the centre won a £6 million EPSRC grant to develop the next generation of DED (Directed Energy Deposition) AM processes. The project target is to manufacture at 8kg/hour net shape in titanium to a specific shape, with no post-processing and proven full integrity. "The build rate is nearly one order of magnitude higher than current AM techniques, and uses our novel patented Multi Energy Source concept," says Stewart. The plasma arc process is dynamically combined with lasers to give full control over the size and shape of the meltpool. "We have deduced over a long time that you can do this better if you design your heat source to do what you want it to do."

WAAM3D

To exploit the large scale AM research and provide industry with the required supply chain a new spin-out company, WAAM3D, has been established. WAAM3D was founded by Prof. Williams, principal researcher Dr Jialuo Ding and former senior lecturer Dr Filomeno Martina, who is now CEO. WAAM3D provides a complete technical solution for industrial companies wishing to exploit large scale AM, including turnkey systems featuring in-process sensing and control, specialised CAM software, training, support for part manufacture and high quality wires. WAAM3D has just received an initial £1.5M of overseas investment.

Following big progress in all its research areas in 2019, the NEWAM (New Wire Additive Manufacturing) project and new partner engagement in sectors from space to construction, and 'sustainability' continuing to influence manufacturing, the Centre is expecting a strong 2020.

For more on the Welding Engineering and Laser Processing Centre, please visit: https://www.cranfield.ac.uk

FAST FACTS

WELDING ENGINEERING AND LASER PROCESSING CENTRE

- **The biggest Centre specialising in large scale metal additive manufacturing at any UK University or RTO**
- Focus areas: Large scale additive manufacturing (70%),advanced laser processing (20%) and novel welding processes (10%)
- **Established in 1961 by Bob Apps**
- Key people: Professor Stewart Williams, Centre lead. Dr Jialuo Ding, Dr Wojciech Suder, Dr Supriyo Ganguly, Dr Goncalo Pardal and Dr Sonia Meco.
- **Headcount: 7 academic staff, 10 researchers, 15 PhD students, 3 technicians**
- Facilities: 10 large scale AM systems including several laser systems, inc 1x 10kW and 2x 6kW fibre lasers
- **Recent project wins:**
  1. **Innovate UK (113164) Open Architecture for £1.8million**
  2. **EPSRC (EP/R027218/1) £6 million NEWAM project for next generation of directed energy deposition additive manufacturing processes.**

ENHANCED COMPOSITES AND STRUCTURES CENTRE

Professor Krzysztof Koziol, Head of Enhanced Composites and Structures Centre

Innovations in composite materials and structures are essential for the zero carbon economy and for producing efficient, lightweight vehicles and components used for renewable energy generation at a low cost. This Cranfield University centre is at the vanguard of these changes.

With its advanced design and manufacturing capability, the Enhanced Composites and Structures Centre at Cranfield University is an established partner to manufacturers and members of their supply chains through short courses, consultancy and research.

The Centre investigates and develops advanced materials (including carbon nanotubes, graphene and other 2D materials) and processing technology for lightweight and efficient structures and combines an expertise in low cost manufacturing with modelling, simulation and structural health monitoring technologies.

Historically, the Centre was highly focused on the development of aerospace composites. It has produced a complete unmanned aircraft airframe using low-cost composite manufacturing; composite reinforcing techniques for aerospace landing gear; sensors for built-in detection of structural degradation; and a cost model for composite design and manufacturing. Its research into the development and processing of carbon fibre multi-axial fabrics is now part of the Airbus A380.

More recently, the centre has been working in new sectors, like the automotive industry, as it seeks to use more lightweight structures and energy with particular focus on the sustainable and affordable large-scale hydrogen production technology.

It is also working with the construction industry and engaging with partners looking into rapid housing development and the use of sustainable materials, which will not only reduce the cost of building, but also make housing more efficient.

The Centre is also working with what may be referred to as "extreme environment" industries, such as space and Formula 1, which are looking for new materials and pushing boundaries for performance and safety reasons.

From a materials perspective, industry is looking for materials that perform. The issue with this is the security of the supply of those materials. Companies need to make sure they are getting the same material over and over again.

Sustainability is also a big focus and industry is now looking for materials that both perform and are sustainable. It is a constant challenge for industry to find new, sustainable materials.

> "The Centre estimates that copper conductors on a Boeing 747 can be reduced from five to 0.5 tonnes, leaving 4.5 tonnes of saved weight or space for substitute payload"

The Centre is looking into completely new manufacturing technologies, for example, pushing boundaries in the area of new generation conductors by making carbon nano-tubes from sustainable source of natural gas and turning them into electric wires. The idea is to replace copper and aluminium conductors with significantly less resistive nanotube wires, furthermore offering up to 9x weight reduction and at least 10x higher mechanical strength.

As an example, a Boeing 747 carries about five tonnes of copper as a conductor on board – researchers at the Centre estimate that can be reduced to 0.5 tonnes, leaving the potential for 4.5 tonnes of something else to be carried.

The Enhanced Composites Centre is also leading innovation in graphene manufacture and rolling out a long list of graphene-based applications with high technology readiness level and strategic industrial partners. We are offering support to our inductrial partners at every stage of their graphene journey, incluing support on small scale production as well as bespoke implementation into a variety of applications to make other materials more sustainable or open doors to applications which are not possible today.

The Centre is a core partner in the strategic EPSRC Centre for Innovative Manufacturing in Composites (CIMComp), supported by major manufacturers.

TO LEARN MORE, VISIT: https://www.cranfield.ac.uk/centres/enhanced-composites-and-structures-centre and contact k.koziol@cranfield.ac.uk.

SURFACE ENGINEERING & PRECISION INSTITUTE

The future in Materials and Manufacturing is where science, technology and design collide. Cranfield's Surface Engineering and Precision Institute (SEPi) is a world-leading centre that brings together scientific and engineering disciplines, integrating materials characterisation, design and manufacturing expertise to enable the manufacture of future smart systems, sensors and coatings through the discovery/development of materials with purpose-built properties.

The Surface Engineering and Precision institute (SEPi) at Cranfield University is an internationally recognised centre of excellence in material research and development. Its research covers two main specialisms: Coating/Surface Engineering and Device/Smart Materials; both aiming to undertake world-leading research in the areas of materials engineering and functional materials.

Each specialism is supported through distinct organisational structures based on research groups with particular disciplinary expertise (e.g. polymers, nanotechnology), and research themes (e.g. biomedical, high temperature corrosion and protection), which facilitate cross-disciplinary interaction between groups, other schools, research institutes in the University, and external organisations.

These cross-domain groups deliver on our strategy of opening the door to new technologies, whether they are in sustainable, aeronautical, biomedical, or sensor engineering.

SEPi's vision is supported by fundamental and applied research that aims at addressing challenging material engineering problems facing the world and providing translational and sustainable solutions as explained by Dr. Gregory Bizarri, acting Head of the centre.

Surface coatings

"Our main research activities relate to the design and manufacture of protective coatings to allow engineering systems to operate in harsher and more demanding environments. Here, research is focused on the design and manufacture of Thermal Barrier Coatings, High temperature corrosion resistant coatings and the development of in-situ diagnostics (Smart Coatings), as well as and the design of surface engineering solutions at the systems level," he says.

High Temperature Corrosion and Mechanical Interactions

"Our approach encompasses the assessment of materials performance in a variety of aggressive environments from all aspects of industry from the aero-gas turbine to boiler plant to concentrating solar power plant. Not only do we offer a testing solution, within the centre we are able to offer solutions to engineer materials performance through in-house coating solutions."

Sensors and devices

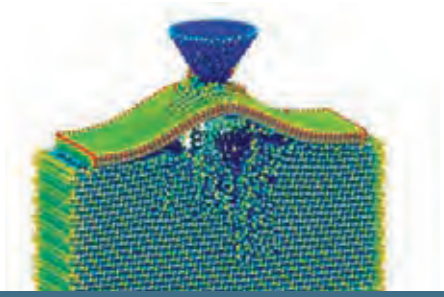
"Our research focuses on providing solutions for sensing devices, functional materials and their integration at system level. We have a speciality in advanced functional materials such as piezoelectric, pyrolelectric, thermoelectric, catalytic, luminescence, radiation detectors and biosensors working at the nano to micro and macro scales. This effort greatly benefits from our expertise in ultra-precision engineering that allows rapid and fine feature generation processes for multi-scale processing and effective quality control."

Recent achievements at SEPi

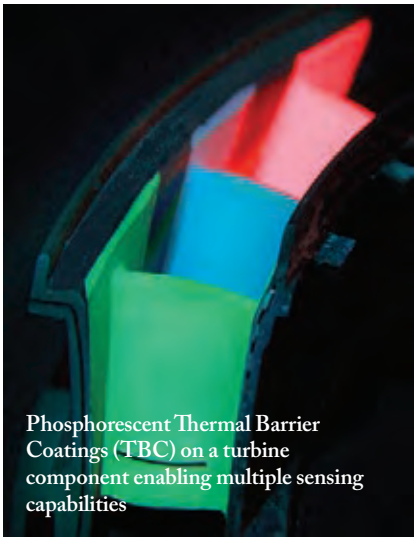
- Growing, sustainable and diversified research income. A portfolio of UKRI, EU and charitable funding supports fundamental research that advances the intellectual boundaries of our engineering disciplines. Our research reputation attracts industrial sponsors with industrial research funding forming a significant proportion of our research income.
- Conduct internationally recognized research to provide the fundamental and technical knowledge that underpins technological innovation.
- Extension of our world leading technical facilities such as i) National High Temperature Surface Engineering Centre (NHTSEC) and ii) Ultra Precision Machining Centre.
- Increasing our research student numbers currently amounts to 26 with support coming from diverse sources (Research Councils, Industry, self-funded, Overseas Governments)

www.cranfield.ac.uk/centres/surface-engineering-and-precision-institute

Example of a specimen under test under an extreme environment containing flowing SO2 and salt.



Molecular dynamics showing delamination of a carbon coating probed by nano-indentation.



Phosphorescent Thermal Barrier Coatings (TBC) on a turbine component enabling multiple sensing capabilities

Images courtesy of Sensor Coating Systems Ltd

SUSTAINABLE MANUFACTURING SYSTEMS CENTRE

One of the biggest energy users and carbon emitters - after transportation - is industrial production. A technical centre at Cranfield is helping industrial systems to get cleaner, quickly, to help decelerate climate change and make them sustainable.

Cranfield's Sustainable Manufacturing Systems Centre (SMSC) is focused on two main areas: the energy efficiency of industrial systems, and simulation of manufacturing processes and systems to find more efficient ways of manufacturing.

Energy efficiency of industrial systems: Improving foundries' performance

After centuries of development, foundries - the oldest type of manufacturing process - are often reluctant to accept change. But working metal in a liquid state requires huge amounts of energy.

Researchers and staff at the Sustainable Manufacturing Systems Centre (SMSC) are attempting to convince this traditional metallurgical industry to reduce its energy consumption by highlighting best practices in energy efficiency. "This includes changes to be made both on the technology and practices of the casting processes side (such as designing of the casting system for reducing energy requirements) but, equally important, on the management of the process," says Professor Kostas Salonitis, head of the centre.

The SMSC helps foundries redesign their casting systems and manufacturing processes; how the melt occurs; the pouring; the casting; and post-processing. It also analyses how they manage the whole process, how they organise their work, and where this could affect their energy efficiency.

Beyond government funding, the centre partners with several large companies on a one-to-one basis, some of whom provide funding, including foundries both inside and outside the UK, in countries such as Germany, Sweden and even Brazil.

Professor Kostas Salonitis, Head of SMSC

Simulation: Manufacturing processes to the whole factory

The Centre believes there is enormous potential in assessing how things are manufactured before systems are built, and optimising these processes digitally.

Its simulation work centres on devising ways to optimise different processes by redesigning these processes using digital twins. It can simulate a basic process digitally – such as a casting or a laser cutting – right up to an entire, large factory with multiple machines, processes and people. Several manufacturing companies from sectors including defence and pharmaceuticals have used the SMSC's analysis to design their plants better.

"Depending on where you apply the boundaries of the analysis you can take a different snapshot of the system, from a high detail level, such as the interaction of material with a manufacturing tool, all the way up to high abstraction level, such as the entire enterprise or even the extended supply chain", says Kostas. "Then measure, for each level, what is the impact of the process parameters during this stage of the process, and the impact on energy consumption and carbon footprint to the company."

Their simulations show what the shop floor looks like and how it performs now and using simulations to change aspects of the layout, sequencing, or planning and control of parts of the production system in order to improve productivity, and to make the system more robust.

HOW THE SMSC CAN HELP FOUNDRIES CUT ENERGY USE BY 65%

- **Energy-intensive: The average energy burden for the foundry sector in UK is 55 GJ/tonne which is more than double the climate change target of 25.7 GJ/tonne.**
- **Through simple interventions, e.g. by adopting lean approaches in the shop floor, foundries can reduce their waste by up to 27%, with consequent energy savings.**
- **Changes in the melting and holding processes, as well as the way heating takes place, can result in reductions of up to 40% in energy consumption.**
- **New casting approaches, such as the CRIMSON process that has been developed in SMSC, could result in reductions of 65% for aluminium casting.**

"Our centre's strong selling point is the capability of simulating things at different levels; at the process, workstation, shop floor and supply chain, depending on the needs of the problem we have to solve, and then to connect the data from these levels up to the factory level, reliably."

In a very traditional factory simulation, all the different machines and processes are considered as "black boxes", where you don't know what is happening in each. They are isolated and you might use some generic data to describe how they perform.

"With the Cranfield simulation and our additional algorithms, you would be able to do some process improvement inside the black boxes, which would have an impact on the entire factory," says Kostas.

SEE THE ONLINE ARTICLE AT:
www.ukmfgreview.com/cranfield-sustainable-mfg-centre for information about the centre's work with manufacturing companies.

THROUGH-LIFE ENGINEERING SERVICES INSTITUTE

ANDREW STARR, HEAD OF THROUGH-LIFE ENGINEERING SERVICES (TES) INSTITUTE AND PROFESSOR OF MAINTENANCE SYSTEMS AT CRANFIELD UNIVERSITY, EXPLAINS WHY HIS MANUFACTURING CENTRE IS VITAL FOR THE OPERATION AND MONITORING OF COMPLEX ASSETS.

High value and increasingly complex assets – such as aircraft and railway networks – demand intelligent support, from conceptual design all the way to the end of their lives.

Through-life Engineering Services (TES) focuses on finding ways to manufacture products with the highest levels of reliability and lowest levels of cost over their entire life cycle.

The TES Institute at Cranfield University is developing the next generation of systems needed to manage the design, manufacture, operations, life extension and end-of-life processes of large-scale assets with expected lifetimes of up to 60 years.

We concentrate on research and education in three key areas: asset management, condition monitoring and damage tolerance.

The key stages of life cycle we focus on are:

- Design – preparing for long, cost effective system life and feeding back operational experience;
- Life extension – justifying reliable decisions to keep using high-value equipment;
- Planning – tackling optimisation, no-fault-found and obsolescence;
- Preventive approaches – avoiding serious failure by sensing, diagnostics and prognostics.

Cost, safety and environmental impact are considered throughout life cycles and optimised support integrates diagnostics and prognostics, self-aware/sensing systems, and planning and scheduling for maintenance decisions, support and logistics.

Cranfield's TES Institute brings together the Through-life Engineering Services Centre and Operations Excellence Institute.

The Through-life Engineering Services Centre allows us to work with industry on disruptive technologies and our Operations Excellence Institute shares our activities and knowledge, working with students and clusters of small manufacturing companies on collaborative projects. Our virtual reality and simulation suite provides state-of-the-art visualisation of complex engineering data, event and risk simulation.

We work in partnership with industry to examine important challenges and provide solutions that add value. We analyse commercial data to search for patterns and improve information and decision-making, including research with people to establish best practices. We simulate and model systems to predict behaviour in mechanical and electronic devices and test physical degradation in components and materials, building novel sensors and test machines."

> The Centre estimates that copper conductors on a Boeing 747 can be reduced from five to 0.5 tonnes, leaving 4.5 tonnes of saved weight or space for substitute payload

Applications for our work are found in aerospace, defence, transport, manufacturing, agriculture, utilities, and facilities management.

The Institute's partnerships have worked on design, monitoring, diagnostics, prognostics and life extension for assets as diverse as aircraft engines, railway infrastructure, smart grids, fuel tanks and systems, gearboxes, wind turbines and agricultural systems.

TO LEARN MORE, VISIT: https://www.cranfield.ac.uk/centres/throughlife-engineering-services-institute

UK MR REGIONS

SCOTLAND'S MANUFACTURERS SAIL ROUGH SEAS

BY ERIKKA ASKELAND

From ships to whisky, manufacturers set sights on future support and calmer conditions

Scotland's manufacturing sector faced a challenging year being buffeted by domestic and international crises outside its control. It faced uncertainty over the UK's departure from the European Union, currency fluctuations and, in the latter part of the year, punitive tariffs applied by the US on exports that are the very essence of Scottish-made products: whisky, shortbread and cashmere jumpers.

Rough seas

Turmoil formed a backdrop to a dramatic struggle over one of the jewels of Scotland's manufacturing heritage. Ferguson Marine was one of the last ship builders on the Clyde when it was rescued in 2014 from collapse by Jim McColl, one of Scotland's best-known industrialists. McColl, who retains a portfolio of global engineering businesses through his investment vehicle, Clyde Blowers Capital, pledged investment and growth. The deal was underpinned by a £97million order for two new dual-fuel ferries for Caledonian Maritime Assets, the state-owned company that leases vessels to Caledonian MacBrayne (CalMac) also owned by the Scottish Government and operator of life-line ferry services on the West Coast of Scotland.

Jobs at Ferguson Marine were saved when the ship builder was nationalised after an acrimonious dispute over delays with its owner Jim McColl.

Delays and acrimony caused the Scottish Government to call in loans plus interest, worth around £49million, in a move that put the company into administration and took the shipyard into state ownership in November, saving 300 jobs.

Finance Secretary Derek Mackay pledged to complete the unfinished ferries and further welcomed some better news for Scottish shipbuilding.

Number crunch

Manufacturing employment in Scotland has been in slow decline, down to around 185,000 in 2017 from 189,000 in 2014, according to the Office for National Statistics. However Scottish Enterprise says the sector is still strong, comprising around 10,000 companies.

The most recent figures available

Whisky (see main image of Aberlour Distillery) remains Scotland's leading export but it's not the only star in the food and drink sector. Shortbread is another global favourite.
Credit: Walkers

SCOTLAND MANUFACTURING DATA

£14.4bn
TOTAL MANUFACTURING OUTPUT

6.7%
MANUFACTURING AS % OF REGIONAL EMPLOYMENT

182,000
TOTAL EMPLOYED IN MANUFACTURING

MANUFACTURING OUTPUT AS %AGE OF REGIONAL OUTPUT 10.5%

113.0%
AVERAGE MANUFACTURING SALARY AS % OF REGIONAL AVERAGE

show exports of manufactured goods had been in rude health – driven perhaps by pound sterling volatility that followed in the wake the vote to leave the EU in 2016. International exports from the manufacturing sector increased 10.3%, to £17.6 billion in 2017.

Food & drink and Trump

The star performer of Scotland's manufactured exports remains whisky. HM Revenue and Customs (HMRC) revealed the export value of Scotch grew 7.8%, to a record £4.7billion in 2018; exports to the US passed the £1billion mark for the first time. A 25% rise in tariffs on exports to the US in October came as a blow, in what was a retaliatory move over EU subsidies paid to European aerospace firm, Airbus.

SWA chief executive Karen Betts warned the taxes would cause a drop off in investment, productivity and jobs in the sector and called on the UK government to reduce taxes domestically to mitigate the impact. Walkers, the UK's largest exporter of biscuits and shortbread, had already shipped most of its Christmas product to the US before the tariffs came into force but expressed worry about the 1,600 workers it requires for its peak manufacturing season. James Whithers, chief executive of trade body Scotland Food & Drink, said that the

Babcock International's 'Arrowhead' project has been selected for the Royal Navy's Type 31 Frigate fleet. It will be built at Rosyth yard.
Credit: Babcock

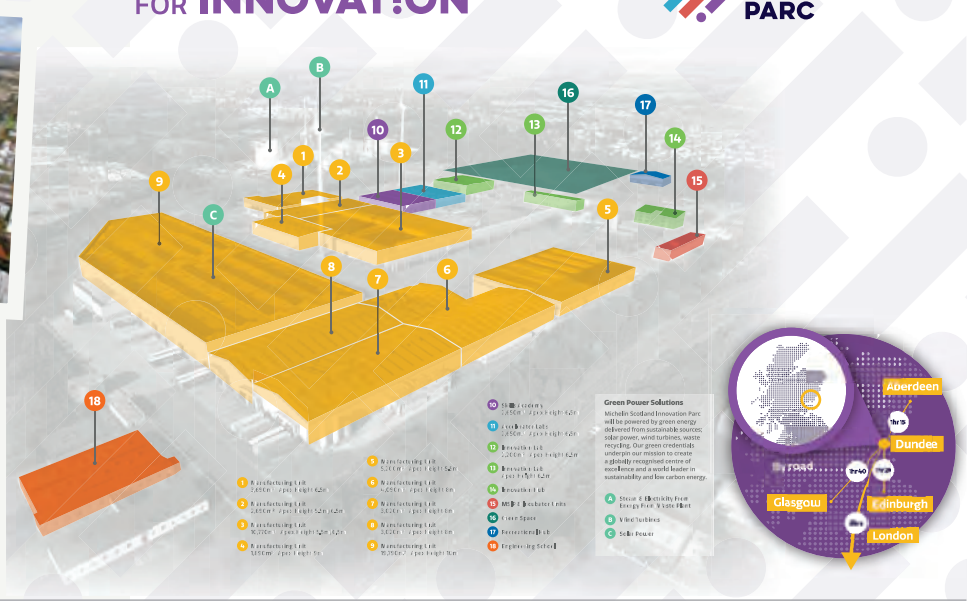
Babcock, which operates from the port of Rosyth on the east coast of Scotland, was named the preferred bidder for the £1.3 billion contract to build a new fleet of Type 31 Royal Navy frigates. The aerospace contractor led the consortium bid for the "bargain" frigates –estimated to cost £250million each – which also includes Ferguson Marine. Prime Minister Boris Johnson said the deal would support 2,500 jobs throughout the UK and could herald better times for the now nationalised workforce on the Clyde.

Rosyth Dockyard in Fife is involved in the construction and support of HMS Prince of Wales, which is (with HMS Queen Elizabeth) the UK's largest-ever aircraft carrier.
Credit: Royal Navy

BEYOND MICHELIN

Following the announcement that French tyre firm Michelin would close its plant in Dundee, the Scottish Government announced a £60m funding commitment in November to turn the site into the Michelin Scotland Innovation Parc (MSIP). It will be a focal point for clean transport and low carbon energy, which fits in with the Scottish Government's plan to re-engineer Scotland's economy to be net zero emission by 2045 – five years sooner than the rest of the UK.

Michelin's long-established plant in Dundee is no more. The site is to be transformed into the Michelin Scotland Innovation Parc (MSIP).



tariffs were a "real blow" but there were hopes of some change.

"It looks like there will be a review next February. At that point, the level of tariff on individual products could change; so too the categories of products affected. Either way, at a time of Brexit uncertainty, new barriers in another key market is not good for anyone," he said.

Sentiment tanks

The Scottish Chambers of Commerce's quarterly economic survey revealed the impact of manufacturers stockpiling materials ahead of the first Brexit deadline at the end of March, to prevent supply chain gaps if goods were held up at the border. In July, the Chamber confirmed that the manufacturing sector took the biggest impact from Brexit uncertainty as stockpiling in Q1 meant capacity utilisation hit its lowest level in ten years in Q2. By the third quarter survey, the Scottish Chambers noted that confidence among frustrated manufacturers had "tanked".

North Sea stabilises

There was some return of confidence in the oil and gas industry, as commodity prices largely recovered from lows hit in the oil price crash of 2014.

Balmoral employee undertakes research at the company's Aberdeen HQ

Two well-known manufacturing names in the energy supply chain consolidated in 2019. Balmoral Group, which specialises in buoyancy and elastomer subsea products as well as a growing international tanks business, undertook two transactions investing cash in Turriff-based Ace Winches.

"The past year has not been without its challenges," said Jim Milne, chairman of Balmoral Group. "As with most UK manufacturers we have had to deal with significant uncertainties in the raw materials supply chain while future potential import and export regulations remain of concern.

"We are making good progress in the offshore wind market, with a number of patented cable protection products about to be fully launched into the industry. Overall, we remain optimistic across all divisions of the Group as we head into uncharted territory in 2020."

The £65million National Manufacturing Institute Scotland (NMIS), which includes the Lightweight Manufacturing Centre (LMC), opened earlier in 2019 by First Minister Nicola Sturgeon, and the University of Strathclyde's Advanced Forming Research Centre (AFRC), submitted plans to Renfrewshire Council for consent in November.

HLM architects artist image of National Manufacturing Institute Scotland.

David Leven, Head of High Value Manufacturing at Scottish Enterprise, said "We are embarking as an organisation and a country on achieving a restructuring of the economy and part of that is a move towards high value manufacturing,

"We recognise that, to be a resilient and prosperous economy we need to do more to industrialise our fantastic research capability. Scotland stands out from many places in the world in terms of research and innovation. We could do more in terms of industrialising and, by definition, growing the manufacturing base."

SCOTTISH MANUFACTURING ADVISORY SERVICE COMMENTARY

2020 is a watershed moment for Scottish manufacturing. The creation of the industry-led £65m National Manufacturing Institute Scotland (NMIS) sits at the centre of the new Advanced Manufacturing Innovation District, turning Scotland into a global leader in advanced manufacturing and a magnet for investment. Located just outside Glasgow, NMIS will capitalise on Scotland's manufacturing prowess.

Nick Shields, Head of Business Support Services, Scottish Enterprise, Scottish Development International, SMAS

From Harris tweed to ship building, the country has long been a hotbed of industrial excellence. Added to this will be the UK-wide Medicines Manufacturing Innovation Centre (MMIC) and several distributed Manufacturing centres will be created to reach across the whole of Scotland.

More space

Plans have been announced to make Scotland a hub for space exploration, along with the development of full spaceport capability. Already, more satellites are manufactured in Scotland than anywhere else in Europe, with estimates that Scotland's space industry could be worth as much as £4bn by 2030. It's this ambitious vision that will put Scottish manufacturing at the forefront of global manufacturing.

Another highlight during 2020 will be the SMAS National Manufacturing Conference. Taking place at the EICC in Edinburgh on the 26th May (www.smas.co.uk), 600 delegates drawn from across Scotland's manufacturing community and beyond will attend the only event of its kind in Scotland. Historically the conference has provided an outstanding platform to showcase Scotland's sector, with this year's agenda focusing on the opportunities that technology presents and featuring leading industry keynotes and a state-of-the art technology showcase.

> "History tells us that dramatic increases in productivity have been driven by industrial revolutions and many commentators are saying that we are at the start of the fourth."

However, there's still serious effort required to address Scotland's productivity performance in order to maximise these opportunities. Scotland currently sits in the third quartile of productivity amongst OECD members. Although the country's manufacturers punch well above their weight – accounting for over half of its exports and 54% of Scottish R&D spending – increasing Scotland's productivity is the defining economic challenge of our age.

History tells us that dramatic increases in productivity have been driven by industrial revolutions and many commentators are saying that we are at the start of the fourth. Scotland is one of the few countries to have experienced every industrial revolution – and they have all driven our economy forward.

We're committed to helping Scottish manufacturers exploit the opportunities that this next industrial revolution offers. Last year, we supported over 100 manufacturing businesses on their Industry 4.0 journey, with our free Industry 4.0 Review. We'll continue apace over the course of this year to help even more businesses implement digital solutions to become more productive, competitive and resilient.

While 2020 will see businesses navigate their way through some immediate economic challenges, these only serve to underline the need to step up the pace and embrace the concept of digital technology and invest in it. With a renewed ambition for Scottish manufacturing, along with a strong integrated network of support that businesses can now leverage, I'm optimistic that the future for Scottish manufacturing is extremely bright.

THE DRAGON MARKS TIME

After a relatively bullish 2018, the confidence of manufacturers in Wales waned in 2019 as the sector enjoyed mixed fortunes, despite investment by the Welsh Government.

Brexit uncertainty had a tangibly negative effect on manufacturing in Wales, which grew more pronounced as 2019 wore on.

"Things have really slowed up in Q4; every discussion I have attended notes that demand has fallen off a cliff. The uncertainty has really hit; it is even impacting businesses that considered themselves immune to Brexit," says Ian Price, Wales Director, CBI.

Price's view from the ground in Wales is borne out by the CBI's pan-UK monthly Industrial Trends Survey, which painted a bleak picture in both September and October. Manufacturing output declined in the quarter to October, marking four consecutive months of flat or falling output volumes; manufacturers expect output to fall at a slightly faster rate in the next three months. Total new order volumes also fell in the three months to October and manufacturers expect decline to continue in the next three months. Wales is heavily reliant on trade with Europe; almost two-thirds of its exports go to the EU.

STEEL BLUES

Uncertainty continues at Tata Steel, which employs some 7000 people in Wales. Its proposed merger with Thyssenkrupp, which appeared to offer more certainty for the company's future in the Principality, was blocked by EU antitrust regulators. More recently, it has unveiled plans to slash some 3000 jobs across Europe as it grapples with what it called a "severe" international steel market.

REGIONAL SUMMARY

£10.9bn

TOTAL MANUFACTURING OUTPUT

10.3%

MANUFACTURING AS % OF REGIONAL EMPLOYMENT

151,000

TOTAL EMPLOYED IN MANUFACTURING

MANUFACTURING OUTPUT AS % AGE OF REGIONAL OUTPUT 17.5%

122.4%

AVERAGE MANUFACTURING SALARY AS % OF REGIONAL AVERAGE*

Below: Ineos' CEO Jim Ratcliffe announced the company's intention to build its Grenadier 4x4 vehicle at Bridgend, which was good news for a town hit hard by Ford's closure of its engine plant.

Right: Aston Martin DBX takes shape at its St Athan plant n South Wales.

Positive sentiment, plummeting orders

Make UK's Quarterly Manufacturing Outlook Survey, published in July 2019 and covering Q3 2018 to Q2 2019 showed manufacturing output in Wales as stable (outperforming the UK average despite volatility), and positive sentiment towards employment and orders. But the survey also highlighted the contradiction that capital investment has plummeted, with companies more willing to invest in recruitment than other, less fungible, assets such as new equipment or machinery.

"In September, Ineos Automotive selected Bridgend for the production of its new 4x4 vehicle, creating 200 jobs."

Manufacturing remains key to the Welsh economy. In 2018, it employed 151,000 people in Wales; 10.3 percent of the workforce. It accounts for 17.5% of total output, the largest of any UK region.

Automotive: some good, some bad

The automotive industry well illustrates the mixed bag that manufacturing in Wales has held through 2019. In September, Ineos Automotive selected Bridgend for the production of its new 4x4 vehicle, creating 200 jobs. In November, Aston Martin unveiled the first of its new luxury SUVs to leave its production line at a new factory in St Athan, South Wales. The site will eventually employ 750 people. Both companies received financial support from the Welsh Government, though the amounts were not disclosed.

The investments and jobs are much needed. Both new plants are located within a 20-minute drive of Ford's Bridgend plant, which will close in

Credit: Airbus

Left: Operators John Huxley (left) and John Kennedy at the controls of the new drilling machine in the Airbus A350 jig , North Factory, Broughton, North Wales.

September 2020 with the loss of 1700 jobs. The company blamed changing customer demand and rising costs. It denied Brexit was a factor.

There are positives elsewhere. Airbus, which employs 6000 at its wing factory in Broughton, Flintshire, and a further 400 in Newport, warned in 2018 it could leave the UK if the terms of Brexit are unfavourable. The Welsh Government gave financial support to help it prepare for transition.

More recently, it has been more bullish. In November, its chief executive stated that the company would remain loyal to the UK even in the event of a no-deal Brexit. The company has also unveiled some very big orders and invested heavily in improving its facilities in Flintshire.

WALES' BIGGEST MANUFACTURING SECTORS	
Transport equipment	15.9%
Food and drink	15%
Chemicals	10.7%
Other manufacturing	58.4%

Source: ONS / EEF Regional Manufacturing Outlook July 2019

Investing in modernisation

The manufacturing sector weathered the post-2008 economic slowdown better than many regions because of Welsh Government initiatives to upskill workers. EU funding amounting to £1.7m was secured as part of a wider £2.8m Advanced Design Engineering project intended to help SMEs leverage technology. Such priorities are guided by the Welsh Government's Economic Action Plan, launched in December 2017 but fleshed out in May 2018 and again in early 2019, which is now broadly supported by the private sector.

The Development Bank of Wales invested £80 million in total in its last full financial year, an increase of 18% on the previous year, and manufacturing has been a key target; in the 12 months to September 2019, it had invested some £11 million in the sector.

Many of those investments are designed to make manufacturers more efficient and improve productivity. Simon Vittle, Barclays manufacturing sector specialist for Wales, refers to the Barclays Corporate Banking Manufacturing report, released by the bank in November, that highlights the potential rewards for manufacturers that embrace new technology and distribution models. The report suggests that, in Wales alone, manufacturers able to use technology to sell direct to consumers would benefit from an £836 million boost. One in five firms in Wales have already embraced this trend.

"Many manufacturing firms still operate from Wales, having chosen to buck the trend of outsourcing manufacturing operations to Eastern Europe or Asia," Vittle says. "Whilst 2019 has been a challenging year the manufacturing sector remains positive, with a number of success stories. High-tech customers, in particular, see Wales as a great location to grow and develop their business. 2020 promises to be an exciting year for Welsh manufacturing and the technology sector."

One company epitomising this change – and the role of the Welsh Government – is Something Different Wholesale, a £6 million wholesale giftware business in Swansea that supplies products to retailers mainly in the UK (89%) but also Europe (12%) and the rest of the world (8%). It designs and distributes its products in Swansea but manufactures them in China. It is investing in technology that would enable its wholesale customers to market and sell its products, without touching them. Something Different Wholesale would deliver direct, in a model known as drop shipping. It has secured support from the Development Bank of Wales in the form of a £100,00 loan, which it used for bigger premises.

SEVENOAKS MODULAR

Sevenoaks Modular, a Neath-based specialist in timber frame and modular construction, invested £6.5 million in acquiring and regenerating an iconic industrial site known as the Metal Box factory.

The company has had no support from the Welsh Government. From its new 250,000 sq ft site, much of which is indoors, it will manufacture large segments of homes, ready to be assembled on site. The investment will allow Sevenoaks to go from producing 1000 homes per year to more than 3000.

"The construction industry is moving more towards offsite construction methods, which save time and money. and this site is perfect for our expansion into this way of working across all the businesses. We look forward to creating many more high-quality jobs in the town and returning this site to its former glory as a hub of industry in Neath," says Jonathan Hale, chairman of Sevenoaks Modular.

BORDERS, BUSES, WINGS AND OPPORTUNITIES

Almost four years since the UK voted to leave the EU, Brexit still dominates the landscape for Northern Ireland's manufacturers.

Manufacturing is a key part of Northern Ireland's economy, with more than 88,000 employees across 5,800 businesses, according to Invest NI, the regional business development agency. The sector has grown almost three times faster in Northern Ireland in recent years than in the UK as a whole, accounting for more than 11% of employment and over 15% of gross value added (GVA).

However, Brexit has hung over the sector since the June 2016 referendum. Northern Ireland's position is uniquely sensitive due to its land border with the Republic of Ireland, an EU member state. This has placed the region at the heart of tortuous negotiations between the EU and UK over the latter's withdrawal agreement (WA), with sometimes conflicting priorities at play: the desire to maintain an open border on the island of Ireland, even while Northern Ireland leaves the EU with the rest of the UK.

At the time of writing in late November, the UK was in the midst of a general election campaign, which could lead to a new set of negotiations, depending on the outcome. However, should the WA – or something similar – become reality, it has a number of implications for Northern Irish manufacturers. Many of these are positive, according to Stephen

Spirit AeroSystems' recently agreed deal to acquire Bombardier's Belfast facilities is expected to complete in the first half of 2020. *Credit: Bombardier*

Kelly, chief executive of trade body Manufacturing NI. Most importantly, it would take the threat of 'no deal' off the table.

Additionally, the deal would make Northern Ireland effectively part of the EU customs union and single market for at least four years, while being de jure part of the UK customs territory, a scenario that could provide manufacturers with unique opportunities, Kelly said.

However, there are concerns that such a

NORTHERN IRELAND DATA

£5.2bn

TOTAL MANUFACTURING OUTPUT

10.6%

MANUFACTURING AS % OF REGIONAL EMPLOYMENT

95,000

TOTAL EMPLOYED IN MANUFACTURING

MANUFACTURING OUTPUT AS % AGE OF REGIONAL OUTPUT 13.0%

116.2%

AVERAGE MANUFACTURING SALARY AS % OF REGIONAL AVERAGE

Credit: SDC Trailers

SDC Trailers – a producer of lorry trailers that employs 650 people in the region – said that it planned to cut jobs, though no details on numbers have yet been released.

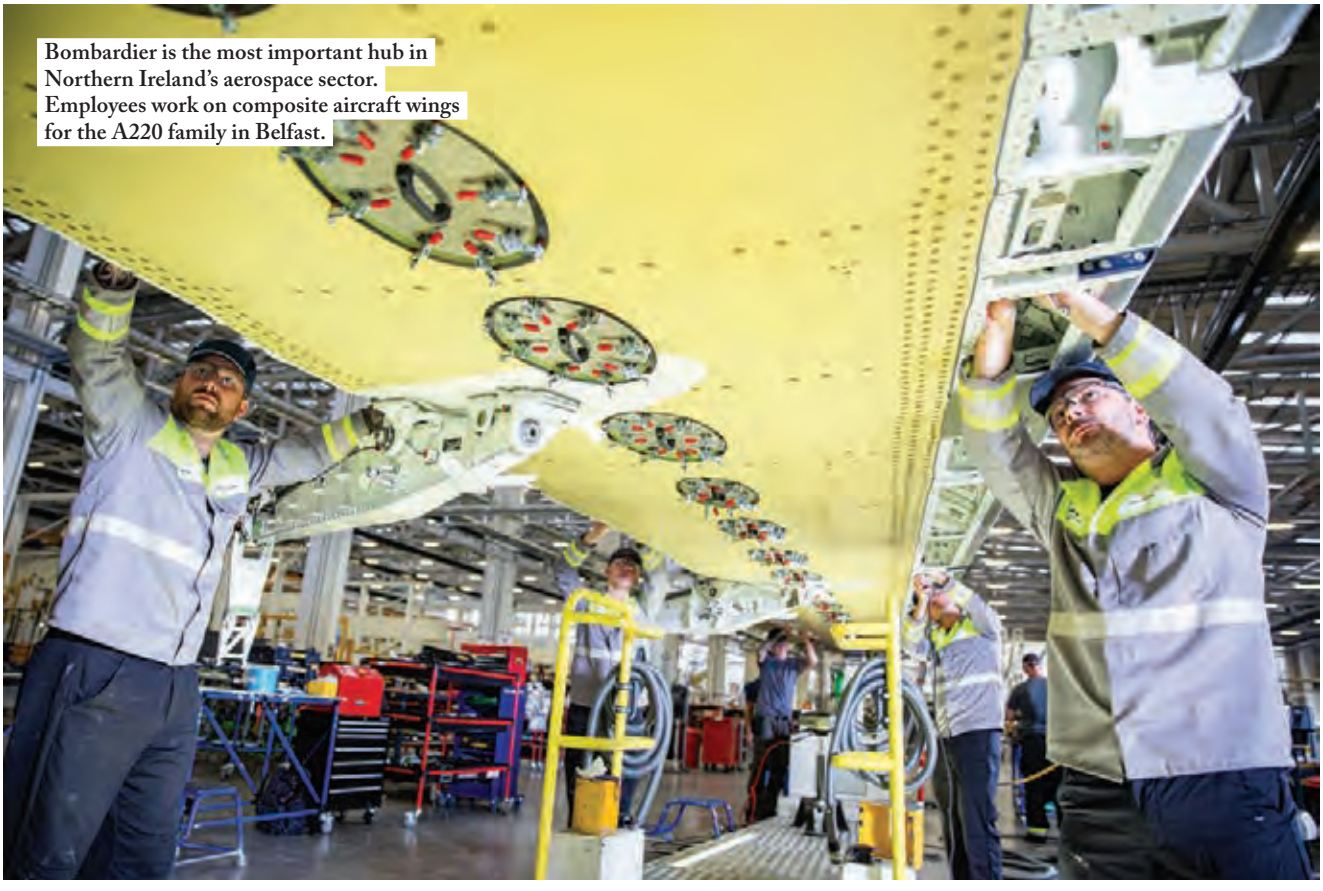
deal could hinder companies' position within the UK market, with new costs and complexities around tariffs and paperwork when 'exporting' from Northern Ireland to Britain. Northern Irish sales to Britain are worth one and a half times the value of all its exports, and almost four times the value of exports to the Republic of Ireland. Should the WA go ahead, "there's a lot of compensation and legislation required to protect us", Kelly said.

For some manufacturers, concerns over Brexit have already had an impact. In early November, SDC Trailers – a producer of lorry trailers that employs 650 people in the region – said that it planned to cut jobs, though no details on numbers have yet been released. In a statement at the time, the company said "the uncertainty of Brexit and other economic concerns has resulted in a slowing down of capital purchases from retailers, logistics firms and others".

Beyond Brexit, the past year was dominated by changes in ownership at three major Northern Irish manufacturers, all of which seem to present more stable and positive futures for the companies. For example, Energy firm Infrastrata agreed a deal to acquire Harland and Wolff, the shipbuilder whose giant cranes dominate Belfast's skyline.

The transactions did not stop there. Bombardier – the most important hub in the region's crucial aerospace segment, manufacturing composite wings for the Airbus A220 aircraft family, among other projects – announced in May that it was putting its Belfast facilities up for sale. That process came to a swift end in October, when a deal was announced with Spirit AeroSystems.

Carol Phillips, vice-president of human resources in Bombardier's Northern Ireland operations, said the transaction is expected to close in the



Bombardier is the most important hub in Northern Ireland's aerospace sector. Employees work on composite aircraft wings for the A220 family in Belfast.

Credit: Bombardier

Above: **Moy Park is Northern Ireland's biggest private sector business.** *Credit: Moy Park*

Left: **Jo Bamford acquired WrightBus in October. Photo shows some of the first buses to be delivered under the new ownership, part of an order from First Group for use in Leeds, England.** *Credit: WrightBus*

first half of 2020, subject to regulatory approvals and other customary closing conditions.

"Bombardier Belfast brings world-class engineering expertise to Spirit and adds to a strong track record of innovation, especially in advanced composites," she added.

A fall in market demand for diesel buses forced WrightBus into administration in September. The manufacturer of London's New Routemaster double-decker buses was subsequently acquired by Jo Bamford, a member of the family behind JCB. In a statement at the time, he said that while there was "a very big job to do to turn it around", the company sees opportunities for the future as the market looks to decarbonise, an area in which Wrightbus had already made some headway.

"This is our central vision for Wrightbus – to be market leaders in the zero emissions buses of the future."

US-owned company Terex is targeting growth in waste management, recycling and mobile conveying with a new facility in Campsie, in the West of Northern Ireland.

Poultry producer Moy Park is Northern Ireland's largest private sector business. Andrew Nethercott, retail director of the company's Prepared Foods business unit, said the company had invested £45 million in its Northern Irish facilities in 2019. The region's strong agricultural heritage and its close transport link with Great Britain make it an ideal base for the company, he said, though he noted that decision-making locally had been impacted by the absence of a local political administration, with Stormont suspended since early 2017.

"Moy Park has spent a lot of time focusing on the things it can control, such as building and enhancing relationships with retailers as well as investing in talent development and career advancement," Nethercott added.

US manufacturers have established a number of operations in the region. Terex, a producer of lifting and material processing products and services in construction, quarrying, mining and other industries, opened a new facility in Campsie in Derry/Londonderry in September, part of a £12 million investment. This is part of the company's goal of targeting growth in waste management, recycling and mobile conveying sectors, according to Kieran Hegarty, president of Terex Materials Processing. He said the facility will manufacture product lines for Terex Ecotec (waste management and recycling) and Terex Conveying Systems, its mobile conveying business. The company also operates facilities in a number of other parts of Northern Ireland.

The continuing lack of a regional political administration is a challenge, said Hegarty, along with uncertainty around Brexit.

"As an exporting manufacturer, as well as being an importer of materials needed to make our products, the freer the trade environment the better," he said. "We are following the situation closely and while we will need to adjust to new policies that might come in place for Brexit, we will continue to focus on our long-term business plans, new product development and executing our manufacturing strategy."

THE POWER PLANT

Bosch Rexroth future factory.
Credit: Bosch Rexroth UK Ltd

The combined London and South-East region has seen some extreme changes in its business profile, as rising land values have driven out manufacturing in favour of a service economy. The rise of high vale food and drink production, electronics and other highly skilled jobs may turn this tide.

BY RICHARD FENTON

The last few years have seen stratospheric rises in land and property costs in the region and have forced many traditional manufacturing companies to relocate outside Greater London, generally marked by the M25 orbital highway. The change in the make-up of manufacturing, the move from heavy engineering, furniture, other household goods and food production, to 'high-tech' enterprises in both soft- and hardware have led to the region being on the brink of becoming the country's biggest manufacturing region. This would mean that London and the South-East would overtake the North-West and continue its rise above Britain's traditional industrial heartlands of the Midlands, East Anglia and Yorkshire.

From food & drink to electronics, aerospace and automobiles

To satisfy the increasingly sophisticated palates of South-East consumers many new food and drink companies have sprouted up in the region, making and selling high-value products with excellent profit margins. The aerospace and electronics sectors have continued to grow, in locations such as Farnborough in Hampshire and on the edge of the 'motorsport' valley in Oxfordshire.

As well as its home-grown success, the region has benefitted from the global volatility of raw materials such as steel and aluminium, commodities vital for the heavy industry found in the traditional heartland of the north and West Midlands. This has particularly affected car manufacturers and their supply chain, traditionally highly profitable businesses, who have not only been hit by commodity cost rises but also the uncertainty of Brexit, the downturn in the vehicle in China, and the massive investments

Above: The auto sector is strongly represented in the South-East, with OEMs like Mini and specialist manufacturers like Ricardo

needed to switch from petrol and diesel engines to hybrid and pure electric powertrains.

Justin Benson, Head of Automotive for KPMG in the UK and leader of the firm's Brexit response in the Industrial Manufacturing sector commented that, "We have seen London and the South-East emerge as a very strong player in manufacturing over the last decade and this has accelerated recently as food and drink production has mushroomed. Added to this is the UK's and global rapidly growing demand for electronics, in both consumer products and in industrial automation and control."

Brexit - challenges and opportunities

Nervousness and fear have spread throughout the UK's industrial heartland at the thought of difficulties in importing everything central to manufacturing - from raw materials to components from European suppliers made cheaper than UK companies can provide. This anxiety appears to be in sharper focus in the South-East than in other parts of the UK, perhaps as the region is closer to the seat of parliament and the major financial institutions. Fears of severe supply chain delays, crippling tariffs and the consequent unprofitability of manufacturing certain products in the UK abound. Some companies will profit from the situation though; by harnessing the new technologies - IT and advanced software and systems manufacture. Companies can import and export their products electronically, in the case of software and expertise, and those that manufacture smaller, high-value goods should not see their profits unduly dented by new customs controls and charges.

So, while Brexit will throw up many hurdles, for the new breed of manufacturer in the South-East - creators of advanced technology solutions - there may be opportunities bred by the march of Industry 4.0.

Technologies that are easily licensable and produced in other countries without shipping large (or any) items of hardware – such as software, electric vehicle charging systems, food science systems and products that can be shipped as kits such as furniture – may escape many of the restrictions, delays and tariffs likely to be imposed on the passage of goods and services after the UK's withdrawal from the EU.

As Brompton Bicycles' Butler-Adams observed, the human element is central to the success of the South-East. It may be surprising to learn that many more people work in manufacturing in the southern regions than in the north of the UK. Some 413,000 people are employed in manufacturing in London and the South-East, according to Oxford Economics, compared to 344,000 in the North-West.

LONDON & THE SOUTH-EAST DATA

£28.1bn

TOTAL MANUFACTURING OUTPUT

<5%

MANUFACTURING AS % OF REGIONAL EMPLOYMENT

412,000

TOTAL EMPLOYED IN MANUFACTURING

MANUFACTURING OUTPUT AS %AGE OF REGIONAL OUTPUT <5%

>105%

AVERAGE MANUFACTURING SALARY AS % OF REGIONAL AVERAGE

NOTE: GREATER LONDON IS THE ONLY REGION IN THE UK WHERE THE AVERAGE MANUFACTURING SALARY IS LESS THAN THE REGIONAL AVERAGE (92.7%)

Brompton Bicycle CEO Will Butler Adams on an electric bike in the company's factory in London.

Above: The power of being different: Brompton's game-changing folding bike.

BROMPTON BICYCLES

An important factor that favours the South-East is its wealth of intellectual capital and the diversity of its skilled workforce, as evidenced by the success of Brompton, a bicycle manufacturer that invested in a new 90,000 square foot factory in west London three years ago.

"With the growth of popularity of the urban bicycle, we have seen a sort of 'gold rush' - bikes have gone from being just bicycles, to movement, to a service, as in hiring bicycles, to high technology, as in the launch of our electric bikes," said Brompton CEO Will Butler-Adams. He feels that making bikes in London makes good sense in many ways.

"When we moved to our new factory, we thought long and hard about other locations but we realised that, as we see net migration to cities, it makes sense to make your product close to your customer," he said, adding: "We could have gone to the far east, or Wales, or the north of England where labour and land is cheaper, but we decided to stay in London where we have a skilled and diverse workforce already in place. It helps having staff who know the business and know the culture, particularly in Asian markets. Also, we are known as made in London, and that element is key."

Talking of Brexit, Butler-Adams outlined Brompton's strategy: "Two years ago we realised that Brexit was something we had no control over, we built up stock, worked on an electric bike, looked to new markets in Asia, and got our distribution back from Europe."

Brompton decided to remain in London and manufacture close to it largest market.

BOSCH REXROTH

INVESTING IN DIGITISATION

Another great driver of the South-East's success is its rapid embrace of the so-called Fourth Industrial Revolution. Industry 4.0, smart manufacturing, factory of the future - call it what you will – the evolution of manufacturing is underway, at least for some UK manufacturers. Across the country, businesses vary drastically in their adoption of these smart technologies.

Paul Streatfield, Business Development - Strategic Product Manager at Bosch Rexroth Ltd. UK posits that the South-East has led the way in investing in digitisation, starting with a question: Why are manufacturers yet to fully embrace the new dawn of connected manufacturing? He said that for many, the answer lies in the cost - or the perceived cost - of digitisation."

The initial investment in smart technology can be enough to put many manufacturers off making the move to a smarter way of working but the benefits of real-time quality check, continuous improvement and equipment maintenance will undoubtedly lead to cost savings and productivity improvements." Streatfield believes that this awareness is most apparent in the South-East, where customer demand and overseas competition is most apparent to companies. "Customer demands are changing and the manufacturing industry and technology is being forced to adapt to keep up. More and more often, products need to be produced in small, highly customised batches, putting pressure on businesses to reduce their time-to-market and adapt to changes in demand. To do so, businesses need to invest in technology that gives them the flexibility to adapt quickly to fulfil demand. And that capital seems more readily available to companies who are closer to the financial centre of the UK - London."

Above: The cost of the initial investment in smart technology can be off-putting.

RICARDO

ADVANCED, AGILE AND VERSATILE

Specialist engineering company Ricardo is headquartered on the south coast, in West Sussex.

Ricardo recently invested £1.5 million on a spiral bevel grinder for transmission manufacturing.

Headquartered on the UK's south coast at Shoreham-by-Sea in West Sussex, Ricardo is a global strategic engineering and environmental consultancy that specialises in the transport, energy and scarce resources sectors. Indeed, as well as its work in passenger cars, commercial vehicles, rail, defence and motorsport, it has shown its awareness of the changing business world by expanding into energy management and environmental-impact research and development. Its client list includes transport operators, manufacturers, energy companies, financial institutions and government agencies.

Having 'moved with the times' since its founding in 1915, Ricardo is a fine example of the versatility of UK companies - moving from the pursuit of power and vehicle performance to the topical areas of cost reduction, safety management, regulatory compliance and environmental impact assessments. In vehicle terms this has meant a shift away from internal combustion engines and drivelines to the prototyping and low-volume manufacturing of electric motors and generators, battery packs and fuel cell systems.

This type of endeavour requires considerable investment. The company has recently spent £1.5 million on a spiral bevel grinder for its transmission manufacturing division. As well as being used in motorsport applications, the new equipment will bring frictional reductions and thus efficiency gains in electric vehicle drivelines, as Ricardo Performance Products MD Martin Starkey said:

"This investment has enhanced Ricardo's capability to design, analyse, manufacture and inspect bevel gears with a closed loop system, not only for our high performance applications but also to help us drive forward the development of more efficient powertrains for future mobility solutions, including hybrid, electric and fuel cell vehicles."

MANUFACTURING IN THE UK 2019

IN 2018 THE UK MANUFACTURING SECTOR ACCOUNTED FOR

£182bn

OF OUTPUT

IN 2019 THE UK MANUFACTURING SECTOR ACCOUNTS FOR

£194bn

OF OUTPUT

IN 2018 IT EMPLOYED 2.7 MILLION PEOPLE DIRECTLY

IN 2019 IT EMPLOYS 2.7 MILLION PEOPLE DIRECTLY

2019: Average salary across all manufacturing sectors is £33,592, which is 13% higher than the rest of the economy

2018: Average salary across all manufacturing sectors was £33,500

2019

66%

of the UK's total R&D spend is by manufacturing businesses

2018

69%

of the UK's total R&D spend is by manufacturing businesses

2019 THE UK'S EXPORTS OF GOODS, INCLUDING MANUFACTURING, ARE WORTH £354 BILLION OVERALL

2018 THE UK'S EXPORTS OF GOODS, INCLUDING MANUFACTURING, WERE WORTH £301.3 BILLION OVERALL

2018

THE UK'S EXPORTS OF GO INCLUDING MANUFACTUR AMOUNT TO

55%

OF THE UK'S TOTAL O GOODS AND SERVICES

2019

THE UK'S EXPORTS OF GOODS INCLUDING MANUFACTURING AMOUNT TO

54%

OF THE UK'S TOTAL OF GOODS AND SERVICES

2019 MANUFACTURING R&D ACCOUNTS FOR 15% OF TOTAL BUSINESS INVESTMENT

2018 MANUFACTURING R&D ACCOUNTED FOR 13% OF TOTAL BUSINESS INVESTMENT

GO FOURTH: MAKING MANUFACTURING SECURE

Manufacturing is among the sectors most likely to experience a data breach, headed only by financial services and insurance. But it's among the least protected, according to the manufacturers' organisation Make UK.

Cyber threats are constraining UK industry's progress with digitalisation.

Companies can be hacked, covertly observed, and have their assets damaged or stolen while remaining completely unaware – until it's too late.

Because Industry 4.0 technology makes a company more connected to machines, the Internet and other companies, firms are wary – with good reason – that high levels of digital adoption will increase their exposure to cyber attack. In a study with cyber security providers Vauban Group, Make UK found that, while manufacturers are investing in digital technologies, 35% think that cyber vulnerability is inhibiting them from doing so fully.

Cyber attacks also show how closely integrated business IT (business communications and computing, storage and back-office technology) is with operational technology today.

"For Industry 4.0 especially, IT and OT have already converged, and at a speed greater than companies have been able to secure them adequately," says Graham Thomson, chief information security officer at Irwin Mitchell. Industrial cyber attacks will increase, Graham says, impacting industry in areas like

"Hacking and modifying a factory operation can be achieved by attacking any management system of operations technology."

breaches of security, outages, data and IP theft, physical damage to IT systems and to capital equipment.

Industrial espionage

There are several ways a cyber criminal can attack a manufacturing company, including phishing and other "social engineering" techniques, resulting in malware (virus) infections like ransomware and Trojan horses.

Phishing is the fraudulent attempt to acquire sensitive information like passwords and protected files, or to deploy booby-trapped files, by posing as a trustworthy party. It's the most common form of cyber attack because there's a constant stream of different vulnerabilities that a hacker can take advantage of. It could be elicited through a fake advertisement on social media, or masquerading as an email from a work colleague.

The risk is magnified with such attacks because companies can't always detect the level of security risk being introduced. "Say a company installs a new HVACS [air conditioning] system, but they didn't know this is accessible via the internet," says Graham. "It can be accessed from afar simply with a commonly-known password, if this isn't set up securely.

"A hacker can play with the settings, making conditions too hot or cold to work efficiently, or possibly even use this system to then access other internal IT systems," says Graham. "It's a very effective impact from a simple intervention."

Hacking and modifying a factory operation can be achieved by attacking any management system of operations technology, or supervisory control and data acquisition (SCADA) architecture. Most manufacturing companies have a variety of these OT systems to manage their factories inside their corporate IT structure which are also accessible remotely, which is where criminals target.

Normally, industrial companies have an 'air gap' between OT and machinery and their IT network, preventing easy access to the plant for cyber criminals.

"We regularly see simple methods like a USB stick breach the air gap," says Graham, "So by itself, partitioning factories from the network with an air gap isn't an effective measure."

Password or credential stuffing

A rising cyber trend that manufacturers should know about is password stuffing.

The login pages for a website, email account, management or control system for operational technology are all at risk from this method.

Cyber criminals can acquire lists of previously compromised email address and password pairings. They run a program to populate login pages with millions of combinations.

"There are about 3bn passwords and usernames on these lists that have been compromised, where numerous security researchers have found these databases on the dark web," says Graham. "They point the program at the login page, press go, and the combinations auto-populate until there's a match."

While the method relies on complete chance, it's possible to gain unauthorised access using email addresses and passwords that were compromised years ago and are totally unrelated to the current business, where an employee used an identical or commonly-used password. The solution: use two-factor authentication for remote access to important systems, or at the very least enforce long random passwords.

IMPROVE YOUR CYBER SECURITY

GRAHAM THOMSON, CHIEF INFORMATION SECURITY OFFICER AT IRWIN MITCHELL, RECOMMENDS THESE STEPS:

1. Appoint somebody with sole responsibility for cyber security for the organisation. Provide them with a framework and reporting structure. For SMEs, this may mean combining the job with another role like IT director.
2. Make security part of the organisation's culture, not just an IT issue. "Being cyber secure covers employees' behaviours, training, and deploying cyber safe processes. Staff need training and better awareness of the risks," Graham says.
3. Become familiar with the different security standards. Several documents can tell you how to apply good IT security: many are free like NIST and CIS, some like ISO27001 are paid-for. Most are very lengthy, and will need a lawyer to translate appropriately for the business.

FLIGHT AND MAIN

The South-West peninsula looks out to the rest of the world and is the preferred location for makers of superyachts, precision machinery, agricultural equipment, advanced electronics and even generic and other medications, as well as Hinkley Point C, one of the largest construction projects in Europe.

There's a lot more to the South West than just Bristol, although it tends to be the first place that springs to mind. Yeovil, to the south, is the UK manufacturing home of Leonardo (formerly Finmeccanica), the manufacturer of helicopters and a full partner in Project Tempest, the next-generation combat aircraft consortium. Honeywell Aerospace is a near neighbour, maintaining the region's aerospace tradition that also includes the BAE Systems Advanced Technology Centre and Airbus' production site for A400M cargo plane wings, both at Filton, Bristol.

Another two hours' travel to the South West on the M5 will get you to Plymouth, home to the thriving Plymouth Manufacturing Group (PMG), which includes in its membership Kawasaki Precision Machinery; Babcock International; Plessey; Princess Yachts International; MSubs; Collins Aerospace; Mars Wrigley; and Artemis Optical.

Plymouth's manufacturing hub

Along with most other parts of the country, skills are a major concern in the South West – or rather, the skills shortage. Stephen Phipson CBE, CEO of MAKEuk, remarked during his visit that the skills shortage is the single issue most regularly raised by members.

PMG and its membership are taking a proactive approach to the problem. Its 5th Apprentice Jobs Fair, held in March, attracted more than 40 exhibitors and around a thousand visitors – a new record. The event was jointly organised with 'Building Plymouth', which represents construction firms in the area. Manufacturing and construction together account for nearly a quarter of Plymouth's economy and one in six of all jobs.

Promoting manufacturing

PMG seeks to stimulate and sustain interest in manufacturing on an ongoing, year-round basis, with a series of events

THE PLYMOUTH FACTOR

GVA (gross value added) from manufacturing: **£866 MILLION**

16% of the local economy

Manufacturing GVA grew **4.3%** between 2016 and 2017

Manufacturing GVA up nearly **40%** since 2010.

The Airbus Filton site manufactures wings for the A400M heavy-lit cargo plane.

Credit: Airbus

NUCLEAR OPTION

Hinckley Point C, near Bristol, is one of the largest construction projects in Europe.

The numbers involved are staggering:

850,000 hours of engineering studies were part of the four-year design approval process

8,626 new job opportunities have been created on site

£1.7 billion has been committed to supply contracts with regional companies in the south west

£200 million a year will go into the region's economy during construction

3 million tonnes of concrete will be used in the site and power plant's construction.

The design of the EPR (European Pressurised Water) reactor uses **17% less uranium** than older technology.

The electricity generated by the two EPR reactors will **offset 9 million tonnes** of CO^2 emissions a year, or 600 million tonnes over its 60-year lifespan.

During 2019, Hinckley Point C passed **500 apprentices** recruited since the project began, reaching 529 by the end of the year.

With a main boom lifting capacity of 5000 tonnes, **Big Carl** is the world's biggest crane. It arrived at the site in September 2019 and lifted a 170 tonne prefabricated part of the reactor's steel containment liner into place at 4.30am on Wednesday, December 18.

Credit: EDF

Cutaway of Hinckley point C, showing main reactor

Credit: EDF

"Big Carl"

At the other end of the construction scale is JCB's 1.8 tonne **E-TEC**, the industry's first-ever, fully-electric mini excavator.

Credit: JCB

JCB E-TEC

SOUTH-WEST MANUFACTURING DATA

£14.3bn
TOTAL MANUFACTURING OUTPUT

7.6%
MANUFACTURING AS % OF REGIONAL EMPLOYMENT

227,000
TOTAL EMPLOYED IN MANUFACTURING

MANUFACTURING OUTPUT AS %AGE OF REGIONAL OUTPUT 11.2%

128.2%
AVERAGE MANUFACTURING SALARY AS % OF REGIONAL AVERAGE

and competitions that involve members, students at the local university, and schools. Its 'Year in Industry' competition is run in conjunction with the Engineering Development Trust (EDT), based at Plymouth Science Park, and (this year for the first time) with the University of Plymouth. PMG's Annual Summer Conference attracts representatives from major manufacturers all over the UK, and Germany: Carsten Roettchen, Managing Director, Global Production, Rittal, parent company to Plymouth-based Rittal-CSM presented at the Conference, as did representatives from Saltash-based Composite Integration Ltd and Babcock International.

2019 saw PMG chairman Mike Snaith announce and sign a partnership agreement with the University of Plymouth's Vice-Chancellor, Professor Judith Petts CBE. The Agreement will "enable local industry to formally engage with the University as its local Higher Education key strategic partner along with the agencies of local and central Government. This includes engagement with industry to fully utilise the university's physical and intellectual assets. The impact will include collaborations for joint grant applications for funding, new commercial developments and innovations, access to university specialist equipment as well as businesses benefiting from student talent and collaborative research opportunities".

This review was compiled with invaluable help from Steve Gerry, secretary of the Plymouth Manufacturing Group and non-executive director of the South West Business Council.

BREXIT'S LONG SHADOW

BY DUNCAN TIFT

Brexit stalked the West Midlands' manufacturing industry throughout 2019, generating an unwanted climate of uncertainty.

Predictions are for a tough 2020, with growth rates being revised down and optimism a commodity in increasingly short supply.

The region's traditional manufacturing bastion, the car industry, has had a dreadful year and has coloured much of the West Midlands' economic activity.

However, anyone thinking the region's manufacturing industry is in terminal decline is missing the larger picture. Whilst teetering on the brink of recession, many view the current climate as the perfect time to invest.

Automotive

Perhaps no single industry is more entwined with the fortunes of the West Midlands than automotive but 2019 has been extremely tough for the car industry.

Jaguar Land Rover's ten-year cycle of growth under the ownership of Tata Motors has come to an end, with sales down globally and its massive programme of investment stalled. There are even rumours the company could be vulnerable to a takeover, with rival BMW poised to step in.

Hundreds of companies which comprise JLR's supply base are collectively holding their breath, waiting with some apprehension about the year ahead.

Elsewhere, Honda has announced the closure of its Swindon plant, BMW has

switched some of its engine production away from Hams Hall, the future of Vauxhall is being questioned and Aston Martin needs to see a major return on investment in a new factory and its venture into the SUV market.

All these companies are supplied by West Midlands-based component firms.

However, the development of new battery technology could be the region's salvation.

Its commitment to lead the next generation of automotive propulsion is evident from the development of the £126m UK Battery Industrialisation Centre

Credit: Protolabs/Sarah Ekenberg

WEST MIDLANDS DATA

£21.7bn

TOTAL MANUFACTURING OUTPUT

10.7%

MANUFACTURING AS % OF REGIONAL EMPLOYMENT

317,000

TOTAL EMPLOYED IN MANUFACTURING

MANUFACTURING OUTPUT AS % AGE OF REGIONAL OUTPUT 16.5%

124%

AVERAGE MANUFACTURING SALARY AS % OF REGIONAL AVERAGE

CITIZEN MACHINERY

Whilst many in the UK may lack confidence in its ability to weather the Brexit storm, this isn't necessarily true for the rest of the world.

CNC machine tool specialist, Citizen Machinery UK (CMUK) has been the recipient of significant investment from its Japanese parent which despite the vagaries of Brexit, retains significant confidence in the UK manufacturing industry.

The company has looked to capitalise on growth opportunities globally by expanding production capacity at its factories in Thailand, Vietnam and the Philippines.

Yet the investment into the UK exceeds all of these.

During 2019 the company underlined its confidence in the West Midlands by investing millions in the development of a new UK centre of excellence. The location of the new centre in Brierley Hill was deliberately chosen to place CMUK at the heart of its UK customer-base.

The 1,660m^2 facility offers extra space for preparing high-value, automated turnkey installations complete with programs, tooling and accessories.

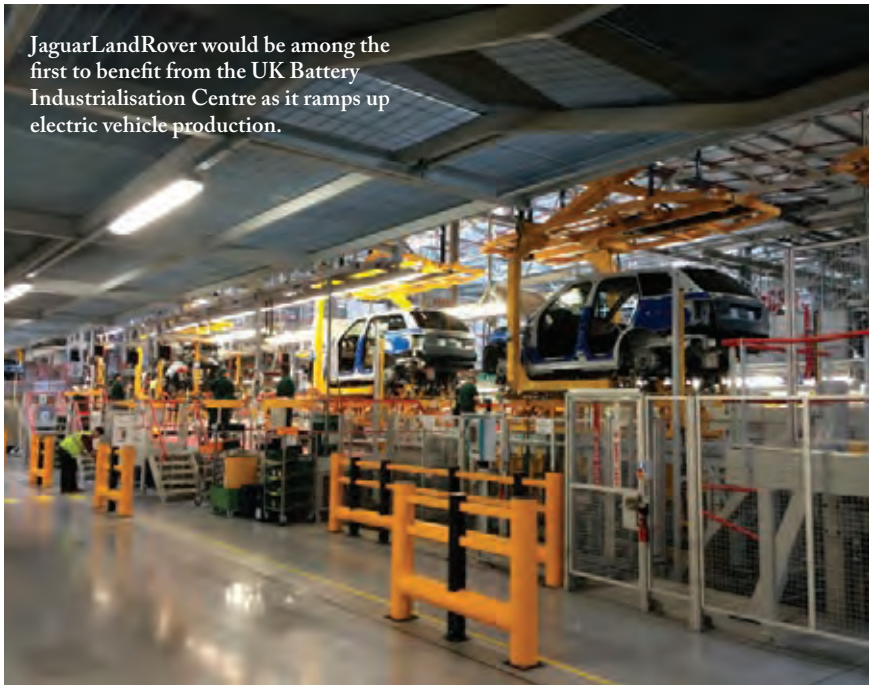
The new centre, which has helped bring new jobs to the area, also comprises an international conference area, customer training school, engineering department and administrative offices.

Keiichi Nakajima, president of Citizen Machinery Japan, said: "Whereas other machine tool builders focus more on investing in emerging markets such as China and India, Citizen has always had faith in the quality of the UK engineering industry.

"Therefore, it was a simple decision on my part to commit to investing in this new facility. I am convinced this investment will bring significant benefits to Citizen including growing its market share."

Darren Wilkins, deputy managing director, CMUK, added: "Whilst the UK manufacturing industry may be experiencing headwinds, the demand for precision components is growing and we stand ready to fulfil that demand."

The company is looking forward to a busy 2020. It is exhibiting at SteelFab in Sharjah for the first time in January and has high hopes of securing further business at MACH 2020, which takes place at the NEC in Birmingham in April.



JaguarLandRover would be among the first to benefit from the UK Battery Industrialisation Centre as it ramps up electric vehicle production.

(UKBIC) in Coventry. The government has backed the project with £80m, which was topped up in May 2019 by a further £28m, awarded through the Local Industrial Strategy for the West Midlands.

The West Midlands Combined Authority (WMCA), keen to see the region become the national centre for industrial battery manufacturing, has also awarded it £18m.

JLR would be amongst the first to benefit as it ramps up electric vehicle production. It has already pledged to building the next generation Jaguar XJ at its Castle Bromwich plant, which will become the home of the company's Electric Drive Unit (EDU).

It has also confirmed the development of a new Battery Assembly Centre at Hams Hall. The new facility is expected to be operational during 2020, with initial capacity thought to be around 150,000 units.

The UKBIC consortium, supported by the WMCA and JLR, is now putting pressure on the government for a new gigafactory, capable of producing batteries in sufficient numbers to make them commercially viable and hence electric vehicles, more affordable.

So, whilst the fate of the West Midlands' manufacturing economy remains on a knife-edge, 2020 could yet be the most defining year in its long history.

Aerospace

After automotive, aerospace and defence remain key supply

Credit: Boeing

INVESTMENT

In anticipation of a hard Brexit, smaller manufacturers are investing for the future by ploughing funds into the purchase of new machinery, re-tooling or upskilling programs.

Despite the climate, investment opportunities persist, with banks and other funders keen to lend and capitalise when the market improves.

Black Country-based A Perry, the UK's largest independent manufacturer and supplier of hinges, hardware and ironmongery, is one of those to benefit. It secured £7.33m from HSBC UK, which has been keen to underline its credentials as a Midlands-based institution following the opening of its new national headquarters in Birmingham.

The finance package will allow the family-run business to invest in the latest robotics technology with the aim of doubling turnover over the next four years.

Expansion

Protolabs, a digital manufacturer of custom prototypes and low-volume

Credit: Protolabs/Sarah ekenberg

production parts, is ploughing £5m into the expansion of its European headquarters in Telford. The 50,000 sq ft extension will house at least 50 new CNC machines, in addition to a further 20 injection moulding presses.

The investment, which will help meet growing demand from the automotive, aerospace, medical, electronics and heavy industry sectors, will create 60 new jobs, taking its workforce to 500.

Reshoring

Albert Jagger Engineering, which supplies the commercial vehicle bodybuilder, boat builder, agricultural and engineering industries, secured investment from its parent company to reshore up to one million products back to the UK from China.

Production of its Antiluce Fastener will return to its Bloxwich factory for the first time in almost 20 years, benefitting the business in terms of shorter lead times and price guarantees.

By bringing everything in-house, the company will regulate batch quality control more efficiently by dramatically decreasing lead times, a process which could take up to six months in China.

The practicalities of such a strategy are many, especially as producing goods in China is no longer as viable as it was due to rising labour costs.

sectors for many West Midlands manufacturers. Whilst conditions have been tough, there are now signs of a revival.

Meggitt, which is centralising much of its UK operation at a brand new £130m headquarters in Coventry, has secured a six-year $130m deal to supply fuel bladders for the F/A-18 Super Hornet,

"After automotive, aerospace and defence remain key supply sectors for many West Midlands manufacturers. "

V-22 Osprey and the CH/MH-53 Super Stallion aircraft.

Elsewhere, Warwickshire-based Melrose, which sparked outrage amongst many with its hostile takeover of GKN, maintains the group's aerospace division is the jewel in its crown.

GKN Aerospace sales grew more than 5% in Q3 2019 compared with the previous year, outperforming the Melrose board's expected longer-term growth rate. In addition, the division saw good margin improvement compared to Q3 2018, offering hope for better things in 2020.

GKN Aerospace – Kings Norton delivers commercial and military flight deck transparencies to a global customer base. This site provides toughened glass flight deck windows and specialist safety glass to over 50 programmes including: Airbus A320neo, Boeing 747-8, Boeing P8 and AgustaWestland AW159 and AW101, as well as a range of toughened glass products for civil and military vehicles & locomotive applications.

Credit: GKN

Left: **GKN's King's Norton facility manufactures commercial and military flight deck transparencies to customers including Boeing and Airbus.**

FAST FORWARD

According to Make UK's annual survey, the powerhouse of the East Midlands is the most improved region in the UK over the last twelve months in terms of increased output, now worth £17.2 billion in total. *Mark Venables*

Manufacturing is vital to the region's overall economy, contributing nearly 17% of its total output, well above the UK national average of 10%.

Its recent growth is reflected in the employment figures, with 8000 new jobs created in 2019, lifting manufacturing employment to its highest figure for 15 years. The area has a rich heritage in aerospace and automotive, with global brands of Toyota, Bombardier Transportation, Caterpillar and Rolls Royce having a large presence in the area but it is food and drink that remains the dominant sector.

Refreshments are served

The food and drink sector made up just over a fifth of the region's output, with rubber and plastics in second place. The region hosts several household names, such as Belvoir Fruit Farms in Bottlesford, Leicestershire, who produce the Belvoir range of cordials and presses; Samworth Brothers, in Leicester, which makes a range of pasties and pies including Ginsters Cornish Pasty; and in Melton Mowbray, Long Clawson Dairy, a traditional English cheesemaker.

"I think the East Midlands is really underrepresented and under championed," Charlotte Horobin, membership director – Midlands & East of England, Make UK says. "It has the largest proportion of people working in the UK manufacturing sector. Along with very credible

EAST MIDLANDS MANUFACTURING DATA

£17.2bn

TOTAL MANUFACTURING OUTPUT

306,000

TOTAL EMPLOYED IN MANUFACTURING

12.8%

MANUFACTURING AS % OF REGIONAL EMPLOYMENT

MANUFACTURING OUTPUT AS % AGE OF REGIONAL OUTPUT 16.5%

122.7%

AVERAGE MANUFACTURING SALARY AS % OF REGIONAL AVERAGE*

DEVELOPING NEXT GENERATION AUTOMOTIVE SKILLS

MIRA Technology Institute (MTI) was built in Nuneaton in 2018 with £9.5m investment from the Government's Local Growth Fund. It provides students with a bespoke curriculum aimed at satisfying an ever-increasing need for specialist skills in the UK automotive sector with a focus on disruptive technologies, such as electrification and driverless cars, cultivating the skills necessary to operate at the cutting edge of automotive technology.

Over 5500 students and delegates have used MIT since it was opened in November 2018

The 24,500 square ft facility celebrated its anniversary in November. In its first year of operation over 5500 students and delegates have used the facility including over 360 studying for accredited qualifications from a Level 1 Institute of the Motor Industry certificate up to Masters' degrees, and nearly 200 following apprenticeships at all levels.

"We're delighted to mark such a successful first year for the MTI and pleased that we are already delivering a sustainable supply of future specialist technicians and engineers," Marion Plant, OBE FCGI, chair of the MTI operations board, and principal and chief executive North Warwickshire and South Leicestershire College said. "Our ambition is to be a global centre of excellence and we made some progress towards achieving that when, in June this year, we welcomed the chairman and group CEO of the HORIBA Group, Atsushi Horiba, to the MTI for HORIBA's global strategy meeting."

Bombardier Rail's facility in Derby is at the heart of the world's largest cluster of rail-connected businesses.

MONORAIL TO CAIRO

In the rail sector, Bombardier Transportation, headquartered at the iconic Litchurch Lane facility in Derby, is at the heart of the largest cluster of rail-connected businesses anywhere in the world. A global leader in the industry, the company offers a comprehensive product portfolio spanning the full spectrum of rail solutions. The Bombardier site at Derby alone employs over 2000 people including over 400 specialised engineers.

In a landmark deal this summer a Bombardier-led consortium signed a major new order to build and supply the new Cairo Monorail system in Egypt. Bombardier will design, supply and install the electrical and mechanical equipment for the two lines including 70 four-car Bombardier Innovia Monorail 300 trains (280 cars).

A VIRTUAL RIDE

The region is not just about traditional skills; there are plenty of examples of digital technologies. Holovis, a digital disruptor and innovator of next-generation solutions featuring immersive, emerging, and interactive technologies, has a unique cross-sector client base. It is shaping the Industry 4.0 revolution with AI-driven virtual manufacturing innovations on the one hand and developing next-generation entertainment solutions using AI and Machine Learning algorithms on the other.

In 2019 the company launched its ViX Suite of solutions for virtual manufacturing and advanced engineering; a collection of software packages that span across the manufacturing cycle from design and visualisation through to applications for build and retail. All solutions work from the same CAD throughout, to streamline the process.

The ViX Build module has been implemented on automotive manufacturing lines to check the quality, consistency, and accuracy of parts coming off the line. It uses an innovative application of automated Augmented Reality combined with native CAD to verify that real-world applications of sealant, anti-flutter and rivets are in the correct place. This results in an increased right-first-time ratio, reducing rework costs, and creates a digital data trail.

Holovis' new Flying Theatre attraction for theme parks reverses the traditional guest experience by putting them in the prone position and having them soar over immersive content as if genuinely flying. This patented innovation is a complete multisensory experience combining visuals, audio, perfectly synched motion, SFX, and real-time media, connected to innovative data capture mechanics, which measure guest reactions and take them on a personalised journey.

global players there is a fantastic, diverse supply chain."

Mark Carney, governor of the Bank of England, once referred to the East Midlands as a bellwether of economy. "We see that in the results of our annual surveys," Horobin adds. "In more volatile times the region weathers it well because it has that diversity with food and drink, rail, aerospace, automotive, aggrotech and the motorsport industry."

Challenges for export

The East Midlands remains a strong exporter, accounting for 6.5 per cent of the nation's manufacturing exports, more than half of which goes to the EU, therein lies its greatest challenge according to Jon Gilpin, head of manufacturing at BDO in the Midlands.

"East Midlands manufacturing is in a challenging place now with three things impacting the region," he said. "The leading challenge is obviously Brexit and that has been hanging over the area since the referendum three years ago now. Number two is the ongoing trade wars between the US and China. That creates another layer or level of uncertainty which businesses do not like. Even if your business is not directly exposed to the US or China, somebody somewhere in your supply chain or your customers will be. And then the final aspect is that a lot of the major economies have started showing increasing signs of moving towards a downturn or recession."

Right: **Aston Martin Red Bull Racing Team Principal Christian Horner at the team's high-tech facility in Milton Keynes, Bucks, close to Silverstone. The team employs over 900 people.**

Toyota landmark

Transport equipment fell behind the two leaders into third place, reflection on the turbulent trading scenario globally, but automotive manufacturing remains very important to the region.

Despite it being a difficult year the Toyota Manufacturing UK (TMUK) vehicle assembly plant at Burnaston, Derby celebrated the start of production of the all-new Toyota Corolla Hatchback and Touring Sports wagon early in 2019. At the official ceremony in January Dr Johan van Zyl, president and CEO of Toyota Motor Europe, explained that Toyota had invested more than £2.75 billion in the UK since the start of production in 1992.

"As part of our strategy to secure the competitiveness of our UK operations, we took the decision in 2017 to upgrade our Burnaston plant to manufacture cars based on the new TNGA platform," he said. "Our continued investments, combined with the dedication of our members, will ensure that we can deliver ever better cars to our customers.

"The new Corolla will play a critical role in our market ambitions in Europe. It delivers the benefits of the new TNGA platform and increases the appeal of our industry leading, self-charging hybrid electric technology."

Fast and furious

The region is well represented in motorsport generally and Formula One especially, with Racing Point F1 at Silverstone, Aston Martin Red Bull Racing at Milton Keynes and AMG Mercedes at Brixworth. The 2019 campaign was successful for Red Bull, with lead driver Max Verstappen finishing in third place in the driver's championship behind the two Mercedes cars of Lewis Hamilton and Valtteri Bottas, and the team finishing third in the Constructor's championship, behind Ferrari. Producing the two cars that take to the circuit 21 times a year is a massive engineering undertaking, supported by over 900 staff members.

Each year, Aston Martin Red Bull Racing produces around 100,000 drawing releases.

"The components we will design in a year will produce about 100,000 drawing releases," Christian Horner, team principal at Red Bull Racing says. "There are about seven and a half thousand parts to each Grand Prix car, each of which will probably be revisited three to four times during the year and updated and superseded. There are about 1000 designs a week released from the drawing office and we make about a million parts per year to produce these two Grand Prix cars.

"It is all in small production runs. We only make five cars for the whole year, so it is ones and twos, threes, and fours of these all of these different components. It is this relentless quest for performance that we keep revisiting. For example, the front wing that has the most attention during the year because that dictates the most performance over the car. We can have 18 variants of that across the 21 races, and the car is never in the same specification twice during the season."

CLEAN GROWTH

East Anglia has a diverse manufacturing base, with no one sector dominating. This gives plenty of opportunity for entrepreneurial businesses to try out new ideas in an innovation-friendly environment.

BY HUW SAYER

According to the Make UK/BDO Regional Manufacturing Outlook report (2019), the East of England (including Suffolk and Norfolk) is the UK's fourth largest manufacturing region, accounting for 8.2% of national production and worth around £17.8bn. This is almost 12% of the region's total output; well above the 9.7% UK average. Goods exports in 2018 were worth £7.3bn, around 8.3% of the UK's total, with some 60% going to European markets.

Manufacturers in the region employed around 244,000 people (7.5% of the workforce) in 2018, up 4,000 on 2017 – and manufacturing reportedly accounts for a higher proportion of jobs in Suffolk and Norfolk than the UK average. There is no single dominant industry although food and drink, as for the UK as a whole, is the largest at around 15% of manufacturing output. There are also numerous specialist sub-sectors, such as automotive, clean-tech, renewable energy, and industrial automation.

Electric vehicles driving innovation

The region's big manufacturing story in 2019 was the unveiling of the new Lotus Evija. This made headlines around the world, with the automotive and business press as well as the fashion media. Built

at the company's Hethel HQ in Norfolk, the 2000hp two-seater captures the Lotus sports car spirit in every exquisite precision-engineered detail – but what really sets it apart is that it is the first fully electric, zero emission, British hyper-car.

From its ultra-light-weight carbon fibre monocoque to the dramatic Venturi tunnels through each rear quarter that give the Evija its breathtaking appearance, this really is a car for the drivers. Yet, when thinking about the incredible technology, it is easy to overlook the supreme artisanship that goes into finishing – and in many cases personalising – each vehicle. The interiors are hand-clad in hand-stitched materials and

EAST ANGLIA MANUFACTURING DATA

£17.8bn

TOTAL MANUFACTURING OUTPUT

7.5%

MANUFACTURING AS % OF REGIONAL EMPLOYMENT

244,000

TOTAL EMPLOYED IN MANUFACTURING

MANUFACTURING OUTPUT AS % AGE OF REGIONAL OUTPUT 12%

124%

AVERAGE MANUFACTURING SALARY AS % OF REGIONAL AVERAGE*

customers can specify not only fabrics but also precise colour schemes.

Technicians spray-paint each car on site, too, and paint all the panels of one car at the same time to ensure a homogenous finish across the whole body. The paint process is unusual and definitely groundbreaking. Carbon fibre and composites cannot be baked at the same high temperature (400^{o}C) as normal metal panels so Lotus worked with its paint supplier to develop a new, low-temperature (70-80^{o}C) curing process that delivers a finish that is as good as on metal. The paint supplier is now offering the same process to the refinishing industry – a good example of how innovation in one area can flow through the industry supply chain.

The Evija helped Lotus win the title 'Luxury Brand of the Year – 2019' at the prestigious Luxury Briefing awards. Retailing from £1.7m and with a limited production run of just 130, the Evija is not your everyday run-around. However, as with many other technologies developed for premium vehicles, it is almost certain that much of the learning that's gone into developing this all-electric marvel will filter down to more affordable vehicles in time.

Top: **Lotus technicians spray-paint each car (here a Lotus Evora) at the company's HQ in Norfolk**

Above: **Technicians at Equipmake's new Snetterton factory work on EBus, the company's fully-integrated electric bus chassis**

Building the future of public transport

Something that might seem mundane by comparison with a hyper-car but could be just as important is an electric bus, designed and developed by Equipmake, which started life at the Hethel Engineering Centre, next door to Lotus. It recently moved to a new, larger, purpose built manufacturing facility just by the famous Snetterton racetrack.

The government's industrial strategy, launched in 2018, identified four Grand Challenges and set a big mission for each. One Grand Challenge, 'The future of mobility', represents the UK's mission to be at the forefront of zero-emission vehicle design and manufacturing by 2040.

To achieve that goal, the UK will need more than high-tech hyper-cars. It will need to produce mass market EVs at scale. Equipmake is developing just such a solution: the EBus advanced electric drive train. This platform uses two of Equipmake's class-leading APM200 spoke motors; the latest-generation lithium-ion battery pack; and an advanced power control system.

Equipmake's MD, Ian Foley, is a highly experienced engineer with a background in global motorsport, including F1. His passion for precision engineering and efficiency led him to create an affordable, zero-emissions vehicle suitable for public transport. His team has the capability to design, test and manufacture everything from electric motors to entire electric automotive platforms.

The EBus platform can fit a range of vehicle sizes and configurations, which allows any bus maker to go electric. Its ultra-compact, lightweight spoke motor is highly efficient and, combined with clever management of energy use, makes the EBus cheaper to run over 10 years than a diesel bus. The company's first client is South American commercial vehicle maker Agrale, which is scheduled to start running the buses in Buenos Aires in 2020.

The EBus project has received £7.5m in funding from the UK's Advanced Propulsion Centre. Equipmake expects to build 700 EBus drive trains for Agrale in the first year of production but is already receiving enquiries from other companies.

"The global market for clean, affordable electric buses is around 300,000 vehicles a year," says Ian Foley, "and that is only growing."

Accelerating environmentally friendly manufacturing

Advanced robotics, digital imaging systems and high-speed motors are driving efficiency across a range of industries. Some call this Industry 4.0 but for PCE Automation (part of the PCE Group) in Suffolk, it's business as usual.

MANUFACTURING NEWS IN BRIEF FROM SUFFOLK AND NORFOLK 2019

May 2019

Unilever confirmed a 10-year supply agreement and capital investment programme with Condimentum Ltd, a consortium of the region's mint and mustard growers. The partnership is supporting the construction of a state-of-the-art milling and processing factory on Norfolk's new Food Enterprise Park. This will supply milled mustard flour and blended mint to Colman's, so maintaining the area's 200-year link with the iconic British brand.

Condimentum construction team progressing with final build stage of Mustard milling silos and mustard seed drying process.

June 2019

Teknomek Ltd, based in Norwich, announced it had supplied the new Fast & Furious film (Hobbs & Shaw) with a wide selection of stainless steel products, including chairs, tables and other production accessories. The firm is the UK's leading manufacturer of hygienic stainless steel equipment and furniture. Its customers include food manufacturers, pharmaceutical companies, medical centres and scientific research institutes. (See main image)

August 2019

Mirus production technicians assembling a Mirus linefit seat frame.

Mirus Aircraft Seating Ltd announced the first shipment of its Linefit Shipset seats, designed for the Airbus A321neo aircraft, to its client AirAsia. The high-performance, lightweight seats, made from carbon fibre and forged aluminium at the firm's factory in Norfolk, were inspired by the design team's engineering experience working on F1 racing cars. "This marks the culmination of an eight-year mission to deliver an economy seat to the Airbus Final Assembly Line as an approved Airbus supplier," says CEO Phil Hall, "but we see this as just the start of our innovation journey as we continue to set new challenges for Mirus."

Entrepreneurs wishing to set up manufacturing business in Suffolk and Norfolk are invited to contact please contact the New Anglia LEP (https://newanglia.co.uk/our-team/)

Right: PCE apprentice Aaron Gouldby carefully checking electrical and pneumatic supplies to lens processing components

PCE makes a wide variety of automated product handling, assembly and testing systems. It has the skills to design, manufacture, program, and install innovative production equipment that blends complementary technologies, such as high-speed robotics and vision inspection cameras. These enable precision handling of even delicate and intricate objects at speed, from plastic packaging and glassware to contact lenses and pharmaceuticals.

One of PCE's long-term clients is another Suffolk firm, Berry M&H, based in Beccles. It produces plastic packaging from recycled materials for sectors as diverse as pet care, personal care, health and beauty, food and drink, DIY and industrial chemicals. It has a reputation for helping clients create innovative, bespoke products.

GarçonWines Merlot and Sauvignon Blanc.

This approach attracted Santiago Navarro, CEO & co-founder of award winning Garçon Wines. He is on a mission to advance and rethink the bottled drinks market – starting with wine bottles that are flat enough to post through a letterbox yet still hold a standard 75cl. "I wanted a supplier who could overcome the technical challenges of creating an aesthetically pleasing bottle that was light, strong and fully recyclable – and didn't fall over."

He drew on the design and injection stretch blow moulding expertise of Berry M&H to create a wine bottle that is 87% lighter and 40% spatially smaller than a traditional glass bottle. By using 100% post-consumer recycled food-safe PET for the bottle and compatible plastic for the cap and label, they have developed a product that is fully and widely recyclable.

"This is not just a sustainable product, it is sustainable at scale across the supply chain and product lifecycle," Santiago Navarro says.

SMARTER, CLEANER, DIGITISED

2019 was the year when North West manufacturers set their sights on digital journeys. *Rupert Cornford* reports on 12 months of pilots and productivity gains, as Made Smarter gained traction and companies tried to get match fit.

Bells of Lazenby has implemented robotics to meet demand for gluten-free products.

As manufacturers woke up to New Year headlines about Brexit uncertainty and global shifts in car production, there was a growing focus in the North West on solving the industry's productivity challenge.

While companies were checking their Spring order books and getting their house in order ahead of political disruption to supply chains, the £20m Made Smarter pilot was getting inundated with enquiries, just two months after being launched.

"By January 2019, we had a really big number of companies wanting to talk to us," says Donna Edwards, managing director for business finance at The Growth Company, which is administering the scheme. "There was a real appetite to engage."

Made Smarter, which is helping companies to implement a digital and connected backbone to their operations, has got a target to engage with 3,000 businesses by March 2021, and at the time of writing, was well over halfway there.

More than 60 projects have been match-funded in the past 12 months, and many more have explored what they could implement. Edwards says it's been an eye-opening year and

Credit: Made Smarter

NORTH-WEST MANUFACTURING

£28.5bn

TOTAL MANUFACTURING OUTPUT

9.0%

MANUFACTURING AS % OF REGIONAL EMPLOYMENT

350,000

TOTAL EMPLOYED IN MANUFACTURING

MANUFACTURING OUTPUT AS % AGE OF REGIONAL OUTPUT 16.3%

130.4%

AVERAGE MANUFACTURING SALARY AS % OF REGIONAL AVERAGE

MADE SMARTER IN BRIEF

60

THE NUMBER OF FUNDED PROJECTS UNDERWAY IN THE MADE SMARTER PILOT.

£115M

THE VALUE, IN GVA, EXPECTED TO BE RETURNED TO THE REGION, FROM THE £20M INVESTMENT.

3,000

THE NUMBER OF COMPANIES EXPECTED TO 'ENGAGE' DURING THE TWO-YEAR PROJECT; THE TEAM EXPECTS TO WORK "IN MORE DEPTH" WITH 600, WHICH INCLUDES MENTORING, LEADERSHIP AND MANAGEMENT PROGRAMMES, AND GRANT FOR EQUIPMENT.

Left: Oxley Group focused on cultural change as a driver of productivity. *Top Left:* Plastic Card Services sped up manufacturing with software that encodes data on each card during production. *Above:* Playdale Playgrounds has boosted profitability through the adoption of digitised predictive maintenance.

believes that most manufacturers in the region don't have a digital strategy in place. It's no surprise that interest has been high.

Cumbrian bakery Bells of Lazonby, which employs 250 people, has implemented robotics to meet the capacity demands of gluten-free production. Plastic Card Services, based in Macclesfield, has written software to encode the data for each card during production, speeding up manufacturing times and paving the way for contracts worth £1.5m. Across the region, stories emerged of companies adopting small changes, or niche projects that began to unlock their potential.

Productivity gains

Barry Leahey, managing director at Playdale Playgrounds, which is based in Ulverston, Cumbria, says Made Smarter has been part of an ongoing drive in the business for continuous improvement and profitability in recent years.

"We are 2.5 per cent behind our turnover objective [for the current financial year], but we are around 25 per cent ahead on profit," he says. "We've got 55 people in production and have generated a couple of hundred ideas to improve productivity. If an idea gets chosen, we pay people £25 and have so far paid out about £1,200. It's cost us £14,000 to make the improvements suggested and has saved us an additional £60,000 in the past 12 months."

Stock levels have been reduced from £1.9m to £1.2m but on-time in full delivery has shot up into the high nineties. The team has moved on to predictive maintenance using sensors, which is helping to increase capacity and schedule work more effectively.

> "We are 2.5 per cent behind our turnover objective but around 25 per cent ahead on profit"

At Oxley Group, also in Cumbria, marketing manager Jayne Moorby says the company has had its best year ever, after getting its house in order and focusing on cultural change as a driver of productivity. The company, which makes lighting for military installations, is a big exporter to South Korea, Sweden and the US.

"The business still is privately owned and we got to a point where we had lost sight of some of the things the founder stood for," she says. Darren Cavan has been in place as chief executive since the end of 2018 and, Moorby says, there is a philosophy in the business aimed at "empowering people to achieve success together".

"We now have a lot of visual management, which is driving productivity," she says. "There is much better measurement and business data. Because people are empowered and engaged, we are identifying improvements everywhere in the business."

The innovation challenge

The twin drivers of technology and innovation are common threads in the North West manufacturing narrative. It was a year when Tata Chemicals Europe announced plans to build the UK's first industrial scale carbon capture plant in Northwich. The Manufacturing Technology Centre outlined plans for a £15m for expansion in Liverpool, and Siemens teamed up with Atos to boost cloud computing resources at Daresbury, to help businesses understand connected production.

Brian Holliday, managing director at Siemens Digital Industries, is adamant the sector's focus is right, but also

Siemens teamed up with Atos to boost cloud computing resources at Daresbury.

concedes traditional businesses need time and help to adjust.

"There is a real mix out there and we have to be honest about that split," he says. "There are some very innovation hungry SMEs looking to solve problems, but there a number that feel irritated of talk about Industry 4.0 because it doesn't speak to them and their current challenges. We have still got a job to do, to demonstrate the relevance of what industrial digital technology can do."

But Barry Leahey at Playdale, a productivity ambassador for government spin-out Be the Business, is more direct. "It's a no brainer," he says, about technology adoption and Made Smarter. "It frustrates me that the ambition has to be piloted. We have got to improve productivity, so why don't we go straight from concept to completion."

Into the future

The future has potential for the region's manufacturers but they have work to do to compete on a global playing field, and embrace the skills needed to run connected factories. Some believe that 2020 marks the beginning of a decade that will separate those who will survive, supported by a network of catapults and innovation hubs, and those who won't. This is a story about innovation and investment, with an eye on sustainability, of course.

"We have all got very comfortable with our working environments, and our accountability to our working environments," says Leahey. "We have got a little bit relaxed and fat around the middle. Some businesses have realised we have got to lose a little bit of weight and get match fit to be able to be a global superpower. Failures in the sector will fall at the door of the leadership."

Siemens' Brian Holliday believes there will need to be a focus on the real economy again, after the political paralysis of the past three years. If manufacturing is about regionalised jobs, growth and productivity and progress, then technology and the right support has to part of the answer.

"If we think that something is going to happen without investment, then we are kidding ourselves," he says. "Aiming to improve productivity through investment, training and working with the innovation community, matters. The catapult model works; and we would advocate continuing a public and privately funded innovation approach.

"There is still a challenge to stimulate private investment in plant and equipment. But there is a correlation, through Made Smarter, that if you invest less then guess what, you become less productive. If we waver on this, then we'll be playing catch up."

The £20m Made Smarter pilot is slated to return £115m of GVA for the North West economy by the time it finishes in March 2021. Early indications suggest it will achieve that figure; the eyes of the manufacturing world will be watching, in hope, that it actually does.

BENTLEY PLUGS INTO A SOLAR FUTURE

In May, car manufacturer Bentley told the world it had installed the "UK's largest ever solar car port" at its headquarters in Crewe. The project, which is part of ongoing efforts by the company since 2013 to reduce its carbon footprint, added 10,000 solar panels with a capacity of 2.7MW and was installed by industry specialist FlexiSolar. All the energy supplied to the factory now comes from the sun or certified green sources.

While Bentley hasn't shared the size of its investment in this initiative, there is a clear message that it had to move in this direction, as consumer attitudes changed towards an industry under pressure.

"The reality is, in this fast-changing environment, the values, attitudes and behaviours of our current customers are naturally evolving in the direction of our new luxury audience, as they become exposed to new information and experiences," says Head of Corporate Communications, Matthew Reed. "They care about the world we live in, and they seek out brands with a strong purpose, progressive values and a sense of social responsibility and diversity."

By 2023, all of Bentley's cars will be available as a hybrid or electric and, Reed says, the business is "hopeful of introducing a full battery electric Bentley by 2025. Of course, being part of the Volkswagen Group allows us access to the world's most innovative battery technologies and this puts us in a very fortuitous position should we want to take advantage of that."

Bentley still makes its classic engines but it is moving towards an electric future.

Emissions from the factory from production processes are still being offset, although are expected to reduce in the future, he says.

"2020 marks the beginning of a decade that will separate those who will survive, supported by a network of catapults and innovation hubs, and those who won't."
Credit: Made Smarter

VEGAN FOODS GROW, AUTO UNDER THREAT, RAIL TAKES A STEP BACK

England's North-East has a diverse and vibrant manufacturing base that appears to be flourishing, despite some headwinds.

The North East's manufacturing sector has successfully come through a challenging year but difficulties could multiply if the Brexit outcome is negative. No other region in England exports as much (60%) of its output to the European Union; a further 10% goes to non-EU European countries. But the North East has plenty of reason for optimism - especially in the field of renewables - and will rebound quickly in 2020 if there's an upturn in the transport sector.

Road and rail

Mixed fortunes were reported by the region's two Japanese-owned manufacturing giants.

Hitachi Trains' Newton Aycliffe factory is to receive an £8.5 million boost to its painting and welding capabilities but 250 redundancies were announced at the end of 2019.

It has been a difficult year for the motor industry worldwide but morale at the largest car plant in Europe has been boosted by a £100m investment in the Sunderland site, which has led to the new Juke hatchback being produced there. The new model has been designed, engineered and manufactured in the UK and will be made only at Sunderland.

Hitachi will play an important role in a new £400 million contract to deliver next-generation rolling stock for British railway lines. It will supply 33 five-car-

Nissan announced a £100m investment in its Sunderland factory, which will produce the new Juke.

Hitachi's Newton Aycliffe plant received mixed news at the end of 2019: up to 250 redundancies but £8.5m investment in painting and welding facilities.

Credit: TBA

riage trains to operator Abellio UK by 2022, which will run on the East Midlands Railway franchise and secure hundreds of North East jobs at the Newton Aycliffe plant.

NORTH EAST MANUFACTURING DATA

£8.0bn

TOTAL MANUFACTURING OUTPUT

10.7%

MANUFACTURING AS % OF REGIONAL EMPLOYMENT

126,000

TOTAL EMPLOYED IN MANUFACTURING

MANUFACTURING OUTPUT AS % AGE OF REGIONAL OUTPUT 15.2%

125.1%

AVERAGE MANUFACTURING SALARY AS % OF REGIONAL AVERAGE*

*Average manufacturing salary in the NE of England has the highest advantage over the total regional average salary of any area in the UK.

Credit: TBA

The 150 acre International Advanced Manufacturing Park, adjacent to Nissan's plant in Gateshead, has attracted more than £400m of private sector investment.

Credit: IAMP

The IAMP is becoming a hub for advanced manufacturing in aerospace, rail, automation and offshore development. The first large tenant is French autoparts manufacturer SNOP (pictured), who moved in in December 2018.

Advanced manufacturing

The importance of the North East to the Japanese giants, along with many other major manufacturing and technological concerns, is set to be underpinned by the development of the International Advanced Manufacturing Park (IAMP), which has a similar physical footprint as Nissan and sits alongside it, spanning the border of Sunderland and South Tyneside.

Spread across 150 acres and with 1.6m sq ft (260 million m2) available for industrial, manufacturing and R&D use, it has attracted more than £400m of private sector investment and will become a hub for advanced manufacturing spanning aerospace, rail, automation and offshore development. The Park has received the strong backing of local authorities.

"IAMP gives us an outstanding opportunity to bring new, skilled employment to the North East, with a development that puts us at the heart of advanced manufacturing and the automotive industry in this country," said Graeme Miller, leader of Sunderland City Council.

Offshore work

The North East's traditional associations with the old heavy industries of coal, shipbuilding and steel are very much a thing of the past. Nowhere can that difference more clearly be seen than in the field of green and renewable technology.

North East offshore wind companies expect to create more than 1200 jobs to meet growing international demand, boosting the existing workforce of more than 2500. The recruitment process will involve doubling the number of graduates and

Workers at UK Docks help HMS Enterprise dock at the Tees as part of a £150m Ministry of Defence contract for the region.

Credit: UK Docks

UK DOCKS

MOD GIVES UK DOCKS NEW LEASE OF LIFE

Harry Wilson, MD of UK Docks.

Ship repair on the Tyne and Tees is enjoying a revival with Tyneside-based UK Docks completing the first phase of a £150m Ministry of Defence contract to service Royal Naval vessels HMS Echo, HMS Protector and HMS Enterprise.

"Ship repair was an industry that was thought to have had its day in this country but we've been re-opening dry docks and returning them to full use," said Harry Wilson, Managing Director. "The North Sea oil industry is an obvious source of work but with the MoD looking to service its fleet in British waters wherever possible, it could become very much a growth area."

THARSUS GROUP

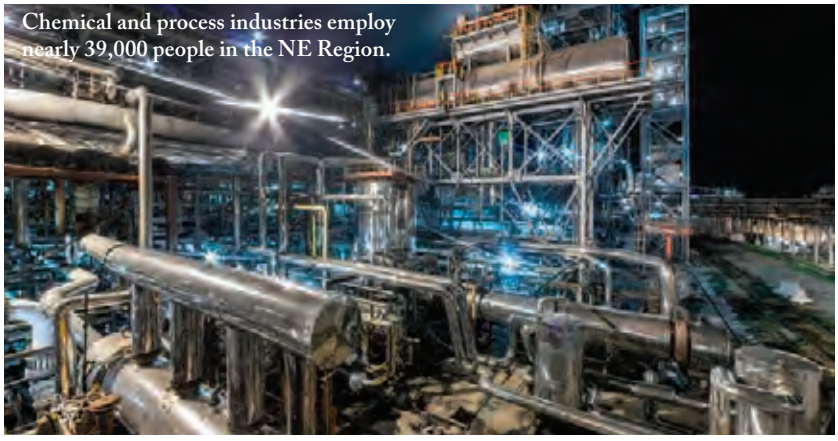
ROBOTS FOR ONLINE GROCERIES

Northumberland-based Tharsus Group, one of Europe's fastest-growing technology businesses and the UK's market leader in service robotics, recently moved into a new £3m headquarters in its home town of Blyth.

The move will help quadruple manufacturing capacity for advanced machines and robots (AMRs), where one of Tharsus's biggest markets is picking robots for online grocery orders.

The group reported overall revenue growth of 85% in 2018, to £51.2m, allowing it to invest and expand operations to meet growing demand from international customers. Headcount has also risen over the past 18 months, from 216 to over 300.

Above: NE ports are seeing investment aimed at boosting capacity and range of services.



Chemical and process industries employ nearly 39,000 people in the NE Region.

trebling the number of apprentices to capitalise on growing marketing opportunities, including conversion of former oil and gas assets into offshore wind apparatus.

Communications: road, sea and air

A number of infrastructure projects are boosting access to markets nationally and internationally.

The North East coast has always been pivotal to the complexion and development of manufacturing in the region with the Port of Tyne and the Port of Tees, in particular, becoming powerhouses in recent years.

On land, a huge amount is being invested in improving the region's road networks, not only improving trade routes to and from the North but also creating an internal market with the major infrastructure developments.

In the air, Teesside International Airport has been saved from housing development - a move which could be vital to the future development of the Tees Valley as a commercial and manufacturing centre.

At Newcastle Airport, Loganair is adding new business routes to Aberdeen, Cornwall, Cardiff and Bergen to the existing Brussels and Stavanger destinations.

Although transport and associated industries provide the biggest arm of manufacturing in the region, the North East is also home to the UK's largest single cluster of process, chemicals and energy companies in the UK, manufacturing half of the country's foundation chemicals and third of its pharmaceuticals. The sector employs 39,000 people across the region, with chemical-using industries – including healthcare, electronics, automotive and textiles – reliant on it.

It suffered a setback this year with Ineos announcing the potential closure of its Seal Sands site and the loss of more than 220 jobs, citing the cost of investing in the plant's fabric. But the loss of that plant, which supplies material used in clothing, carpets and plastics, could be offset by a £10 million investment by steelmaker Liberty House Group in Middlesbrough to create a new powder metals development facility to extend its reach in an £8 billion (and growing) global market in specialist metals and 3D printing.

Food manufacturing remains important in the North East, with Greggs and Quorn Foods now joined by entrepreneur Heather Mills' VBites – the world's biggest producer of meat-free vegan meat substitutes. Peterlee in County Durham become the HQ of the brand with the redevelopment of the former Walker Crisps plant and it is expanding into Seaton Delaval, Northumberland, with the acquisition of the 55-acre former Procter & Gamble factory site. The intention is to manufacture vegan products, including food and cosmetics, and to provide business incubator space for plant-based start-ups. It is set to create hundreds of jobs and be the core of a "Plant-based Valley" hub for plant-based industry.

The uncertainty of future trade relationships with the EU remains the 'elephant in the room' for the North East. Latest figures from MAKE UK show current investment and employment intentions in the region are the lowest in the UK, with orders slightly down, and all eyes will be focused on the hope of smooth waters ahead to allow the economic upturn of the preceding years to continue.

"There is a real 'can-do' culture developing in the North East in so many areas, which has been reinforced by innumerable regeneration and infrastructure projects that have literally changed the landscape, especially in terms of opportunity and access," Arthur Hodgson, manager of the Advanced Manufacturing Forum, which provides a voice for the region's manufacturing community, reflected. "The positivity is fuelled by so many young people coming out of colleges and universities and keen to build careers in manufacturing in the North East but, as in everything related to business prosperity, so much relies upon other economic factors, nationally and globally."

A WHITE ROSE WITH THORNS

Manufacturing's 2019 in Yorkshire and Humberside has been headline-grabbing, sometimes with good news; othertimes, less so.

BY DAVID WALSH

CHANGE OF THE GUARD

The world of advanced manufacturing was rocked in 2019 by the shock departure of Prof. Keith Ridgway from the AMRC (Advanced Manufacturing Research Centre).

Prof. Keith Ridgway has retired as Executive Dean of the AMRC

Over 20 years he helped create a world-famous research centre that employs 700, has more than 100 paying partners and has attracted more than 100 companies to the area including Boeing, McLaren and Rolls-Royce.

Although part of the engineering department at the University of Sheffield, Prof Ridgway operated at arm's length and with entrepreneurial flair.

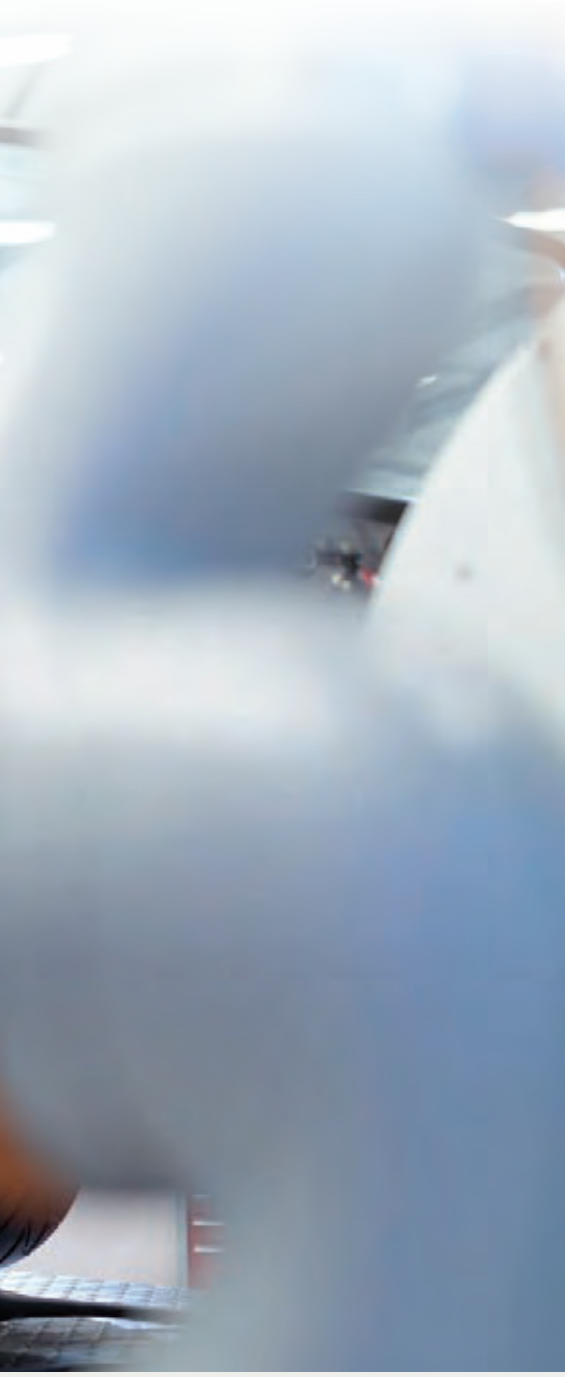
But a push for more oversight by university chiefs, and a new vice chancellor, led to a clash of cultures and the retirements of not just Prof Ridgway, but a string of key people including his wife Christine, co-founder Adrian Allen, longstanding executive director John Baragwanth and well connected fixer, former business minister Richard Caborn.

The AMRC pioneered paid work by academics for manufacturers and led to a Nuclear AMRC, an apprentice training centre and satellites in Derby, Wales, Preston, the Wirral and South Korea. It also powered the engineering department to top spot for research income this year, earning £124m (57% from the AMRC) and overtaking Imperial and Cambridge.

The university says the AMRC is now led by an experienced board that has been mentored by Keith, Adrian and John.

Chris Jewitt, chairman of Footprint Tools in Sheffield and AMRC partner, said Prof Ridgway's legacy is not just the cluster of hi-tech buildings on the Rotherham-Sheffield border, but the people too.

He said: "The AMRC, together with its highly qualified and committed researchers, forged in the Ridgway ethos, are two of our most valuable and treasured assets."



Researchers at Factory 2050, part of the AMRC

Staff celebrate the 40th anniversary of AESSEAL, which is now one of the world's largest seal manufacturers.

YORKSHIRE IS TOO BIG TO BE KNOWN FOR ONE MANUFACTURING SECTOR WITHIN ITS HUGE BORDERS IT DOES THEM ALL.

From glass in Barnsley and Rotherham to Coca Cola in Wakefield, to Burberry trench coats in Keighley and chemicals, caravans and turbine blades in Hull.

Every city, town and district has world class companies. AESSEAL in Rotherham is one.

In four decades it has grown from a tiny distributor into one of the world's biggest seal manufacturers. And it shows no sign of stopping.

The firm has unveiled plans for a £20m extension of its global headquarters and 200 jobs, building on year-on-year record sales, set to soar past £181m in 2019.

The company employs more than 1,800 and has 230 sites in 104 countries.

Founder Chris Rea once confessed he made enough money to retire at 35. Now in his sixties, his drive for success is undimmed.

World famous trench coat company Burberry has plans to invest further in its manufacturing operations in its Yorkshire factories in Castleford and Keighley.

The group's chief financial officer Julie Brown says they remain committed to the county. The company also has a growing office - a shared services centre - employing 400 in Leeds.

In Wakefield, Coca Cola celebrated the 30th anniversary of its factory saying it had invested £49m into operations, including a £24m canning line.

Employing 450, it is the largest soft drinks plant by volume in Europe, making 100 cans a second.

[Insert image: YORKSHIRE Angloco. Caption: Alistair Brown, Managing Director of fire engine manufacturer Angloco. which was established in Batley 1965. Credit: Jonathan Gawthorpe. Copyright @jpimedia.]

And in Batley, Angloco secured a £30m contract to replace and service most of the Ministry of Defence's existing fire engines.

The firm, the UK's oldest manufacturer of fire engines, will not only supply more than 80 new vehicles but will support them in the UK and around the world for the next 12 years.

Looking to the future

Uncertainty abounds, but flight controls company Produmax expects a record year again in 2020.

The Shipley firm has continued to

HULL

HULL IS BECOMING A MANUFACTURING POWERHOUSE

Credit: Jonathan Gawthorpe. Copyright @jpimedia.

Above: Siemens wind turbine factory, Alexandra Dock, Hull.

The sector is the joint largest employer in the city, along with health, employing 18,000, while more than 54,000 work in the wider engineering and manufacturing sectors, with a GVA of £3.7bn.

The biggest include FTSE fresh food giant Cranswick, medical devices company Smith & Nephew and conveyor belt business Fenner, which employs 4,300 and was acquired by Michelin in 2018.

Hull's proud caravan manufacturing traditions are alive and well – and a surge in UK staycations has provided a boost.

Willerby is the UK's largest manufacturer of holiday homes and lodges, with turnover of £174.8m and more than 1,100 employees, while East Yorkshire's Swift Group is the UK's biggest caravan and motorhomes maker, with a turnover of £287 million and more than 1,100 employees.

Chemicals company Croda has made a £27 million capital investment into the production of a new polymer, while Tricoya Technologies' £50 million wood chip production facility - set to start operations at Saltend Chemicals Park in 2020 - has a targeted annual production of 30,000 metric tonnes.

And it's full steam ahead for Siemens' new £200m rail factory in Goole, set to open in 2023 and be fully operational two years later when it will employ up to 700.

RB – formally known as Reckitt Benckiser – has opened a £105m Science and Innovation (S&I) Centre in Hull. It is the first investment of a £200m programme in the city. The company is committing a further £95m to upgrade its manufacturing facilities in Hull, which currently employ 1400.

EXPORT:

BUILD GLOBAL BRITAIN

Brexit is supposed to herald a 'global Britain' in which trade with the rest of the world more than makes up for the loss of tariff-free business with the EU.

William Beckett with Queens Award in 2012.

Credit: Dean Atkins. Copyright @jpimedia

But William Beckett, chair of the International Trade Forum in Sheffield, attended the 'Metalex' trade show in Thailand in November and was dismayed by the dismal UK showing.

He estimates there were 500 Germans on more than 50 stands in all eight halls, while the Brits had 20 people from six companies in "pokey little booths."

Mr Beckett said: "We have a terrible reputation for not getting off our butts."

He believes the majority of exporting manufacturers have turnover of more than £10m and there are "desperately few small firms."

He said: "It's pretty pathetic, enormous numbers are relying on ecommerce. But introductions at an exhibition and face-to-face selling are still vitally important."

Mr Beckett does not fear Brexit because WTO tariffs on most manufactured goods are in the low single figures.

The UK needs a trade deal, but "nobody in Europe is going to pull the plug. Trade barriers aren't as bad as people think."

In 2001, Sheffield had 17 trade associations but they have all died out.

The ITF, a relatively new organisation, tries to replicate them. It has 300 member companies and has led trips to Dubai, the Czech Republic, Poland and Thailand. It is going to Ghana and North America next year.

Mr Beckett believes DIT should switch focus. Its Tradeshow Access Programme only pays up to £2,500. "It should change its remit. The big firms can look after themselves. It's the SMEs that need support."

YORKSHIRE & HUMBERSIDE MANUFACTURING DATA

£17.6bn
TOTAL MANUFACTURING OUTPUT

11.0%
MANUFACTURING AS % OF REGIONAL EMPLOYMENT

MANUFACTURING OUTPUT AS % AGE OF REGIONAL OUTPUT 15.3%

308,000
TOTAL EMPLOYED IN MANUFACTURING

119.1%
AVERAGE MANUFACTURING SALARY AS % OF REGIONAL AVERAGE*

LOOKING FORWARD: ENERGY

Small modular reactor pressure vessel head being machined at Sheffield Forgemasters.

With a climate emergency being declared almost everywhere in 2019, everything is set to change, including energy.

Yorkshire is home to a host of futuristic projects including the holy grail of limitless green power - nuclear fusion.

The UK Atomic Energy Authority is building a £22m fusion research centre in Rotherham to take advantage of the region's advanced manufacturing skills.

The aim is to develop 'joining technologies', such as welding novel metals and ceramics, to help UK firms win contracts on the multi-billion euro International Thermonuclear Experimental Reactor in France, which is set to be switched on in six years.

Prof Ian Chapman, chief executive of UKAEA, said: "It's had this huge potential for so long, now we are on the point of delivery. It will be a paradigm shift in energy production."

Sheffield Forgemasters has its own plans in the energy sector: small, modular nuclear reactors. The company is spending £10.5m on manufacturing techniques in civil nuclear, including electron beam welding, its biggest ever research project.

New boss David Bond believes SMRs could hit a 'sweet-spot' at a firm which already has expertise in making reactors for nuclear subs.

The UK Atomic Energy Authority is supporting a drive to help UK companies win contracts on the International Thermonuclear Experimental Reactor under construction in France.

Another Sheffield company is soaring on hydrogen.

ITM Power is moving all operations to a new factory in Tinsley, Sheffield, where it says it will have the largest electrolyser manufacturing capacity in the world, 1GW per annum, enough hydrogen to power 700,000 homes.

In East Yorkshire, work officially started this summer on the world's largest offshore wind farm. Hornsea One will be able to power well over one million UK homes with clean electricity.

Major investments include the £310m Green Port Hull facility comprising a Siemens Gamesa blade factory and ABP port.

Ørsted is investing £6 billion in offshore wind operations and its East Coast Hub is the world's largest operations and maintenance centre.

invest by taking action against risk, including having more contracts paid in sterling, buying more stock and finishing products early to allow for transport holds ups.

Financial director Mandy Ridyard is also a big believer in engaging with organisations that can help, such as Leeds City Region LEP, Leeds University (it's had a PhD student on a KTP for two years) the 3M Buckley Innovation Centre (around 3D printing in metal), the AMRC, the Catapults and the DIT.

She said: "When times are uncertain, use all the things that are available to you. Engage with help, it can be a labyrinth but there's a lot of it."

Export is 70 per cent of the £8.5m-a-year business, to places like North America, the Philippines and Morocco. Produmax also supplies Boeing in Sheffield and Portland.

The 82-strong workforce is 20 per cent apprentices - making the average age 35 - and 15 per cent women. It also has four graduates and "pretty much everyone is going through some sort of training."

It also engages with primary and secondary schools and has run innovative work experience days for teachers.

Manufacturers are targeting growth and investing accordingly, according to Craig Gray, director of commercial banking at NatWest in Sheffield.

Low interest rates and the current annual investment allowance tax regime mean it is a good time to invest as manufacturers increasingly focus on automation and productivity.

UK MANUFACTURING INTERNATIONAL TRADE

TOP 10	EXPORTS	IMPORTS	TOTAL	BALANCE
United States of America	£99.6bn	£66.3bn	£165.9	+£33.3bn
Germany	£49.1bn	£75.1bn	£124.2	-£26.0bn
Netherlands	£42.4bn	£31.0bn	£73.4	-£11.4bn
France	£33.8bn	£37.6bn	£71.4	-£3.8bn
Republic of Ireland	£26.7bn	£20.8bn	£47.5	+£5.9bn
People's Republic of China	£16.8bn	£42.3bn	£59.1	-£25.5bn
Italy	£17.3bn	£22.6bn	£39.9	-£5.3bn
Switzerland	£21.0bn	£13.7bn	£34.7	+£7.3bn
Belgium	£15.9bn	£26.2bn	£42.1	-£10.3bn
Spain	£14.6bn	£28.0bn	£42.6	-£13.4bn

All goods & services, 2016. Source: ONS

INTERNATIONAL TRADE IN GOODS

TOP 10	EXPORTS	IMPORTS	TOTAL	BALANCE
Germany	£35.6bn	£67.2	£100.9	-£31.6
United States of America	£51.9bn	£41.2	£93.1	+£10.7
Netherlands	£26.5bn	£41.9	£68.3	-£15.4
People's Republic of China	£18.0bn	£43.0	£61.0	-£25.0
France	£24.1bn	£28.7	£52.8	-£4.6
Belgium	£14.0bn	£26.4	£40.4	-£12.4
Republic of Ireland	£20.9bn	£13.6	£34.4	+£7.3
Italy	£10.5bn	£19.0	£29.4	-£8.5
Spain	£10.3bn	£16.5	£26.9	-£6.2
Switzerland	£6.9bn	£6.5	£13.4	-£0.4

Total trade in manufactured goods, 2018. Source: ONS

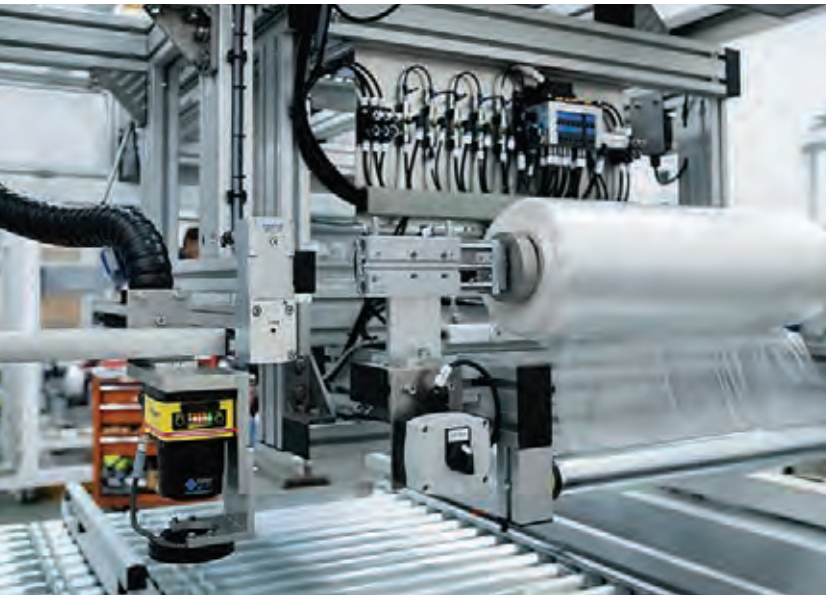

UK
MR
TRAILBLAZERS

COLLABORATION FOR INNOVATION

The **PCE GROUP** is one of the largest designers and manufacturers of automation solutions in the UK providing services across a wide range of sectors including fast moving consumer goods (FMCG), industrial automation, build to print, ocular and medical/pharmaceutical.

The PCE GROUP is comprised of PCE Automation Ltd, db automation Ltd and Premier Bowl Feeders Ltd, who together combine a multitude of complementary technologies to produce world-class, market leading automation solutions for the challenges of today and tomorrow. PCE designs, manufactures, assembles and tests its automation systems, before calibrating and shipping them across the UK and the world.

Above: **PCE GROUP's reputation is based on innovation**



PCE GROUP has invested in recruitment and in training, to ensure that it has the skills levels to support its client base.

PCE AUTOMATION LTD

Based within our modern industrial production facility in Suffolk, PCE has the complete capacity to design, manufacture, program, commission and service, which helps us to offer shorter lead times, and provide a quality of service while maintaining our family ethos.

db automation Ltd

Located in a production facility in the Midlands, our highly skilled, multi-disciplinary team designs and builds innovative automated solutions and provides an unrivalled level of after-sales service and support.

Premier Bowl Feeders Ltd

Premier provides craft-enabling manufacture of a comprehensive range of component feeding solutions to exacting quality standards, providing dependable systems that deliver optimum performance and stand the test of time.

'Exports in 2019 accounted of 73% of total sales and included a number of high-value sales to the company's top export markets'

The Group's reputation is based upon innovation, together with the speed and efficiency of its solutions; coupled with their longevity and high standard of customer service. Its continued investment in its workforce (including apprentices) and its infrastructure inspires the team to greater results; which are reflected in the quality of product. Greater customer confidence leads to stronger sales performance, which benefits both local and UK economies.

Looking abroad

PCE GROUP is keen to continue its international expansion and to prove that British engineering can compete against the largest of competitors. It has its eyes set firmly on the American market, where it believes it can disrupt the current marketplace and demonstrate that a fast-moving British company can compete with much larger multi-nationals.

Exports in 2019 accounted of 73% of total sales and included a number of high-value sales to the company's top export markets: Hungary; Costa Rica; Poland; and the USA. PCE aims to not only maintain these export sales but to increase them, as it engages with new customers over the coming years.

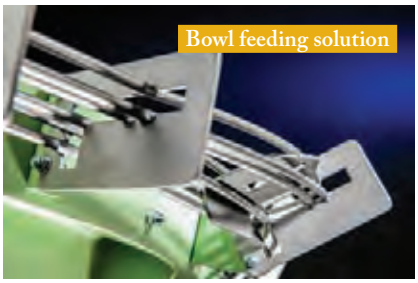
Targeting new countries increases not only the potential number of customers but also the size of individual customers, when compared to UK equivalents. Some of the customers we are working with have operations that span multiple territories; a good relationship with one branch will often open the door to opportunities in other regions, whereas our British customers tend to be UK-only. Approaching new territories vastly increases the reach and the size of feasible target markets.

R&D, innovation and incremental improvement

PCE invests heavily in R&D and in streamlining business processes, to increase efficiency. The company works closely alongside customers, collaborating to

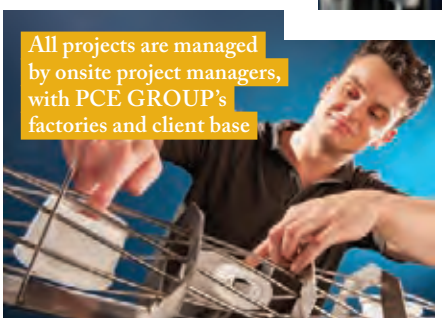

Side entry robot for large reusable and recyclable plastic products

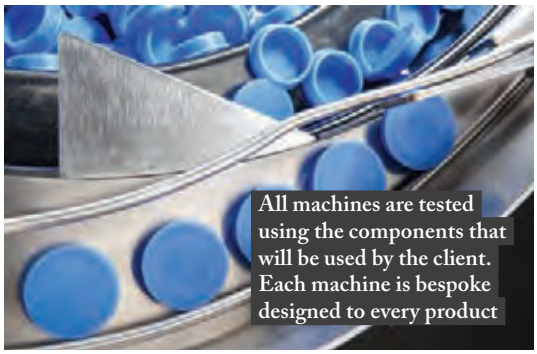

Apprentices and training are essential to the development of the PCE GROUP


Bowl feeding solution


A craft! Creating a bowl feeder

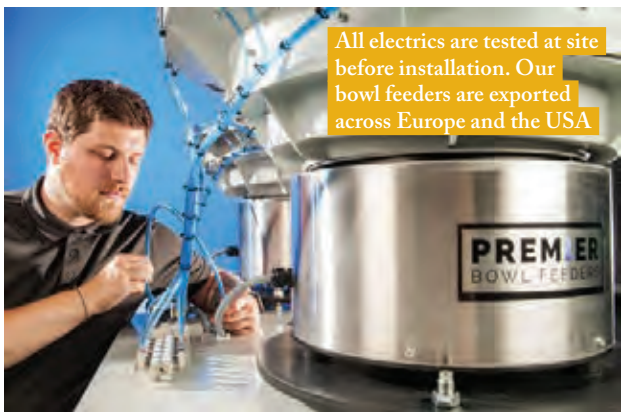

Skilled technicians and engineers are involved across the Group, from design to installation


All projects are managed by onsite project managers, with PCE GROUP's factories and client base


All machines are tested using the components that will be used by the client. Each machine is bespoke designed to every product

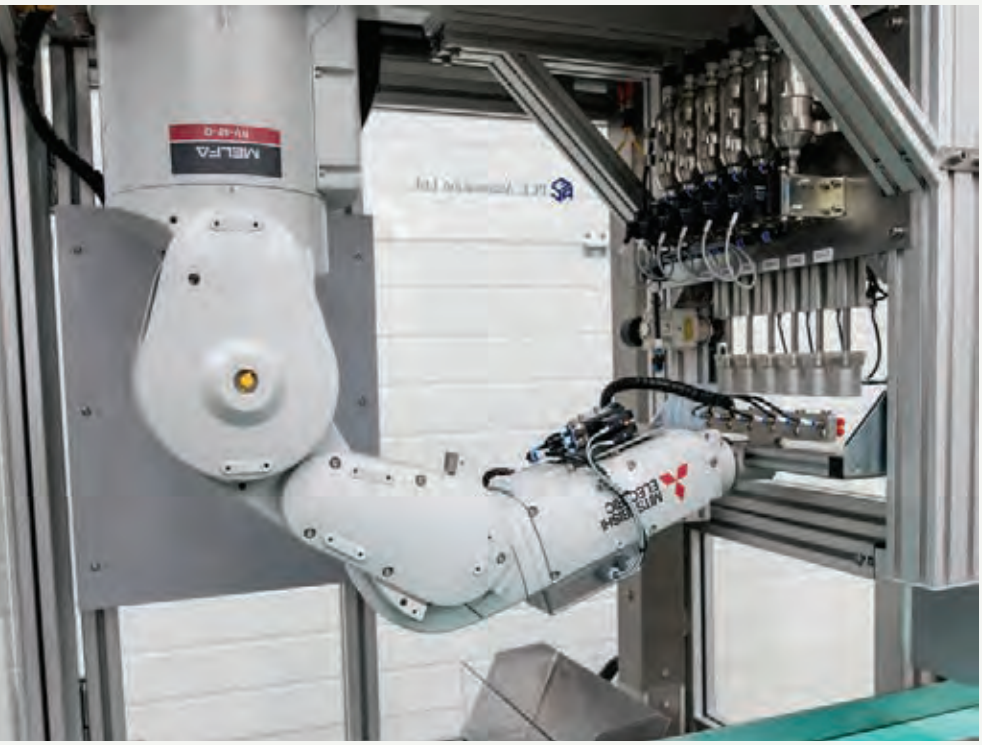

From small components to large: many industries utilise our automation solutions.


An automation solution for ocular, pharma and clean environments



All electrics are tested at site before installation. Our bowl feeders are exported across Europe and the USA


PCE Automation Ltd engineer at work!



Left: PCE GROUP's customers tend to be seeking bespoke, technical solutions for specific industrial processes.

Below: PCE GROUP works closely with customers during implementation and after-sales phases, as well during the sales process.

develop new solutions that not only meet their needs but allows the company to offer similar solutions to new markets.

Orders in 2019 led to a large increase in turn over for the PCE GROUP, underpinned by increased investment in new personnel, upskilling etc, to meet increased production demand. The company achieved it by a program of internal training and external recruitment, with the assistance of Local Enterprise Partnership & European Enterprise Network grant schemes.

Investment in apprentices is a pivotal aspect of PCE's business; it has a proud tradition of investing in the next generation. The company currently employs eight apprentices across its business; many former apprentices are still employed within the workforce.

Bespoke investments

As PCE produces specialist output and services, its clients tend to be companies seeking bespoke products.

"Investment in apprentices is a pivotal aspect of PCE's business; it has a proud tradition of investing in the next generation."

They can be clearly defined by the industry they work in and technology they require, and matched to the Group's specific abilities. They often require a technical solution to a specific process; PCE takes pride at the ease in which it can provide solutions to unique challenges.

As its products often represent a major investment for these customers, PCE apply their vast wealth of experience to build strong relationships with clients, providing exceptional aftersales care and meticulous attention to detail throughout the sales and implementation stages. PCE are customer driven and judge themselves on positive customer feedback and continued working relationships and repeat custom.

DELIVERING CERTAINTY IN AN UNCERTAIN WORLD

Alloy Wire International (AWI) is looking to reinforce its industry-leading reputation with global manufacturers by targeting them with its largest ever range of Exotic nickel alloys, including Inconel, Nimonic, Phynox and MP35N.

The company, which is on course for a record-breaking £12m year, continues to deliver the best solutions for customers looking for high quality nickel alloys for use in the automotive, aerospace, chemical, motorsport, nuclear and oil and gas sectors.

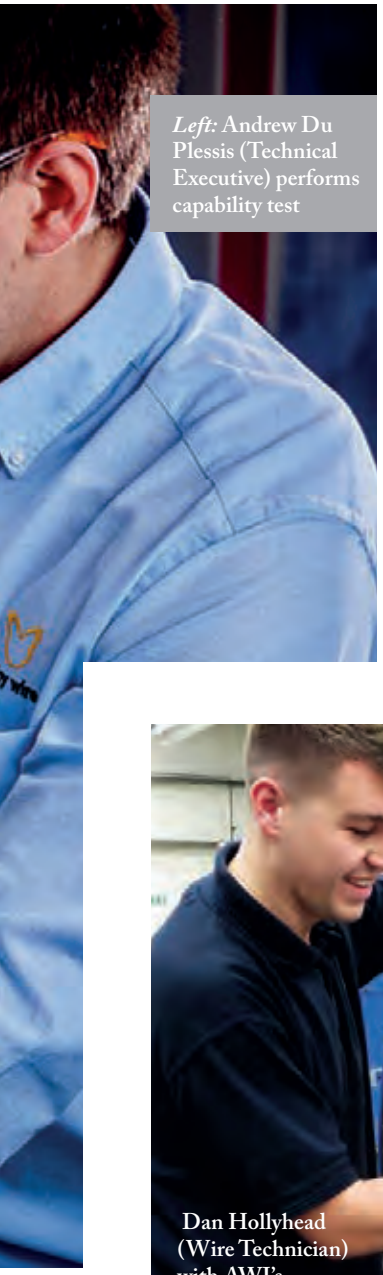
AWI's campaign - 'Certainty in an Uncertain World' - has been an overwhelming success and highlights its ability to make spring wire with a soap coating and consistent temper to order in just three weeks, using its huge stock range that now exceeds 200 tonnes.

Desire for the firm's friendly technical support service also continues to grow at pace. Recent recruitment has seen it strengthen its technical team and Quality Department to ensure it is well placed to discuss material application and to help solve potential manufacturing situations around the need for wire to work in corrosive environments and high temperatures.

Angus Hogarth, Sales Director at AWI, commented: "2019 has been fantastic for us. Our ability to react quickly to customer needs has helped us grow our existing accounts, as well as picking up many new clients - this is right from the initial quoting stage and offering technical support to responding to queries in a timely fashion."

He continued: "We understand exactly what they need and supply exactly how they want it."

Almost 75 years of manufacturing precision cold drawn round wire and



Left: Andrew Du Plessis (Technical Executive) performs capability test

Alloy Wire International, an 100% employee-owned company

Dan Hollyhead (Wire Technician) with AWI's new spooler

"In order to build on year-on-year growth, the company has also invested £250,000 into three new machines to boost speed, repeatable quality and capacity."

cold rolled sections has given Alloy Wire International a unique insight into its global customer base and how customers like to receive their material, whether that is in an order quantity of three metres or three tonnes.

This knowledge allows it to alter the manufacturing processes to give the client a bespoke design solution and, through a combination of cold work and heat treatment, supply a product that will achieve the required properties for their finished product. For example, a spring.

In such cases, AWI perform capability tests on samples and report results to demonstrate the material's ability to achieve their required properties.

Angus went on to add: "For high temperature resistance in both static and dynamic applications, we can offer a wide range of alloys, including Inconels, Nimonics, Rene 41 and Waspaloy, whilst customers looking for corrosion resistance can choose from materials, such as Hastelloys, Monel, MP35N and Phynox."

About AWI

Operating across 55 countries worldwide, Alloy Wire International makes round, flat and profile wire in a range of material that continues to grow, with more than 60 currently available to choose from, each offering superior corrosion resistance and/or excellent performance at high temperatures.

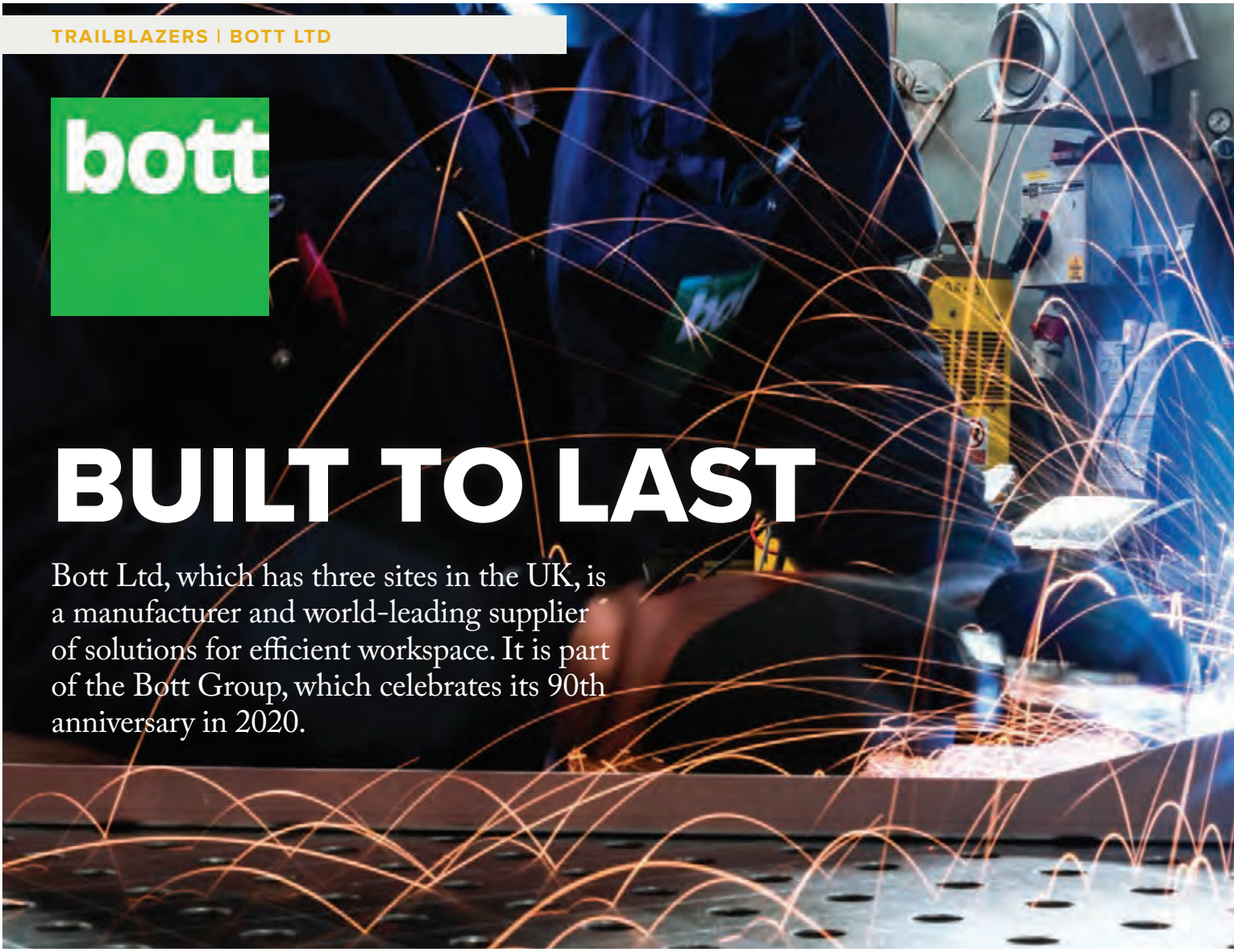
In order to build on year-on-year growth, the company has also invested £250,000 into three new machines to boost speed, repeatable quality and capacity.

Angus concluded: "We know we can't be complacent with our achievements in 2019; there is a continuous need to focus on where the market is going and make sure we are at the forefront of any changes.

"The spend for this year will go towards bringing in new technology that will help us continue the production of high-quality wire - in varying sizes and volumes – even quicker.

"All of our 60 different Exotic alloys are DFARS compliant, of EU origin and, where raw material allows, can be supplied from as small as .001" (0.025mm) to as large as .827" (21mm) in diameter."

WEBSITE: www.alloywire.com
TWITTER: @alloywire



BUILT TO LAST

Bott Ltd, which has three sites in the UK, is a manufacturer and world-leading supplier of solutions for efficient workspace. It is part of the Bott Group, which celebrates its 90th anniversary in 2020.

The Bott Group companies are global manufacturers and suppliers of assembly, workspace, in-vehicle and mobility solutions. As a trusted partner to many specialist brands in manufacturing, motorsport, aerospace and education, Bott offers high-quality value-for-money products, services and solutions.

Bott operates in three countries in the EU: Germany, Hungary and in the UK, where it has two competence centres, including a manufacturing facility at its British HQ in Bude, Cornwall, and a fitting centre for vehicle conversions in Ashby-de-la-Zouch, Leicestershire. It also operates a vehicle conversion centre in Cumbernauld, Scotland.

Clive Woodward – Bott Group COO, based in Cornwall, has been with the company for over 30 years.

"We sell workspace organisation to help customers improve and evolve and get the best from their working environments. What we try to ensure is that the technology that we apply, the processes we use, the culture that pervades through the organization, is one which is focused on delivering value for the customer," he says.

Bott's 'Built to Last' philosophy drives every aspect of its business. From design to product testing and to manufacture, its processes and culture give it the confidence to stand behind its products. All of its UK manufactured products come with a 10-year extended guarantee.

Many of Bott's products have evolved from designs that were created to solve specific problems, but the company's service goes well beyond simple supply of product. It regularly designs, manufacture and installs high specification project solutions to meet customers' unique requirements. The priority is to provide all round excellent service and a heightened brand experience for every client.

Our Environment

This is an age where sustainable growth and environmental awareness are at the core of any business success. Environmentally, Bott is ISO14001 accredited, so customers and stakeholders can be assured that the company takes its environmental responsibilities seriously. It further demonstrates its commitment through additional structured processes and policies, such as the installation of solar arrays at its manufacturing facilities, which generates a significant proportion of the energy required to support ongoing operations.

Bott has invested £1 million in a new extension at its Ashby-de-la-Zouch site

UK TURNOVER 2018:
£48.55m

MARKETS:
Manufacturing, Automotive, Aerospace, Education, Public Sector, Construction

BOTT GROUP
90th Year in 2020

LOCATIONS:
Operates in 21 countries worldwide from Asia Pacific to Europe and UK

- Over 40 years industry experience in UK
- Over 2000 cabinets, cupboards & benches sold each month
- 8 - 10,000 vans converted pa
- Over 400 deliveries per week across Europe & UK
- Average employee length of service 7.5 years
- Developing young apprentices since 1976

An extensive new workshop installation for Multimatic Motorsports' facility in Brackley

Bott's energy committee continuously looks for energy saving opportunities. It invested in rainwater recycling facilities, which collect water for use in manufacturing processes and toilet flushing. Bott proactively invests in systems to treat waste products from its processes. For example, it has built an effluent treatment plant, which removes traces of heavy metals and other pollutants and ensures that the treated water can be processed by the water authority.

To minimise the environmental impact of its transport fleet, Bott has invested in the latest Euro 6 compliant vehicles, and installed electric charge points for electric and plug-in hybrid vehicles.

The environmental factor has also featured heavily in product design. More of its mobile customers are demanding light-weight, ethical and sustainable products so Bott is continuing to focus R&D efforts on developing ever-greater sustainability for the client base.

The Making of the Future

Apprenticeships have long been at the core of Bott's business; over 20% of the current workforce has come through and benefitted from various education and training schemes. Simon Willshire, Design Manager, joined the company as an apprentice back in the 1980s and rose up the corporate ladder into several management positions. He isn't alone; many of Bott's managerial positions are currently held by people who have forged a long-term, successful career out of apprentice-ship beginnings.

"I've lived the engineering apprenticeship story and am testament to its success," Simon says. "I'm therefore passionate about continuing these schemes for others."

Simon is also the company's STEM Ambassador and Industry Enterprise Advisor for the local area. He regularly attends career events and visits schools and colleges, igniting the students' interest in engineering and nurturing a creative, problem solving mindset. Work experience placements and class visits are also regular important commitments.

Moving with the Times

On October 22nd 2019, Bott opened a brand new, £1m extension to its vehicle conversion centre in Ashby-de-la-Zouch. The advanced facility has three new PDI (pre-delivery inspection) bays that are set up for work on electric vehicles, and 25 additional conversion bays, adding up to an expanded total of 80 at the site. The new extension enables the company to manage larger contracts for electric vehicles and to segregate them from other work, allowing access only to appropriately qualified staff.

Manufacturing Change

Technology has moved from an analogue environment to digital; energy resources are shifting from oil to green. Adapting facilities to deal with those changes has been both challenging and exciting. In recent years, the introduction of SAP as an MRP (material/manufacturing requirements planning) system has revolutionised the way Bott plans and manufactures parts.

The Future is Ours

Bott's is a genuine success story. It has come from a period where manufacturing was moving out of the UK to the point now, where it's reshoring - coming back. The company has bucked the manufacturing trend in the UK and continues to thrive. It operates in a very fluid environment: markets have changed it has gone from national focus to European; and now Bott operates in a Global world.

WEBSITE: www.bottltd.co.uk
Bott UK Manufacturing Facility – Official Promo film 2019: https://www.youtube.com/watch?v=UZ4F_DcdV5g
TWITTER: https://twitter.com/Bott_Ltd
LINKEDIN: https://www.linkedin.com/company/1354823
FACEBOOK: https://www.facebook.com/bottltdUK/
CONTACT: Workplace Storage – 01288 357788, Vehicle Conversions: 01530 410600

GALVANIZING INDUSTRY

Sophie Williams, Finance Director, Corbetts the Galvanizers

There's an old saying that a 'picture paints a thousand words', yet few people would ever associate it with the galvanizing sector.

Sophie Williams, Finance Director at Corbetts the Galvanizers, has a different take on things. When products roll out of the firm's vast facility in the heart of Shropshire, the stunning finish is something that usually tells her that the processes, the staff and the investment the management team has signed-off is working.

Since the business was bought by Canadian investment house Ardenton Capital in 2017, it has been on a steep upward growth curve, putting on over £1.2m in sales and enjoying new success in construction and the automotive sector.

This has been achieved despite the uncertainty of Brexit and fluctuating commodity prices, not to mention challenges associated with skills and securing the right staff to cope with expansion.

Rollercoaster ride becomes platform to perform

"It has certainty been a rollercoaster 12 months," explained Sophie, who was appointed to the board at just 28 years-old, making her one of the youngest female directors in the sector.

"A lot of the work we undertook following the acquisition has given us the platform to work through the economic issues and press on with our desire to reinforce our position as one of the UK's leading hot dip galvanizers."

She continued: "In fact, when we actually look at the figures we can see that we actually achieved our best ever year for new sales and a lot of this was down to our repositioning, a new brand and successfully passing our ISO 9001 accreditation.

"Our philosophy is focused on hassle-free service, stunning steel and customer service, as opposed to the traditional 'stack it high, sell it cheap' mentality often seen in the sector."

A 'right first time' commitment has resonated with Corbett's the Galvanizer's client base and helped it convert pipeline business into actual sales, as it looks to head towards £12m of annual sales.

105 people are now employed at its Telford manufacturing base and all of these staff are now part of a new training and rigorous development programme that is designed to blend new starts immediately into the team and allow existing individuals to upskill.

'Right first time' commitment has helped convert pipeline into sales

Corbetts the Galvanizers' work can be seen on street furniture, is used to keep vital IT infrastructure safe, on articulated lorry trailers and static caravan chassis

This has been achieved through the creation of an Operational Support Team, which is in charge of the workplace environment, employee incentive scheme and identifying opportunities for people to grow and positively influence the business.

Major Anniversary

2020 marks 160 years of Corbetts the Galvanizers supplying world class hot dip galvanizing to thousands of customers across the UK and Europe.

The company, which was originally founded by Samuel Corbett, opened its Wellington factory in 1860 and Shropshire has remained its home ever since.

However, today's site on Halesfield, its base since 1999, will be barely recognisable to those that started out all those years ago, with a new water recovery system in place, state-of-the-art kettles installed and a 13-strong fleet of vehicles in the yard acting as the distribution nerve centre for serving its customer base.

Over £300,000 has been put aside for its anniversary year to replace flux and acid tanks that will free up capacity and further speed up the galvanizing process.

"We like to think 'our past, protects your future' and this relates to the years of experience we have built in understanding our clients and what makes them tick," continued Sophie.

The FD, who was recently named in The Manufacturer Top 100, points to the many end uses that Corbetts the Galvanizers contribute to, most of which the public would never realise.

"Our galvanizing can be seen on street furniture, to keep vital IT infrastructure safe and on articulated lorry trailers carrying goods all over the UK. We even have a big say on the chassis that thousands of static caravans sit on. It's all about delivering the performance, yet still making sure they look great."

Sophie concluded: "2020 will be a real celebration of our history, but also a marker in the sand for the next 160 years, starting with a 7% increase in volumes. If we achieve this, revenue should be up by £1m – now that's a good birthday present."

WEBSITE: www.wcorbett.co.uk
TWITTER: @wcorbetts

Michael Gibbs, Managing Director, European Springs & Pressings

TRAILBLAZERS: EUROPEAN SPRINGS & PRESSINGS

European Springs & Pressings is one of the world's market leading spring and pressing manufacturers. Based in Cornwall, in London and with a logistics office in Yorkshire, they are set to enhance their position after achieving record results and investment.

Securing their position as a key international supplier for the automotive and industrial sector, European Springs & Pressings, has invested over £3m in infrastructure in recent months and has multiplied the size of its South West operation to over 4000 square metres, with the purchase of a second factory in Cornwall.

Michael Gibbs, Managing Director of European Springs & Pressings in Cornwall says: "In the last year, turnover in Cornwall has increased by 40% and we've grown from a team of 43 to over 65. Five years ago we relocated to a larger site - we then extended that factory to meet demand and have been rapidly outgrowing our current premises ever since.

Purchasing the second factory in Cornwall has been a really exciting new chapter for everyone in European Springs & Pressings, especially as the Cornwall operations originated from a hut near the beach over 30 years ago."

The additional new factory allows for continual growth across the industrial and automotive product divisions, affording new opportunities for expansion, with the second site specialising in the industrial element of the business, supplying springs across multiple sectors ranging from agriculture to aerospace, robotics to rail to food and marine sectors and everything in between.

In recent months, a new powder-coating line has been installed in a 700 sq. metre extension, a new spring

MAIN ACTIVITIES:
Spring manufacture ranging from 0.03mm to 65mm wire diameter, wire forming, pressing and stamping across multiple metals

TURNOVER:
£23m

GROWTH:
20%

MARKETS:
Automotive, aerospace, defence, electronics, rail, mining, construction, oil and gas industry, robotics, power generation, medical, marine, telecommunications, lighting, heating and more.

The company has invested heavily in processing equipment and production space.

coiling machine purchased (the first of its kind in the UK) a new heat treatment oven acquired and two high-performance spring-end grinding machines complete the recent purchases.

The new equipment, spread across the Cornwall factories, has doubled the grinding capabilities in the company's industrial sector and expanded the automotive sector grinding facilities by 400%. The new heat treatment oven and powder coating line increases automotive production infrastructure by 200%.

Michael Gibbs, adds: "Developing enhanced manufacturing capabilities through investment in high-tech infrastructure and skills training, enables us to sustain manufacturing competitiveness. With a global market place across multiple industries, it is essential that we maintain our reputation for innovation and manufacturing excellence.

Harnessing technology allows us to remain competitive and deliver the highest quality products and our infrastructure and facilities investments are testament to our dedication of being a world-class spring manufacturer. Lesjofors, our parent company, is committed to investing in the UK and has consistently recognised the forward-thinking nature of our management and the unrivalled quality of our production and lean manufacturing processes."

All investments are part of an ongoing improvement initiative, building capabilities in line with demand, providing enhancements to maintain European Springs and Pressings and Lesjofors's, global leading position.

Gibbs concludes: "We're accelerating our expertise in direct response to customer demand and our programme of financing is strategic, reflecting a number of years of record growth. Our multi-million investments in new infrastructure, machinery, training and technologies, is a strong indicator of the strength of manufacturing and we're delighted to be further investing in, and supporting, the UK's £192bn manufacturing industry.

"Despite today's political uncertainty, our faith in UK manufacturing is certain."

WEBSITE: www.europeansprings.com

LEADING THE WAY IN MANUFACTURING FROM PIES TO CARS

Equipped with a unified view of their business and access to the right information at the right time, IFS customers can be challengers in their industries. Here are the achievements of two IFS customers, leading the way in automotive manufacture and the food and beverage industry.

THE IFS TRAILBLAZERS

Morgan Motor Company is known the world over as an iconic British car manufacturer, famed for creating sports cars that boast a unique blend of craft, heritage and pure driving experience.

Pukka Pies are the UK's leading pot pie brand. They service most UK supermarkets, chip shops and various high street shops. Every week they produce around a million pies. As part of their quality commitment, Pukka guarantee traceability from farm to fork.

CHOOSING THE RIGHT SYSTEM

At Morgan, their IT infrastructure had grown and morphed with new technologies and solutions retrofitted to their existing architecture. To move forward and future-proof the business, Morgan needed to integrate their solutions.

"We reviewed what the IFS system could offer and could confidently agree that their system answered all of our questions," says Graham Chapman, Technology Director, Morgan.

"I think IFS has changed our way of work in that it's brought us up to date and in line with other companies" says Nathan Harvey, Frontline Manager—Production, Pukka Pies.

Morgan focused on using IFS to automate processes, enabling their employees to concentrate on tasks that add value to the business. "It's a change in job role, a new focus in their life, they're actually adding some real value. To me, that has started to empower people and as a result the whole business starts to move forward," says Chapman.

increased factory capacity by over 30%. And as a business, they've grown by more than 10%, which Andy Wormald, Business Systems & Process Manager at Pukka Pies, believes wouldn't have been possible without IFS.

SETTING GOALS

The future is bright for Morgan and IFS, but there's plenty still to be done notes Chapman: "Now that we've gone live, the next step is to develop the system. We need to place it into the hands of everyone throughout

> "WE REVIEWED WHAT THE IFS SYSTEM COULD OFFER AND COULD CONFIDENTLY AGREE THAT THEIR SYSTEM ANSWERED ALL OF OUR QUESTIONS."

While at Pukka Pies their decision was based on IFS's commitment to research and development, as this meant their software would grow and evolve with their business.

IMPLEMENTING IFS

When Pukka Pies implemented IFS, they chose core software, covering financials, sales, purchasing, and production carding. They also use IFS Applications on their production floor, where it gives users access to all the information they require, without needing to rely on data analysts or specialists.

REALISING VALUE

Graham Chapman estimates that Morgan's employees will gain 25-30 percent more time with IFS. But the real value gain, he says, is that orders will be more accurate. When a dealer puts in their specifications, this data will go straight into IFS Applications and the paperwork will be created automatically and accurately, ensuring the end customer is totally satisfied with the resulting car.

Whereas for Pukka the biggest benefits have been in terms of growth. Since post go-live they've

the business. When we think about the system at board-level, it's KPIs. It's having the tools to make factual statements to business KPIs."

For Pukka Pies it's all about building on their success. "The strategic plan for Pukka Pies is to continue our astonishing growth rate matched with IFS's equally impressive growth rate to set us on an exciting journey for the future," says Wormald.

INTEGRAL POWERTRAIN

It's not just the automotive sector that is seeing the need for cleaner propulsion technologies to meet the global emission targets. All modes of transport are affected; from commercial and off-highway, to aerospace and motorsport.

Integral Powertrain Ltd (IP) cut its teeth in the CAE world back in 1998 when its current four directors left Cosworth, the famous competition engine company, to set up on their own. Over the subsequent years they transformed themselves into a world leading, record breaking manufacturer of EV drives and control technology and are committed to staying at the forefront of motorsport powertrain development. At the same time they are also taking what they have learnt on the track to lead electric and hybrid powertrain development on the road and in the air.

Innovative and sustainable product development is at the heart of Integral Powertrain and 2018 saw all their hard work pay off, with world records with Volkswagen Motorsport and their ID. R race car, and multiple awards for its ground-breaking powertrain technology including the coveted Dewar Trophy, presented by the Royal Automobile Club. Locally, in 2019 IP was recognised for its tireless work surrounding the innovation and technology of products for a more sustainable future of transportation; winning not only the Technology of the Year award but also scooping the Milton Keynes Business of the Year award.

"The awards have really helped to raise the profile of Integral Powertrain as a hugely successful business in not only the automotive and motorsport sectors, but also in Milton Keynes. With numerous motorsport companies located in the area, the awards received have given us credibility with our customers and demonstrates that we're at the forefront of a revolution in the automotive industry." Says Integral Powertrain's Marketing Manager, Stuart Jaycocks.

Left: High Performance electric drives

Integral Powertrain will open its new facility in May 2020

investment in People

None of this would have been possible without the wealth of knowledge and experience of the 170+ employees. The company has seen rapid expansion over the past 3 years and to meet the increasing demands it has had to adapt its processes and structure. An undoubted key to its success is a commitment to 'growing its own talent' and 'promoting from within' through the elevation of existing staff into key roles. IP continues to address the UK skills gap by offering a range of apprenticeship, graduate and placement schemes as a way to bring new engineering and commercial skills into the business. It has developed particularly close links with Cranfield University.

"Excellent people come out of Cranfield," says Chief Operating Officer, Alan Cherrington. "Being in the centre of Motorsport Valley, there are significant numbers of highly intelligent and professional people. Attracting them is more difficult because engineers in this area are generally petrol heads. However, the engineering challenges here are amazing and when people understand that, it's easier to sell what we do to them."

investment in Facilities

The company operates from four sites across its base in the city of Milton Keynes and is associated with projects such as Aston Martin's Rapide E and Valkyrie vehicles, and the soon to be produced Lotus Evija. An APC funded project will see them develop an electric motorcycle capability with UK manufacturer Triumph Motorcycles. There are many others, which are subject to commercial and client confidentiality.

With an ever-growing client base and moves into the aerospace and marine sectors, expansion has become inevitable for the business. It will move into a state-of-the-art new Technical Centre, currently under construction at Shenley Wood, by Q2 2020.

"It is a massive leap for us but the future is incredibly exciting," Alan admits. "Our sites across Milton Keynes continue to fill up and, while we still have capacity in our existing infrastructure, we felt it was the right time to invest in a new, single facility. I like to keep teams together and bringing the whole business together under one roof is the right way to go." Integral Powertrain is at the leading edge of its industry. The company continues to invest in R&D to maintain technical development and extend the boundaries of what is possible with electric machines.

"We remain committed to growing the business and we believe this latest investment provides a clear signal to our clients, both existing and new, that we are serious about growing our business alongside them." says Alan.

The new facility, which represents an initial £6 million investment, doubles the company's current floor space to 47,000 sq. ft., with potential to expand internally by a further 12,000 sq. ft. Once fully operational, it will house more than 250 employees; a workshop with eight new purpose-built test cells; and low-volume production manufacturing areas.

"IP is currently working on seven projects. That number is predicted to rise to as many as 20, within the next two years. All of that comes with developing processes and systems to enable the growth and improve the efficiency of the company. The new Milton Keynes Technical Centre marks the beginning of an exciting new chapter in Integral Powertrain's growth and it will only serve to support our future expansion plans for the business" Stuart Jaycocks concludes.

JJS MANUFACTURING

Projected growth for JJS Manufacturing as sights are set on another record year

Another year, another opportunity to reflect on substantial growth for UK Electronics Manufacturing Services partner JJS Manufacturing.

With their sights still firmly set on the 'Road to £100 Million', JJS Manufacturing remains confident that the coming year will continue to bring significant growth, development and innovation.

Last year, you might remember we spoke with JJS's Director of Marketing, Neil Sharp, who at the time, referred to this as an 'aggressive goal'. But as they head into 2020 it's looking more achievable than ever. We sat down with Sharp again this year to talk about:

- growth in the face of uncertainty
- new customers
- investment in talent and training
- further expansion in the Czech Republic

Positivity in the face of uncertainty

Before we go any further, let's address the elephant in the room.

Brexit is looming and promises to disrupt the manufacturing industry in one way or another. JJS isn't naive to potential disruptions with the transportation of goods between sites, but they remain confident in their ability to trade with minimal impact to their customers. Here's what Sharp had to say on the matter: "We currently have two facilities in Central Europe so in a 'worse case' scenario, we could trade directly from these if we need to. The biggest challenge we anticipate will be the initial delay in transporting goods to and from our UK site. To help mitigate this risk we have partnered with two major freight forwarders which have preferential border agreements and will call on their services should we require. We have already been building up Brexit 'buffer' stocks for clients so right here, right now, we are relatively calm about the situation and doing what the UK tends to do best - getting on with business even in the face of uncertainty."

And threats of a messy Brexit certainly aren't dulling any plans to stay on track

and work towards their ambitious sales goals.

"Based on current commitments from existing customers we are anticipating an 18% increase in turnover over the next 12 months. We are still working towards our goal of achieving £100 Million sales in the next three years and by the end of our next financial year, we should be over halfway there, which will be a fantastic achievement and a testament to the hard work and effort put in by all of the JJS team."

MAIN ACTIVITIES:
Electronics, Electrical and Electro-mechanical Manufacturing

TURNOVER:
£43M

EXPECTED GROWTH:
18% turnover

ESTABLISHED:
1983

NUMBER OF STAFF:
450

LOCATIONS:
Bedford (UK), Lutterworth (UK) and Chomutov (Czech Republic)

MARKETS:
Industrial Electronics – Process Control, Industrial Automation, Test & Measurement, and Laboratory & Scientific.

Bolstering the workforce

JJS Manufacturing is notorious for its commitment to its workforce, both existing and upcoming. With established Apprenticeship programmes and Commercial graduate schemes already in place, we spoke about how they intend to further address the manufacturing skills gap and continue to attract new talent.

Taking the skills gap as an opportunity to bolster their internal development theme and foster new talent from local areas Sharp spoke about his personal commitment to the programme:

"We've built some strong relationships with local education facilities including Lutterworth College and Loughborough University over several years.

"As a good example, last year, we teamed up with Lutterworth College and hosted our very own local Apprenticeship exhibition to help give students a choice if the University route wasn't right for them. This proved to be very popular, with 40 companies and over 300 students attending the evening. In fact, it proved so popular we have decided to do it all again this year and will be extending the scope to a more general 'Careers Fair'.

In 2019, we placed 2 new Engineering Apprentices, 3 Commercial Graduates and another Engineering placement student across our UK sites and we are currently developing our scheme for the Czech Republic.

While relevant talent can be hard to come by, JJS is ensuring they remain one step ahead of the curve.

In being proactive, JJS continues to address and overcome the impact of a skills gap, resulting in better growth and talent within the business.

Expanding into new industries

"In addition to existing customer growth, we acquired two new customers during 2019, one of which is an AgTech (agricultural technology) start-up."

The AgTech startup has designed a revolutionary product and JJS believes that by supporting the project during this early phase in a developing industry is essential for growth - both for the customer and the EMS provider themselves.

"This is in direct response to changing customer needs and expectations, and we are as open as ever to new innovations and technology. The AgTech industry is disrupting the food production and farming industry and this product works by using electricity as a scalable and sustainable non-chemical weed killer.

With a push to ban chemicals in Europe, businesses are looking for technological solutions to fill the gap which means there is huge market potential for this type of solution. It's a really exciting time for us and the first set of units will be assembled, tested and shipped during Q1 of 2020."

As Sharp puts it, "When our customers grow, we grow with them."

> "Last year, we teamed up with Lutterworth College and hosted our very own local Apprenticeship exhibition to help give students a choice if the University route wasn't right for them."

Further expansion in Europe

Sharp concludes by explaining that in order to support several long-term customer contracts, JJS are now finalising plans to open another site in the Czech Republic. "This new site will provide us with an additional 40,000 sq ft to add to our existing 100,000 sq ft footprint, so a significant increase for us. The new unit is conveniently located on the same industrial estate as our other two factories and we hope to have moved in during Spring 2020.

It's safe to say that JJS Manufacturing shows no sign of slowing down or cowering in the face of seemingly indomitable threats like Brexit and talent shortage.

DIGITAL REVOLUTION

2020 will be an exciting year for Shropshire-based Protolabs. The world's fastest digital manufacturer of custom prototypes and low-volume production parts is tapping into the growing demand for 'speed to market' by completing an ambitious £5m expansion plan at its European headquarters in Telford.

The company, which works with hundreds of customers across a range of sectors including automotive, aerospace, medical, electronics and heavy industry, will shortly start moving in new machinery and equipment to its purpose-built extension in Halesfield.

An additional 50,000 sq. ft. has been created that will house at least 50 more CNC machines and a further 20 injection moulding presses.

Bjoern Klaas, Vice President and Managing Director of Protolabs Europe, commented: "The focus now, more than ever, is on speed and making sure new products and components are either first to market or ready when the end customer needs them.

"We are ideally set-up to meet this requirement, with a combination of our design and analysis team, bespoke production software and, after the expansion is complete, around 300 CNC milling, CNC turning and plastic injection moulding sampling and production machines at our disposal."

He continued: "Digital manufacturing is one of industry's biggest opportunities and, in addition to these capabilities, we will also be introducing new services and materials in injection moulding and 3D printing.

"This will give engineers the opportunity to be even more creative in the way they make lightweight parts, solve long-term issues for society and bring new technology to market."

Operating from manufacturing facilities across three continents, Protolabs works with customers to accelerate product development, reduce costs and optimise supply chains.

Customers upload their 3D CAD drawings to www.protolabs.co.uk, where customised software reviews models and emails an interactive quote with real time pricing and design analysis from a 20-strong team in the UK.

The company, which recently won the Queen's Award for International Trade for the third time, typically produces 1 to 50+ 3D printed parts in 1 to 7 days, 1 to

PROTOLABS REPORT

THE RACE TO ELECTRIFICATION

The UK's automotive industry is doing more than its European counterparts to help tackle climate change, according to research by Protolabs.

Domestic car makers and automotive suppliers are investing more in electrification and alternative powertrain solutions than their competitors in Europe.

Figures taken from 'The Innovation Race' - a report that examines the challenges and opportunities faced by Europe's car makers - show nearly half of the UK's auto firms (46%) are committing significant resources to exploring new possibilities in electric and hybrid vehicles, compared to just 34% in their nearest rivals Germany.

The UK also appears to be leading the field in pioneering new approaches to fuel efficiency (34%) and recognising the potential in developing autonomous parts and vehicles.

"You can see from the scale of recent global protests how important protecting our environment is and it is reassuring to see the automotive industry is meeting the challenge head-on," pointed out Peter Richards, Marketing Director at Protolabs.

"The UK, in particular, is outstripping the rest of its European rivals in its efforts to develop and identify new powertrain solutions that deliver better fuel efficiency yet retain the same driving performance motorists expect.

"We are living in a period of unprecedented change, but with change comes opportunity and if the UK continues to seize the electrification and new powertrain agenda then it could become one of the world leaders in this technology.

"As always, speed to market is essential and making sure car makers, suppliers and engineering consultancies have access to services that can deliver prototypes and low to medium parts quickly will be increasingly important."

WEBSITE: www.protolabs.co.uk

"Operating from manufacturing facilities across three continents, Protolabs works with customers to accelerate product development, reduce costs and optimise supply chains."

200+ CNC machined parts in 1 to 3 days and 25 to 10,000+ injection moulded parts in 1 to 15 days.

Lee Ball, General Manager at Protolabs' Telford facility, went on to add: "Demand for digital manufacturing will only grow and, by 2030, I can imagine a scenario where parts are made even faster than they are today, in materials we haven't even tested yet. The desire for more rapid product development, lighter parts and more complex designs will have stretched the imagination of even our most creative designers and engineers.

"Our latest investment will see us continue to create further employment opportunities for the region, which is great news for Shropshire, a place we are very proud to call home to our UK and European HQ.

"We have access to lots of highly skilled people in the region and it is quite fitting that we are located near the birthplace of industry, as we continue to forge the next industrial revolution."

2020 - AN EXCITING NEW YEAR FOR COFRESH SNACK FOODS

The year when the first two digits match the second two only comes once in a century - which already makes 2020 pretty special. But for Leicester-based snacks manufacturer Cofresh, the year looks set to be an exciting and auspicious one in many other ways - not least because it will see the opening of an additional, £20m food production and warehousing facility to cater for further significant growth and expansion.

Innovation, investment and a flexible approach have always been the bywords for success at Cofresh, owner of two highly successful snack brands - Cofresh, the UK's No 1 Indian snack brand and Eat Real, the UK's No 1 'free from' bagged snack brand. From humble beginnings back in the 1960's in Nairobi - where it manufactured potato crisps and popcorn for local cinemas and shops - the company moved to Leicester in 1974 and thanks to its winning recipe of authentic flavours, family values and business foresight, was soon recognised as a major player in the global snacking market.

Cofresh manufactures around 200 traditional Indian snacks as well as the Eat Real vegan and 'free from' range

Cofresh's range now includes the Eat Real vegan and 'free from' snacks

2020 will see Cofresh open an additional £20m production and warehouse facility in Nuneaton

With a portfolio of around 200 traditional Indian snacks and a rapidly increasing and highly acclaimed vegan and free from range, this family-owned business now exports to 62 countries, employs 220 people and is on track this year to notch up a £55m turnover.

Consumer demand for 'taste adventures' with bolder, ever spicier flavours - plus a growing appetite for 'free from' and healthier snacks influenced by dietary factors and lifestyle choices - is a key factor in Cofresh's phenomenal growth. Having manufactured both brands from its Menzies Road factory in Leicester since 2016, the company last year invested £20m in an additional seven-acre site in nearby Nuneaton - an exciting new venture that will see production split between two sites. The existing site in Leicester will continue to specialise in traditional Indian snacks while the new facility, which will be increased from 140,000 square feet to 180,000 to bring the company's total production and warehousing footprint to just under 400,000 square feet, will be dedicated to the manufacture of the Eat Real healthier snacking range.v

Major investment over the last 12 months has also included an ambitious NPD programme across both brands, as well as a complete review and re-design of the packaging.

"The new site delivers great potential for our ambitious business growth and represents a huge step in the development of the company," comments Priyesh Patel, managing director. "It's fair to say that the last 12 months have been challenging at times, but they've also been exceptionally exciting in terms of business development.

"We're confident that Cofresh is entering the new decade in great shape!"

FUN FACTS

- Across both brands, over 2m units a week leave the Leicester factory
- More than 1,800 tonnes of Bombay Mix produced annually
- Exported internationally to 62 countries
- In March 2019, the company manufactured 4.1m units of Cofresh snacks and 4.7m of Eat Real.

GROUND-SOURCE GROWTH FOR HOME-GROWN MANUFACTURER

Kensa' award-winning Shoebox heat pump is at the heart of shared ground loop arrays technology

British ground-source heat pump manufacturer, Kensa Heat Pumps, is leading the UK's transition to a cleaner and greener economy with the opening of a new factory, capable of producing 30,000 ground-source heat pumps every year.

Established in 1999, Kensa has pioneered the UK's adoption of renewable heating technology and its innovative application to aid the phase-out of fossil fuels and reduce the carbon intensity of home heating.

The new 1000m^2 Kensa Heat Pumps facility at the former Mount Wellington Mine in Cornwall will see a ten-fold increase in the company's ground-source heat pump production and provide 150 jobs at full capacity.

Fifth Generation District Heating with Ambient Shared Borehole Ground Loop Arrays and Kensa Shoebox heat pump.

Like Kensa's current factory, the new premises will have underfloor heating and hot water fed by a ground-source heat pump harnessing heat from water in the flooded mine workings below.

Market and company growth

With an existing market share nearing 50%, Kensa forecasts annual sales growth of around 50%, as Government introduces regulations to outlaw high carbon fossil fuels, particularly in new-build housing by 2025. Ground-source heat pumps offer lower-cost heat than mains gas; their technology has the lowest carbon footprint of any heating system. With a customer base spanning self-builders to housing associations and developers, Kensa manufactures the widest ground-source heat pump range available in the UK.

Kensa's multi-award winning Shoebox heat pump has transformed heating in apartments and flats. Its innovative shared ground loop arrays system – where an individual Shoebox heat pump inside a property is connected to a communal ground array – provides housing associations and developers with an ultra-low carbon and low-cost heating solution, while cutting fuel poverty and improving air quality. Kensa forecasts that this solution will soon be offered to the private retrofit market.

Reducing costs and increasing appeal

Kensa's R&D is focussed on two areas with the potential to radically enhance the appeal of the technology. There are opportunities to reduce ground array costs by utilising waste heat and introducing passive cooling to residences, and to reduce running costs by utilising dynamic tariffs, heat storage products and smart controls. A heat pump is a key component in household energy systems, so connectivity is key; consequently, Kensa is now recruiting more software developers than mechanical engineers!

> "Kensa has emerged as the county's largest employer in the low carbon heat sector and the new facility will provide our committed workforce with an exceptional workspace"

L-R: Craig Pascoe (HSBC), Simon Lomax (Kensa) and Sarah Newton MP celebrate the construction of Kensa's new 1000m^2 production facility

"Kensa has emerged as the county's largest employer in the low carbon heat sector and the new facility will provide our committed workforce with an exceptional workspace," says Simon Lomax, Kensa Group CEO. "Kensa is the established UK market leader and we expect to grow rapidly in the years ahead, as the attractions of ground-source heat pumps become apparent to all."

DRIVING ELECTRIC TECHNOLOGY

Left: Swedish start-up Volta Trucks selected Magtec to design and manufacture its electric drive systems

Fears over a climate emergency are driving change across the transport industry - and Magtec is at the vanguard of the technology needed to make it happen.

Founded by director Marcus Jenkins, Magtec is the UK's leading designer and manufacturer of electric vehicle drive systems and is the technology partner for a growing number of pioneering projects to reduce harmful emissions and improve air quality.

In its home city of Sheffield, Magtec has started trials of electric bin lorries powered by energy produced from the waste they collect. The 26-tonne vehicles have zero emissions, produce no air pollution and are powerful enough to negotiate Sheffield's seven hills.

The project caught the attention of Prime Minister Boris Johnson, who referred to it as "a world-first initiative" in his keynote speech to the Convention of the North. Westminster City Council is also trialling electric bin lorries powered by Magtec as part of the capital's efforts to cut emissions.

OEM interest

Orders from OEMs are increasing. Swedish start-up Volta Trucks chose Magtec to design and manufacture the electric drive system for its prototype truck, which will be unveiled later this year.

Volta is developing fully electric trucks for commercial use in and around urban areas. Beyond reducing environmental impacts, the removal of bulky diesel engines has allowed Volta Trucks to radically redesign its vehicles, ensuring increased safety for cyclists and pedestrians.

In partnership with leasing company Angel Trains, Magtec is on track to deliver the rail industry's first conversion of a diesel multiple unit to hybrid drive. The new unit promises improved fuel efficiency and performance with lower emissions.

Other pioneering projects include the UK's first electric 7.5 tonne commercial vehicles for the urban daily deliveries market and the electric drivetrain for the world's first autonomous 26-tonne truck.

Jobs

Demand for the company's technology is creating new jobs. Magtec currently employs nearly 100 people - including a larger than average proportion of women for the engineering sector - and is recruiting for another 20.

Sheffield and Westminster electric bin lorries are powered by Magtec technology

Mandy Delaney is head of manufacturing at Magtec, which has a higher-than-average proportion of women in its workforce

Andrew Gilligan, UK managing director, said: "We have many opportunities for ambitious and energetic people who want to grow with our business.

"As climate change rises up the social and political agenda, Magtec has the potential to be a world leader in electric vehicle drive systems.

"This is a high-tech growth company with an ambitious vision of the future which puts UK innovation at the centre of the global market for commercial electric vehicles."

SETTING EXCEPTIONAL STANDARDS

SES provided M&E design and installation services for E.ON

Jason Knights, Managing Director, SES Engineering Services

Jason Knights is Managing Director of SES Engineering Services, one of the leading M&E partners in the UK, delivering for a wide range of customers including Mace, McAlpine, E.ON and GSK.

The sector SES finds itself in is seen by some as slow moving with limited immediate impact, due to the fact it can sometimes take years for some projects to come to fruition. In Knight's experience, however, this is the exception rather than the rule, and delivering complex projects that meet the needs and demands of each stakeholder, to the highest standard, is what he prides himself on...

SES has been very successful over the years in demonstrating their knowledge, experience and understanding of the co-ordination of mechanical, electrical and plumbing (MEP) services to multiple and diverse sectors across the UK.

As they begin a new decade, they're looking to future trends and believe the wider energy sector will experience significant transformation as we all become more environmentally conscious. Aided by BIM and its associated processes to create cost and efficiency savings, programme certainty and greater collaboration, they've established a strong footing for future projects.

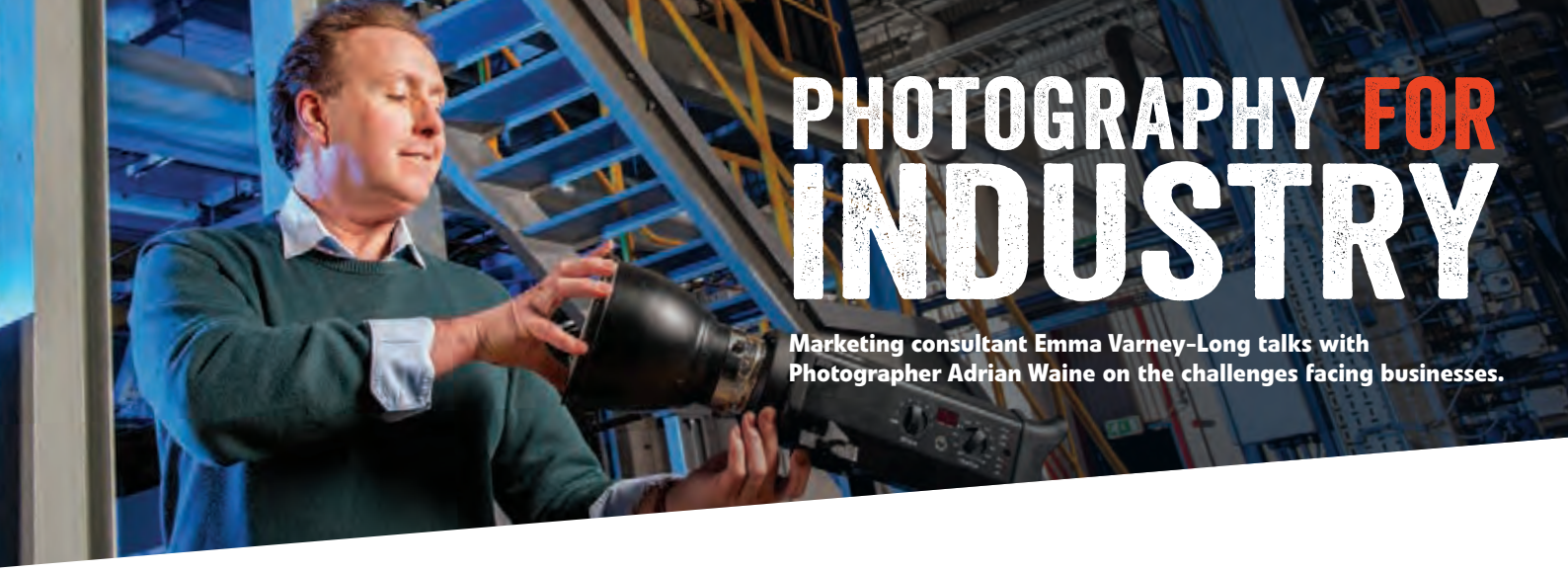
Changing energy

Through these processes SES has seen the successful delivery of Drax Power Station's Biomass Conversion, supporting the UK's largest-ever coal-to-sustainable-biomass conversion with a MEP value of £65m. They've also delivered for the Greater Manchester Waste Authority, covering twenty separate sites across the Manchester area, dealing with 1.1 million tonnes of waste produced per annum, with a MEP value of £20m.

With this accrued knowledge of the sector, SES has been successful in securing several more projects within the energy industry, including Margam Green Energy Plant, near Port Talbot, South Wales. Completed in 2018, the 40MW biomass power plant is capable of processing 250,000 tonnes of waste wood per annum - including contaminated wood - with no pre-treatment. It can also process solid municipal waste converting this into a fuel source in the future.

Above: **The Margam Green Energy Plant can process 250,000 tonnes of waste wood each year.**

SES has several key projects in the pipeline for the near future, including many in the quickly-evolving energy sector. As old coal-fired generators close we will see more conversions to biomass or greener, more sustainable energy plants. These projects come in the form of energy-from-waste, combined heat and power, and flexible generation facilities. It's an exciting time for the M&E sector and SES Engineering Services, and a challenge that they are incredibly fired up to deliver.



PHOTOGRAPHY FOR INDUSTRY

Marketing consultant Emma Varney-Long talks with Photographer Adrian Waine on the challenges facing businesses.

Promoting your company might seem a daunting prospect, so begin by asking simple questions.

What image do we want to create?
How do we make an impact within our industry?
How do we appeal to customers that may have used similar products and attract them to our quality product range?
What do we do to find that target audience?

The fact is there is not one button you press, it's a periodical task that develops over time, and one not to be rushed.

Adrian explained to me, "Manufacturers have to be able to demonstrate the rigorousness of their applications in ensuring quality at each stage of the production process, with a dynamic, visual record, this can the be utilised to market their services as well as their products."

Adrian has worked with me on many projects, and his work captures the quality and diversity of my clients within manufacturing. His photographs, advice and guidance have lead to exceptional quality editorials and digital publishing being produced.

Adrian simply makes manufacturing look its best. If you are looking to create opportunity, you need to find a photographer that invests time prior to your images being shot.

Adrian advises me there are **3 KEY POINTS**:

PATIENCE Photography takes time, you may be one of those lucky people that got a quick snap on your smart phone and it has generated much interest and income, this is RARE. Setting up shots, the painstaking detail of lighting, editing raw images, resizing, and then sending to the client all takes time, something that needs to be considered. There is nothing worse than your business or product ending up on social media as an example of a "they should have thought it through" photograph.

SPACE To light, create and capture a vast piece of newly purchased kit, you need equipment, power packs, cables, lighting rigs, tripods, all take up space so be prepared for this.

TIMING There is no point planning marketing and imagery if you are on a restricted timescale, in the middle of production, developing a project and you do not have the product to shoot, being too proactive can cause further expenditure. Poor images could be the result plus a bad experience for all involved. You must dedicate at least 2 full days, depending upon the scale of the shoot and have flexibility around your workplace and are willing to stand around a great deal whilst finger prints are removed, lighting is being set correctly, it all takes time, good timing, and the willingness to do what's necessary (frequently floor sweeping and cleaning!). There will be some disruption but it equates to an investment in your people and your future.

Adrian concludes: "Good industrial photography can evoke so much more than a simple visual documentation of objects and settings. There is undoubtedly a powerful visual impact that modern manufacturing can have, whether this is about the intricacy of electronic interfaces, the monolithic vastness of automated production lines, or the skills of the individuals involved."

THE KEY TO ALL OF THIS

Know what you want, communicate this appropriately, be willing to pitch in (if you don't – how do you expect to get what you are looking for?), and be nice to people, if you care about those you are working with, they will want to do their best, meet timescales, understand budget restrictions and support you in your project.

The sample photographs from Adrian reflect this, setting up shots, gaining a thrilling atmosphere, working with product and client to achieve the best.

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WINNER 2017 AND 2018 EEF MANUFACTURING PHOTOGRAPHY COMPETITION

Commissioned by VSMM on behalf of Coral Products PLC and db automation Ltd.

AUTODESK: FUTURE OF BRITISH MANUFACTURING INITIATIVE

Asif Moghal, Senior Industry Manager, Design & Manufacturing with Autodesk, a leader in 3D design, engineering and entertainment software, introduces the Future of British Manufacturing Initiative and the companies that have been highlighted in this special section.

Automation has been at the heart of the success of UK manufacturing from the earliest days of the First Industrial Revolution.

As Industry 4.0, the Fourth Industrial Revolution, gathers pace, the importance of digitisation to the UK's manufacturing industry cannot be overstated. It delivers increased efficiency, greater agility and the ability to win and retain profitable business in premium sectors, such as aerospace and automotive.

Digitisation is not just for large, multinational companies – indeed, it is SMEs that have the most to gain from it. Autodesk is committed to helping our clients and customers to grow and compete in the new, digitised world. As a company, we are proud to be sponsors of the Future of British Manufacturing Initiative (FoBMI).

The companies featured in the following pages give an insight into the way digitisation can be transformational, across a range of industries.

BAC (Briggs Automotive Company) uses a suite of software to develop one of the world's fastest, leading edge cars. Its latest model is the first production vehicle to use graphene in its construction.

Hosokawa Micron was helped by Oliver Hopkinson as its Digital Catalyst to resolve problems it was having in implementing AR and enabled design and development time to be cut by weeks.

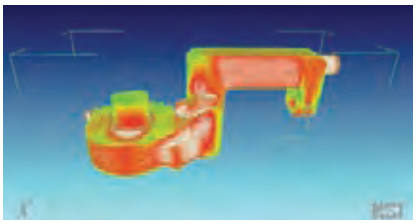
Kingspan's IKON research hub uses advanced digital twin systems to demonstrate how real-time data from sensors enable building users to interrogate occupancy, CO_2 levels, sound performance and structural values.

Lintott Control Systems has used commercially available software and in-house solutions to develop i-CatalystR digital delivery suite, which cuts development time from weeks to a matter of hours.

Mabey Bridge has automated part of the design process to create rules-driven, interactive 3D models more easily, and boost efficiencies across the business.

Stage One designs, build and virtually tests complex sets for Olympic ceremonies and TV spectaculars before delivering 3D printed, laser cut constructions.

Thermotex based its digital strategy on PLM, which enabled the capture of the company's accumulated knowledge and provides accurate tracking and tracing through production.



Ultra Electronics has adopted additive manufacturing technologies to reduced lead time and cost, and greatly reduce wastage of expensive material.

Warren Services was helped by a digital catalyst to implement Lifecycle Management and save hours of unproductive time translating an array of CAD applications into a single, accessible resource.

BRIGGS AUTOMOTIVE COMPANY

Briggs Automotive Company (BAC) is the first manufacturer in the world to use graphene in the construction of a road car, in its latest model, the BAC Mono R.

"The Mono builds on the experiences of earlier models. BAC uses Autodesk CFD (computational fluid dynamics) software to develop elements of the car, along with PLM 360 and Fusion Lifecycle to incorporate lessons learned and insights gained along the way."

Unveiled at the 2019 Goodwood Festival of Speed, the Mono R takes BAC's uncompromising approach to car design a step further than its predecessors. It is a single seater, with no room for anything other than the driver and the engine, has a power to weight ratio of 612bhp/tonne and is as close as you can get to a Formula One car on the road. The limited production run of 30 vehicles was sold out before production even started.

Most car manufacturers' focus is on volume – the space to carry the driver, passenger (or passengers), and cargo, whether it be just the weekend's shopping or golf bags, ski equipment and enough luggage for a family holiday.

BAC's focus is on surfaces and performance, to the exclusion of all else. Its body is aerodynamically styled to optimise low-drag downforce and its chassis, from tubular steel frame to the finished graphene-reinforced carbon fibre tub, plus suspension and drivetrain, is focuses on maximising mechanical grip. It is super-light and gets its outstanding performance from a fairly modest, four cylinder 2.5ltr engine because its weight is so low, at just 555kg.

"A bigger engine needs a bigger gearbox, bigger brakes and a bigger chassis. It becomes a weight spiral," says Stuart Newman. "In order to get to 540kg, you have to think in those ways."

Unique but connected

Despite being a limited run, the Mono has a direct connection with its predecessors. it builds on the experiences of earlier models and incorporates the lessons learned and insights gained along the way. BAC uses Autodesk CFD (computational fluid dynamics) software to develop elements of the car, along with PLM 360, Fusion Lifecycle and Moldflow in its suite of design applications.

Each Mono R is unique. Sometimes in obvious ways, such as paint finish, but

Above and Below: The Mono R continues BAC's tradition of radical innovation in automotive design. It is the first car in the world to incorporate graphene into its carbon fibre chassis; a solution that contributed to nearly 10% weight saving

also in less visible ways, such as gear ratios optimised for Silverstone race track, or the positioning of seat and pedals to suit the owner's build and preferences.

BAC says that personalisation is now a viable option in auto manufacturing, although it is more complicated than, for example, customised footwear, which has to cope with only five or six design elements being subject to change. Company founder and Director of Product Development, Neill Briggs, observed that personalisation for cars will involve interior trim, exterior parts, power upgrades, brake upgrades and more; paint is the simplest thing.

BAC's designers and engineers already use agile technologies to improve the Mono design with every car; "Batches of One" are a reality and continuous improvement is expected.

World's first

"The BAC Mono R is the first car in the world to use graphene in our carbon fibre construction in every single panel," said Stuart Newman, Press & Communications Office for BAC. "The Mono R is at the forefront of a lot of things and the graphene is actually a lot better than anything we have ever used."

Making a car is not a solitary activity. The North-West of England has an established automotive supply chain but it is also home to a number of organisations engaged in innovative activities. Graphene itself was invented at Manchester University, which remains a hub for advanced development. Bolton University has built an Unmanned Aerial Vehicle (UAV) that has a stressed skin made of graphene. Autodesk Fusion Lifecycle is located in the Cloud, so authorised personnel have access to it from anywhere, at any time. The data, experience and information that it holds has been invaluable in bringing the Mono R to reality. BAC is happy to acknowledge that its achievements are based on co-operation.

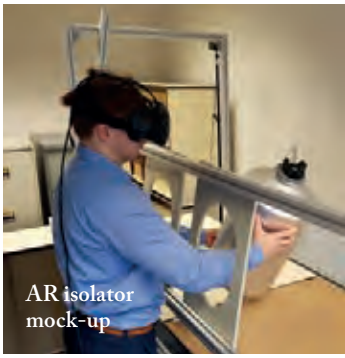
"It has taken endless hours of research and testing and the guys in the supply chain have been quite genius," said Newman. "We first achieved proof of concept in 2016 and demonstrated that using graphene was manageable and doable, and it's now improving every day." What the future will hold, in terms of tooling and usage of advanced materials and shared concepts, will unfold in time. If the BAC Mono R is an example, it will arrive at high speed and perfectly balanced.

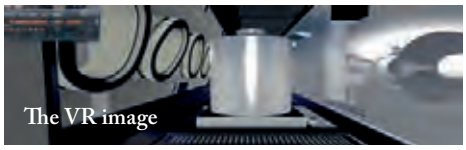
AUTODESK

FUTURE OF BRITISH MANUFACTURING

HOSOKAWA MICRON

Hosokawa Micron uses augmented reality to cut development time and accelerate product delivery


AR isolator mock-up

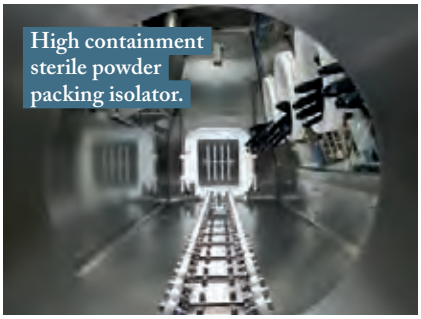

The VR image


Wooden mock-up

Hosokawa Micron developed the process industry's first digital twin plant, combining VR, AR, AI and big data to create a tool that bridges the gap between the physical and digital.

Hosokawa Micron Ltd, based in Runcorn, Cheshire, specialises in high containment and particle size reduction technologies, supporting clients across pharmaceuticals, fine chemicals, food, minerals and nuclear. It designs, manufactures and delivers machinery and systems, provides contract manufacturing services, and supports powder testing and R&D in its new Innovation Centre.

Hosokawa Micron developed the process industry's first digital twin plant, combining VR, AR, AI and big data to create a tool that bridges the gap between the physical and digital.


High containment sterile powder packing isolator.

High containment solutions

Hosokawa has developed a range of high containment enclosures - isolators and gloveboxes – largely used in the pharmaceutical sector, that enable 'shirt sleeve' operation without the need for Personal Protective Equipment (PPE).

Each product is bespoke. Customers usually travel to Runcorn for ergonomic testing and product approval. Inevitable modifications previously required scrapping of the wooden mock-up models, construction of new ones and further journeys back and forth.

Cutting development time

The company sought a solution that would cut development time, was light and easy to modify. It believed that a combined AR/VR (augmented reality/virtual reality) solution had a lot to offer but it struggled to get its AR properly coupled with its Autodesk CAD software. They were put in touch with Oliver Hopkinson, who was studying for an MA in Mechanical Engineering at Bath University, who provided support as a sponsored Digital Catalyst.

"Oliver had no great familiarity with what we did but he could understand the problem," said James Moore, Commercial Operations Director. "He was scheduled to work on our project for a couple of weeks. When we called him after three days, we hoped for some incremental progress. In fact, he'd cracked that first iteration; he really exceeded our expectations. We quickly had him smoothing the model, working on clash detection and refining it."

Building bridges, embracing freedoms and cutting costs

Solving the problems was a liberation.

"We applied the solution to a particularly complex multi-chamber pharmaceutical isolator," said Iain Crosley, Managing Director. "We were able to bring the customer in, use the hybrid digital-physical model to eliminate clashes and ensure it was ergonomically sound. If modifications were needed, we simply adjusted the CAD design and ran the simulation again. We were able to take at least two weeks off the project timeline."

For Hosokawa Micron, AR has shortened lead times dramatically and cut the costs of model making and reiteration. It bridges the skills gap between the experience of the generation approaching retirement and the digital-savviness of young recruits.

AUTODESK.

FUTURE OF BRITISH MANUFACTURING

KINGSPAN

"Our most urgent priority is to find ways to dramatically reduce carbon emissions in buildings all the way through the lifecycle"

Mike Stenson, Global Head of Innovation, Kingspan

Kingspan is using digital technology to become the most sustainable and customer-driven construction materials company in the world.

In Toronto last year, Hass Jishi of Kingspan told the Rotman Design Challenge audience that construction is the only business sector where productivity has fallen in the last 30 years. This startling fact came from a World Economic Forum report in 2017 highlighting that construction is falling behind other industries in several metrics, especially in the use of digital technology. The comment complemented Kingspan's sponsorship of one of the world's largest international design competitions; challenging the audience of 500 MBA students from across four continents to find ways in which Kingspan can inspire the construction industry to embrace digital to become smarter, more efficient and greener.

Kingspan has ambitions to become the most sustainable building materials company in the world, while delivering more performance and value to customers, and digital transformation is a key part of the strategy to achieve this. Three years ago, Kingspan's Global Digital Team was formed to explore this and help turn the company into the most innovative in its sector. "The benefit of digital is to understand the ecosystem you are involved in and supporting," says Hass Jishi, Experience Transformation Strategist at Kingspan. "As a product manufacturer we are best placed to understand our products and how they can be optimised at all stages of the building lifecycle. This knowledge should be shared. Digital is best placed to do this, and it will reveal how the industry can be both more productive and more sustainable."

The Global Digital Team is working with employees, customers and partners like Autodesk on existing and new digital technologies to affect this change. "The future of construction is all about data," according to Hass. "As a manufacturer, we are working on a wide range of collaborative research projects to understand how we should be supporting our products with rich data so that Kingspan buildings are more efficient to design and construct, more comfortable and productive to occupy, and ultimately become net zero carbon across their whole lifecycle including demolition and re-use."

Further benefits of these digital processes are people and product development. "The construction industry has a mix of skills and competencies from the office to the building site, and between sites, and errors creep in," says Hass. "Deeper, real-time digital information can mitigate this, giving all people involved the same information, reducing the problem where a small number of key individuals have all the knowledge. Digital also helps with CPD, it can accelerate training and certification," he adds.

Product and service development are also boosted because digitalisation shows how customers are accessing Kingspan products and how they are putting them to use. The R&D teams then have data to modify or increase a product line or SKU, while the Global Digital Team gains vital insights on service improvements to make it easier for customers and specifiers to do business with Kingspan.

IKON is an icon for a sustainable building industry

In November 2019, Kingspan opened the doors of IKON, its global innovation hub at Kingscourt in Ireland. "All divisions [of Kingspan] were brought together to bring their products and specifications into one system at IKON," says Hass. Collaborating with Autodesk, the new research building is using one of the most advanced digital twin systems in any industry, worldwide. Real-time data is fed from sensors in the building, and as-built modelling shows all the products and characteristics in the entire building as a skeletal frame. From here a user can interrogate occupancy, CO_2 levels, sound performance, structural values and much more. "The research projects at IKON will show for each building decision, where are the benefits, what data we can pull, and how we would manage things like data sovereignty, for example," says Hass.

Mike Stenson, Global Head of Innovation, Kingspan Group, says of IKON's focus, "Our most urgent priority is to find ways to dramatically reduce carbon emissions in buildings all the way through the lifecycle. Digitalisation is a key part of this strategy."

MORE ON IKON AND THE ROTMAN DESIGN CHALLENGE CAN BE FOUND BELOW:

https://www.kingspan.com/group/news/kingspan-news/introducing-ikon

https://www.kingspan.com/group/news/kingspan-news/students-to-develop-disruptive-solutions-to-the-co

AUTODESK.

FUTURE OF BRITISH MANUFACTURING

LINTOTT CONTROL SYSTEMS

Lintott's main marketplace is the water sector.

Lintott Control Systems rewrote its strategy, transformed company culture and authored its own production delivery software to create a more competitive business and differentiate itself from the pack. Creating an end-to-end digital ecosystem makes Lintott a clear Future of British Manufacturing Champion.

Jamie Thums, Chief Operating Officer

Lintott Control Systems is a process solutions provider of water and wastewater treatment systems, electrical control panels and software systems integration. In 2012, the company embarked on a continuous reinvention strategy. Central to this was moving up the value chain, moving closer to achieve its vision of being the client's partner of choice.

"We identified a number of enabling factors," said Jamie Thums, Chief Operating Officer. "First was people; we established the key components to develop an engaged culture where creativity could flourish. The second was digitisation; integrating products, processes, people and places."

Lintott applies its integrated technology to the production process units such as this UV treatment plant.

Preparing the ground

Reinventing business culture takes years. The initial priority was the implementation of 'hygiene' and lean principles, which enabled the next stage, digitisation, to have a greater, value-added impact. Staff involvement has been essential; people were actively encouraged to take a lead in their respective areas.

> "Where the conventional process takes weeks, Lin-finity Builder takes just a few hours. It simultaneously produces the design, a basket of goods including the technical manual, and everything required for teamworking."

"Although the business had numerous ICT-based applications, including computerised design and ERP, they were not sufficiently connected. The need to become fully integrated led us to develop the i-Catalyst® digital delivery suite, a collection of proprietary systems and game-changing internally developed software applications. This drew on Lintott's software writing skills and capabilities as a systems integrator."

A dual role

Lintott's largest market is the process-critical water sector. It recognised one of the biggest challenges was the time taken within the design process. Commencing with control systems, the company developed the Lin-finity Builder application – leading to dramatic benefits.

"Where the conventional process takes weeks, Lin-finity Builder takes just a few hours," Thums said. "It simultaneously produces the design, a basket of goods including the technical manual, and everything required for teamworking". Lin-build, a project delivery application, was designed concurrently. Other applications extend, but are not limited, to CRM, HRM, and operational management.

"What we have today is a continually evolving interconnected digital ecosystem that uses, for example, Autodesk products, such as Inventor, as well as Sage 200," he explained. "Transparency is key. It's built on a single source of data accessible to both internal colleagues and clients. Our ability to connect products, processes, people and places provides clients with integrated solutions, delivered in shorter timeframes and reduced whole life costs.

"In October 2019, we became part of nmcn Plc. This will enable us to accelerate our developments; watch this space!"

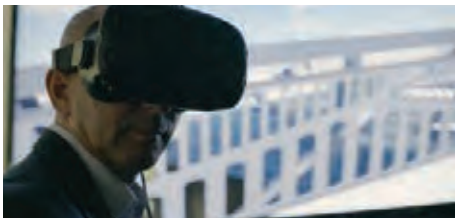
AUTODESK.

FUTURE OF BRITISH MANUFACTURING

BRIDGING THE GAP

Mabey Bridge created a more engaging experience for its customers and improved collaboration and the efficiency of its internal processes by developing a suite of digital tools.

The company specialises in rapid-build, prefabricated modular steel bridging solutions for permanent, temporary and emergency use.



A key feature of Configurator 360 is the built-in online Request for Quotation feature, which now sits on Mabey Bridge's website.

Mabey Bridge engineers have been able to automate part of the design process thanks to Inventor's iLogic tool.

Mabey Bridge is a leading international provider of high-quality modular bridging solutions. Based in Gloucestershire, United Kingdom, the company specialises in rapid-build, prefabricated modular steel bridging solutions to enable accelerated bridge construction in urban and rural areas.

An Acrow Group Company, Mabey Bridge supplies bridging solutions to customers in over 150 countries worldwide in a wide range of sectors, including infrastructure, transport, construction, and extraction. It is renowned for the premium quality of its products, its rich heritage of design, manufacturing and engineering, as well as its use of innovative tools and technologies.

Taking on internal and external challenges

Mabey Bridge had already worked with a number of Autodesk tools over the years, including AutoCAD, Inventor and 3ds Max. Continuing on its digital journey, the company wanted to advance business growth and accelerate innovation by addressing two specific challenges. Firstly, it wanted to improve the customer experience and make information more readily accessible online. It also wanted to enhance information-sharing internally across the business to increase efficiency and productivity in order to deliver customer quotes faster and speed up customer response times.

Improving design processes and customer-centricity

The company decided to adopt the BIM 360 collaboration features within the Autodesk portfolio to boost efficiencies across the business and help Mabey Bridge's project teams work more effectively. Using Inventor's iLogic tool, they are now able to automate part of the design process and create rules-driven, interactive 3D models more easily. Teams can now generate more accurate and detailed 3D models, freeing up design time and resources. Furthermore, the integration of Autodesk's Configurator 360 product into the business has helped reduce the time it takes to generate a quote from days to just minutes, and the built-in online version now sits on Mabey Bridge's website, giving customers the ability to produce customised designs themselves.

A continued path of digital transformation

Mabey Bridge can now respond to customers five times faster than before and has been able to increase the volume of business enquiries generated by a third, using the same resources.

Thanks to the integration of the new Autodesk tools, the team can now re-focus their time on more complex project proposals, as well as looking at the next big product innovations and ways to enhance the customer experience further.

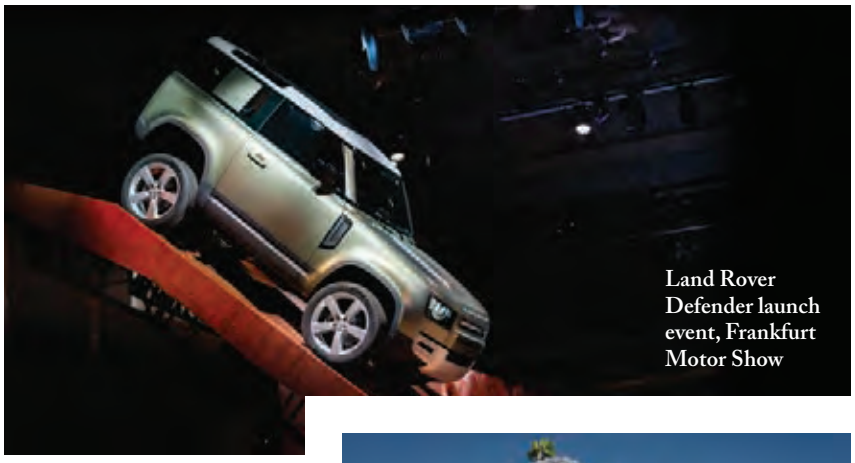
Chris Drew, Head of BIM and Digital Innovation, said, "We knew that technology was a key enabler. We engaged with Autodesk to find solutions that would easily fit into our existing workflows and help overcome the challenges we were facing, ultimately allowing us to accelerate innovation to become even more efficient and customer-focused. We are now working towards a more overarching digital strategy as the next step on our digital journey."

AUTODESK.

FUTURE OF BRITISH MANUFACTURING

STAGE ONE: SETTING THE SCENE

The spectacular automation, scenery and sets for Olympic ceremonies, high-profile brand events or for television shows such as ITV's The Voice and BBC's Sports Personality of the Year all have something in common: Stage One; a specialist manufacturer, interpreter of ideas, innovative design development and producer of pavilions, stage sets, ceremonies and anything that needs a distinct or spectacular setting.



Land Rover Defender launch event, Frankfurt Motor Show

Right: BBC Studios Pavilion - each of the 9250 aluminium discs was precisely engineered to avoid solar glare.

Right, below: The set used by American broadcasting company NBC for its NBCSN English Premier League coverage

Making "props" – scenery, models, studio sets, outside stages and platforms – is a profession that is as old as theatre. Stage One is taking the process a step forward.

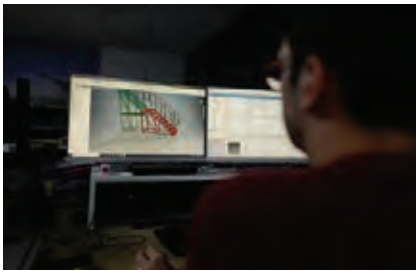
The company is headquartered in a 14,000sqm facility in Tockwith, near York. It has space and security to develop designs, build and secretly test complex sets, like the tilting wall that showed off the new Land-Rover Defender's capabilities at its launch event at Frankfurt Motor Show.

Stage One also built the spectacular, two-storey pavilion for the BBC Studios Pavilion at MIPCOM, Cannes, with its façade of 9250 precisely engineered and positioned aluminium discs, which limited glare from the Sun while allowing far-reaching views at eye level. After 18 months development, it was built on site in just six days.

Turning ideas into reality

"Projects rarely come to us in a production ready state" said Managing Director, Tim Leigh. "Every project we work on is unique and nearly all have to go through Design Development to work out the best methods for manufacture and installation." Stage One uses Autodesk's CAD software to make sure that every project they deliver meets or exceeds their client's vision.

"With such a large capacity and with workshops across our site, we use the software to communicate to each department, the designer specifying different components, structures, materials and the particulars as to how each element should be made and built," he explained.



"Designs are tested virtually, within the computer, to ensure that everything fits, the right materials have been used and that loads won't bring the whole thing crashing down."

Designs are tested virtually, within the computer, to ensure that everything fits, the right materials have been used and that loads won't bring the whole thing crashing down. Approved designs are printed off and delivered to the appropriate workshop.

In addition to wood and metal work, construction itself can involve 3D printing/Additive Manufacturing, laser cutting and large volume 5-Axis CNC machining. Schedules can often be tight. The set used by American broadcasting company NBC for its NBCSN English Premier League coverage was designed, tested, built and installed in just two weeks from order.

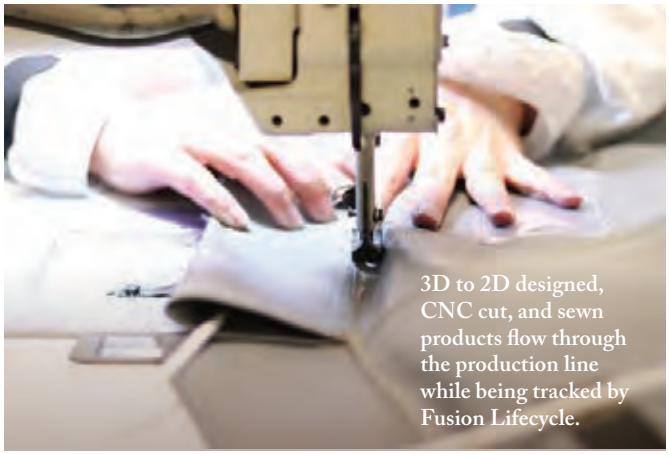
"It's not a production line; everything is bespoke," Tim adds. "We work on and install projects across the globe. Detail is incredibly important so reliable software that ensures accuracy is essential."

AUTODESK.

DIGITISING A FAMILY BUSINESS

FUTURE OF BRITISH MANUFACTURING

Thermotex Engineering Limited, a family-owned and managed business, used Autodesk Fusion Lifecycle PLM to upgrade and modernise.



3D to 2D designed, CNC cut, and sewn products flow through the production line while being tracked by Fusion Lifecycle.

Below: Rigid and flexible insulation products installed on a processing skid, ready for shipping offshore to the North Sea.

Chesterfield-based Thermotex Engineering Ltd supplies specialist insulation and protective solutions to customers in energy, process and construction industries. Now 25 years old and with 20 employees, it was founded by the parents of current MD Chloe Watmore, who was tasked with making the company 'future fit'.

Thermotex' ingrained customs and practices needed to be updated. The process of change was not easy but Chloe put in the time and effort to build relationships, addressing concerns that automation and digitisation would threaten jobs, learning from the team and understanding what caused headaches and bottlenecks.

The existing manual, paper-based systems were susceptible to human error. Thermotex had avoided disaster and done rather well but, while the legacy structure was not suitable for purpose, plenty of accumulated expertise from its 25 years of existence was priceless.

"I wanted to capture the knowledge and experience of my parents, the company founders, and that of the team, and make sure it would be available for years to come," Chloe said. Fusion Lifecycle PLM (product lifecycle management) was the solution.

"We worked with d2m3, an Autodesk partner and PLM solutions provider and integrator, who helped us develop an iPad app," she continued. "We now have an easy to use, simple user interface, and a system that provides accurate tracking and tracing through production."

Thermotex manufactures to order, rather than batches, and introduced unique serial coding with QR codes on all products.

"We work with some very big companies and ISO accreditation is very important. It gives us credibility," Chloe explained. "Fusion Lifecycle enabled us to become ISO 9001:2015; we added 45001 health and safety, and then 14001 environmental."

Embedding ISO-accredited processes through Fusion Lifecycle has had another benefit.

"Because of the system's stage-gated design, we naturally have more security. People understand the process flow, without having to write Standard Operating Procedures. They are ingrained." Larger companies have been particularly impressed with what Thermotex has achieved on tracking and management systems.

"An easy to use user interface provides accurate tracking and tracing through production. Thermotex recently won its largest-ever contract, directly as a result of its digitisation strategy."

Above: A family business. R to L: Beverley and Peter Watmore, company founders; daughter Chloe, MD, and son-in-law Joe, Sales Executive.

"We recently won our largest-ever contract, directly as a result of our digitisation strategy," Chloe Watmore said. "It's unlocked something else, too: hunger to grow the business, which we can now do, from a stable foundation."

Thermotex is forging the next step in its digital journey, offering modelling, FEA and CFD to solve complex thermal engineering problems in Fortivus, its new division.

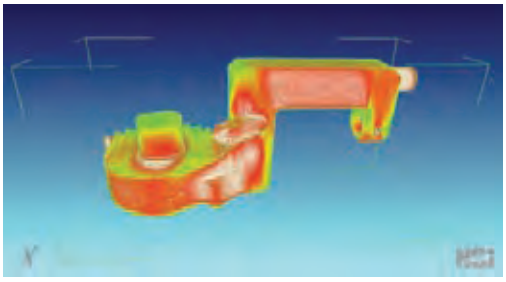
AUTODESK.

ULTRA ELECTRONICS

FUTURE OF BRITISH MANUFACTURING

Above: Cutaway of launch tube array, showing internal arrangement

CT scan of a high reliability AM produced Sonobuoy Management Pod Release Lever



Additive Manufacturing and digitised design cut cycle time and guarantee quality

Specialist applications engineering company Ultra Electronics operates primarily in defence and other highly-regulated markets, as a systems provider at tiers 2, 3 and 4. It is focused on providing mission-specific, bespoke solutions and capability. Its core markets are North America, the UK and Australia.

A substantial proportion of its work is with naval operations, in both surface and aerial roles.

New approaches, integrated teams

Ultra is taking new approaches to traditional designs and bringing advanced commercial technology and design techniques into the military domain. It has fully integrated development teams, incorporating the different engineering functions and design for manufacture (DFM) engineers, working together collectively to develop novel solutions. This approach enables products to be made with fewer defects, because the designs are aligned with the manufacturing process more than ever before.

"We plan to use all of these techniques in production runs, because of the time and cost savings."

"Ultra Electronics' adoption of digitised design, inspection and manufacturing technologies, including Inventor CAD, CT scanning of pre-production assemblies and Additive Manufacturing processes have enabled it to accelerate development, cut production time and dramatically reduce material usage, while improving quality and reliability of mission-critical naval and military solutions."

The deployment of tracking and detection solutions can sometimes be an urgent priority, for which aircraft-based systems can provide faster detections than surface ships. Ultra has designed and demonstrated a system for the air-launching of Sonobuoys comprised of a multi-barrel array with wireless programming and automated opening and closing of individual tubes.

Additive manufacturing and digitised design

The lower section of the tubes is made of direct metal laser sintered (DMLS) Additive Manufactured (AM) aluminium with high stress areas constructed from DMLS AM Inconel superalloy. The aluminium housing would have been expensive, difficult and time-consuming to mill from a billet. Selective laser sintering (SLS) AM is used to produce the lower stress upper nylon section of the tubes. This process was selected to reduce lead time, cost and greatly reduce wastage.

Ultra designed the sonobuoy launch system with Autodesk Inventor. North Star Imaging was contracted to provide CT scanning of the entire assembly, to identify any material defects ahead of final manufacture.

"Using these processes enabled us to produce a high quality demonstrator of the product in a very short space of time," said Nicholas Charles, Engineering Director, Ultra Electronics, Command and Sonar Systems. "We have used the demonstrators in aircraft trials and plan to use all of these techniques in production runs, because of the time and cost savings."

AUTODESK.

FUTURE OF BRITISH MANUFACTURING

AUTOMATING THE NON-PRODUCTIVE

Warren Services saved hours of unproductive time and made more effective use of its employees valuable skills with the implementation of a PLM program that talks across vendor language barriers.

Warren Services provides a range of engineering services to clients in aerospace, auto, energy and other industries.

Warren Services, which was founded in 1990, manufactures components and mechanical or electrical sub-assemblies and offers turnkey solutions in engineering and design. It operates from 80,000 sq ft (7400m2) of production and support space, across two sites in Thetford, Norfolk. In-house capabilities include CNC machining, welding, fabrication and finishing, water jet, laser and folding and services including new product development, value engineering and product documentation. The company has dedicated three of its 100-strong workforce full-time to digital transformation.

"James Tetlow, who originally arrived as an Autodesk digital catalyst, has been with us for a year, now, working on a project we're rolling out now, slashing the amount of time it takes to get clients' process information into our system and onto the shop," explained Will Bridgman, Chairman of Warren Services. The company has implemented Autodesk Fusion Lifecycle; a product lifecycle management (PLM) tool that Warren regards as more than that.

Being able to drag-and-drop any type of CAD information, whatever the source, was a gamechanger for Warren Services.

Every work bay on the shop floor will be equipped with 4K 40-inch screens early in 2020.

> "It saves about half a day per project, at least. It automates time-consuming, repetitive tasks and frees up people to use their skills."

Making the connections

"We can connect everything together," he said. "As it's subscription based, we can have the best at all times. We can upgrade, swap and change, without massive capital investment. It's browser-based and can operate on low-cost hardware, anywhere in the world."

The gamechanger was the ability to view models and drawings from different systems.

"We simply drag and drop any type of CAD information from Autodesk to Catia and SolidWorks, and it allows everyone to be able to access those drawings, in any CAD format, from a browser environment," Will explained. By early in 2020, every welding bay, CNC machine and assembly bay will be equipped its own 4K big screen.

Access all areas to add value

"Whatever they're building, everyone has access to the very latest data in its original format. We're saving a fortune on converting, printing and making job packs," he said. The amount of time it saves made the decision was inevitable.

"It saves about half a day per project, at least," said Will. "Our next move is to share it with our supply chain as well. It automates time-consuming, repetitive tasks and frees up people to use their skills and add engineering value."

LONDON ELECTRIC VEHICLE COMPANY

LECV – AT A GLANCE

2,500 vehicles: sales in 2018/19, doubling the previous year

£500m – investment from parent, Chinese automotive firm Geely

Exported to France, Germany, Norway, the Netherlands, Sweden, Hong Kong and Malaysia

New electric van and Shuttle models will launch in 2020. Van expected to reach 60% exports, up from 10% exports for the current TX Taxi

Opened in 2017, Ansty is the UK's first dedicated electric vehicle manufacturing facility

It's been a year of milestones for the London Electric Vehicle Company's modern production facility. Located just outside of Coventry, the Ansty plant is home to the all-new electric London black cab, the LEVC TX, a vehicle that's a real international success story doubling sales-year-on-year with more than 2,500 units finding buyers in 2019, up from 1,229 the year before.

London remains TX's biggest market, but the world's most advanced cab is on the streets in over 20 cities across the UK, and has been sold in France, Germany, Norway, the Netherlands, Sweden as well as Hong Kong and Malaysia.

This rapid growth has been driven by investment from parent company GEELY – now totalling more than £500m – which has allowed LEVC to build a new facility and develop not just the TX but a range of electric commercial vehicles.

Opened in 2017, Ansty is the UK's first dedicated electric vehicle manufacturing facility and the first all-new vehicle manufacturing facility to be built in Britain for more than a decade. It has created more than 500 skilled manufacturing jobs, the plant handling everything from producing the TX's bonded aluminium structure to final assembly.

Operations step up a gear in 2020. LEVC's goal is to become the leading European green commercial mobility solutions provider and to achieve this, its product line-up will grow with two new vehicles based on the TX Taxi: a Shuttle variant, catering for emerging ride-sharing services in Europe, and an all-new electric van.

The latter will become LEVC's core model, accounting for around 70% of total volume and within three years, LEVC plans to move from 90% domestic sales and 10 per cent export to 60% export volume, taking the Ansty to its production capacity of 20,000 units.

CARRINGTON TEXTILES

A glance into Carrington Textiles' main manufacturing site and some of its sustainable practices

"AS WE CONTINUE TO MINIMISE OUR ENVIRONMENTAL FOOTPRINT, ONE OF THE MOST IMPACTFUL CHANGES WE'VE MADE IS TO REDUCE THE AMOUNT OF PACKAGING WE USE"

At Pincroft Dyeing & Printing, our factory in Adlington, we can trace textile production all the way back to the 1760s and the birth of the first industrial revolution. Fast forward to 2020 and we're facing another period of transformation as the textiles industry looks to reduce its environmental impact in favour of more sustainable practices.

There are several ways we're committing to this at Carrington Textiles – from manufacturing fabrics using techniques designed to lessen the impact on the environment to maximising the sustainability of our supply chain activities.

Packaging

As we continue to minimise our environmental footprint, one of the most impactful changes we've made is to reduce the amount of packaging we use – both on site and when distributing products to the customer. Embracing an environmental packaging initiative means that textile materials are now wrapped in 100% recyclable polythene.

Cardboard delivered to the site with goods is also reused for protecting textile products destined for the customer, thus reducing the amount of cardboard needed.

Additionally, slats made out of pulp from waste paper based products are used for stabilising textile rolls on pallets, replacing wooden slats and ensuring that customer packaging is 100% recyclable.

Transport

In terms of logistics, our Supply Chain team works hard to reduce the company's impact on the environment by making use of 'intermodal transport', which find the most effective mode or carrier(s) and 'most direct route'.

Zero waste to landfill

We've also made improvements to the way waste is managed on site and disposed of. Working with our approved waste contractor, none of the waste produced on our Adlington site ends up in landfill.

Waste, that can be recycled, is segregated for the contractor to collect and reuse further down the waste chain. General waste collected from site is segregated again by the contractor's recycling facility, with any remnants of waste that cannot be reused or recycled sent for incineration with energy recovery.

WEBSITE: www.carrington.co.uk
TWITTER: @carrtextiles
TEL: +44(0)1257 476 850

MANUFACTURING PROCESS CAPABILITY IS KEY FOR A COMPANY THAT SELLS PROCESS CAPABILITY

Renishaw is a FTSE-250 listed company, headquartered in the UK, which performs most of its manufacturing in-house in the UK

RENISHAW MANUFACTURING OPERATIONS ARE COMPLEX AND DIVERSE

They include component production, printed circuit board assembly / interconnection and product assembly across six major global sites; four in the UK.

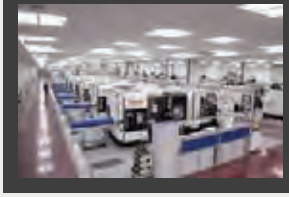
Over 10,000 saleable products, 40,000+ inventory items, leadtimes of two weeks or less, high product complexity and volatile demand patterns. Production volumes from one-off to tens of thousands.

RENISHAW'S GOALS ARE ADVANCING OPERATIONAL PERFORMANCE FOR ITS CUSTOMERS:

- Transforming manufacturing efficiency and raising product quality by achieving process capability
- Maximising research capabilities
- Improving medical procedures and patient outcomes

IN-CONTROL AND HIGHLY EFFICIENT MANUFACTURING PROCESSES ACROSS ALL AREAS

RAMTIC, the in-house designed flexible component machining system operates with a 10:1 machine to person ratio and integrated Renishaw probing process control, to provide highly capable and automated printed circuit board assembly and test processes.

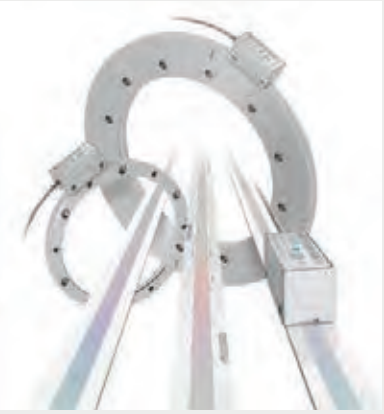


Process validation & verification

With systems and procedures integral to operations, a focus on understanding and eliminating or managing real-world variation.

CUSTOMISATION

Some product ranges have extremely high numbers of variants, across many customers. Renishaw manufacturing processes are designed to achieve high levels of customisation to suit end-user requirements and to do so in leadtimes of 2 weeks or less.



DESIGNING FOR MANUFACTURING CAPABILITY

Early manufacturing involvement in the new product development (NPD) process, guiding development to employ manufacturing processes with established capability and to justify and manage expansion of the manufacturing process portfolio.

Dedicated NPD prototyping and production facilities to minimise development leadtimes.

The Productive Process Pyramid™

PRODUCT CONFIGURATION

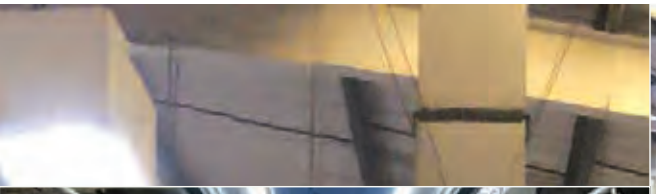
On more complex systems (such as RenAM metal additive manufacturing/3D printing systems) high component count and multiple sub-systems require integration and machine configuration to customer specification.

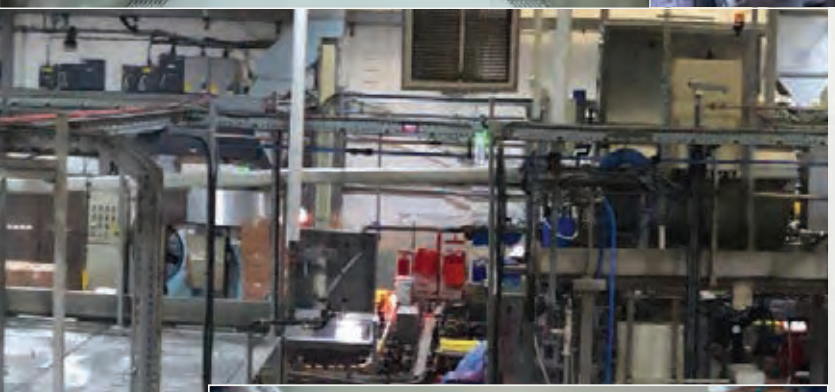
LIVE DASHBOARDS

These are employed across the manufacturing areas. Automated real-time data views are constructed to enable the different levels of the manufacturing organisation (executive, business unit, production cell) to make informed and prompt decisions. They also perform trend analysis for improvement. UK MD

TIPTREE
A FACTORY OF CONTRASTS

"The demand for catering 28g and 42g jars has exceeded expectations with growth in exports to quality hotels in the Middle East, India and America."





Tiptree, Essex, has been the home of Wilkin & Sons Ltd makers of preserves since 1885. Today's factory is one of contrasts where traditional hand processing integrates with modern equipment producing over 100 varieties of Tiptree preserves.

Every piece of fruit entering the factory is checked by hand. During the marmalade season, cooked Seville oranges are prepared by hand, to separate the peel and fruit to be made into Tiptree Orange or Tawny Marmalade. Jams and marmalades are cooked in small copper lined boiling pans, moved to the filling room where sterilised jars are automatically filled, stamped and capped. Each jar is checked by automatic detection systems and traditional "candelling", where an eagle-eyed worker monitors each jar. The jars travel along the belt to the labelling and packaging machine. With exports to over 60 territories, specific labels are required for many different countries.

Diversification has always been part of the company's ethos and the demand for catering 28g and 42g jars has exceeded expectations, with growth in exports to quality hotels in the Middle East, India and America. As consumers' tastes change, the company has adapted and introduced a new range of alcohols infused with fruit from their own farm. The expansion of the Tiptree tea room estate has given the company an opportunity to showcase their products to new consumers.

Based in the driest part of the country, everyone is mindful of water consumption with careful reduction and recycling both on the farm and in the factory. Glass jars can be recycled, waste is kept to a minimum and the new efficient energy centre supplying power to the factory is supported by solar panels. Tiptree is a great source of local labour, with many walking to work.

DAVID NIEPER

David Nieper is a British fashion designer and manufacturer based in Derbyshire. A family run business designing, manufacturing and retailing internationally through mail order and internet.

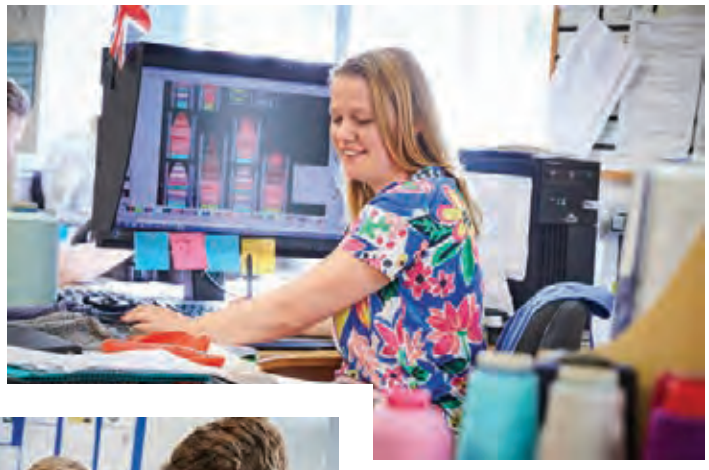
The company has never taken manufacturing offshore and has always invested in local talent and local skills. It has been one of the major employers in the area for almost 60 years.

One of the secrets of its success is its vertical business model. The company has 5 factories in the town of Alfreton including fashion separates, fabric cutting, knitwear, catalogue print and its newest venture; fabric printing & dyeing.

The company also sponsors the town's secondary school for 850 pupils, David Nieper Academy which operates a unique relationship with the world of work to equip pupils for college, university, apprenticeships or jobs - life beyond the classroom.

David Nieper is a very sustainable fashion brand, both environmentally and socially. For example the company uses renewable energy and operates 'zero waste-to-landfill'.

"DIGITAL ALLOWS EXACT QUANTITIES TO BE PRODUCED JUST-IN-TIME AND WITHOUT WASTE"



Its fabric print factory is all-digital, which means very little water is used. Digital also allows exact quantities to be produced just-in-time and without waste. The ambition is to make this one of the greenest textile factories in Europe.

The company's cotton nightwear range uses supreme green cotton responsibly farmed with non-GMO seed at the foothills of Mount Olympus in Greece, using new irrigation technology to deliver 40% water savings compared to traditional cotton irrigation.

An academic study by Nottingham University recently revealed that David Nieper's carbon footprint is 47% lower than garment production in similar overseas textiles production bases.

The company sponsors the local Secondary school, David Nieper Academy.

BRITISH SOFTWARE COMPANY CAN SAVE INDUSTRY GIGAWATTS OF ENERGY

A British university spin-out company has perfected mechanical analysis software that improves the efficiency of compressors and pumps has the potential to save almost 1.5% of total energy costs in the USA.

The market-leading software – called SCORG – was developed by PDM Analysis Ltd, a spin-out of City University, London, performs computational fluid dynamics (CFD) modelling in screw compressors, expanders and pumps that are used in many industrial applications, including refrigeration and air conditioning. The data from SCORG allows compressor manufacturers to design more efficient machines and run them more effectively.

The result of a 22-year journey, SCORG has been proven to increase the performance – lowering both energy consumption and carbon emissions – of these compressors by up to six percent; a huge improvement for already efficient industrial machinery.

Refrigeration and air conditioning account for about 25% of total energy usage in the United States during the summer months; compressors are found in all refrigeration and AC devices. Using SCORG on refrigeration and air-conditioning compression alone and reducing their energy consumption by up to 6%, can lead to a potential saving of at least 1.5% of US total energy consumption.

This does not include the energy reduction in other big applications, like oil and gas and steam power, or the adoption of this technology in the screw expander, gear pump and motors industry, meaning the true potential for energy and CO_2 saving is much higher.

"Pressure and temperature increase in screw compressors are caused by the reduction of volume trapped in the machine," says Professor Ahmed Kovacevic, Director of PDM Analysis Ltd. "In a screw compressor, these volumes are of rather complex shape, formed by the rotors and the casing".

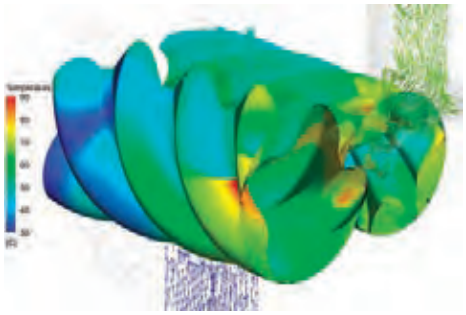
The software works by accurately analysing property changes of the fluid within that complexly shaped volume, using CFD modelling specially modified by PDM Analysis Ltd. SCORG divides the complex chamber volume into small cells using a numerical grid devised by Professor Ahmed Kovacevic, whose PhD at City in 2002 pioneered this game-changing technique.

He adds, "The main obstacle in using CFD to see inside these machines was the lack of a reliable method to produce the numerical grid needed for successful CFD."

Kovacevic and his team's research over 20 years has produced a reliable, industry-accredited method, leading to SCORG. The more recent SCORG 5.7 is enabled to analyse thermal expansions and change in clearances of these machines, essential for their reliable performance and energy efficiency.

The first SCORG licensee was Ingersoll Rand from US. The software has now been adopted by all the major Japanese major screw compressor manufacturers, several US companies, including Gardner Denver, and it has a growing footprint in Europe, China and India.

"With the use of SCORG, we were able for the first time to model a screw compressor in high fidelity using CFD, which provided new and unique insights into the internal workings of our products that are incredibly difficult, if not impossible, to realise through experimentation alone." says Donald Lawson, R&D Manager, Howden Compressors, a global supplier of reliable screw machines.



SCORG software uses specially-modified CFD modelling to accurately analyse fluids' property changes within complex spaces.

Global market potential

"There are up to 700 compressor companies in the world and currently we serve about 200. The potential to increase the efficiency of millions of machines is great and very exciting." says Kovacevic.

The global market for screw compressors is predicted to be worth $11 billion p/a by 2021 with compound growth of 6.62% (https://www.marketsandmarkets.com/Market-Reports/screw-compressor-market-122896617.html). Compressors of all types represent about 17 per cent of energy use in developed countries, producing over 3,000 mega tonnes of CO_2 per year. Energy costs from compressors are about Eu275 billion pe annum.

"With our software companies can improve their operating efficiencies by four, five, up to six per cent – this is a huge improvement for machines that are already very efficient," says Kovacevic.


UK
MR
TECHNOLOGIES

CHANGING TIMES FOR UK ADDITIVE MANUFACTURING

BY CANDICE MAJEWSKI

Jaguar XE SV Project 8.

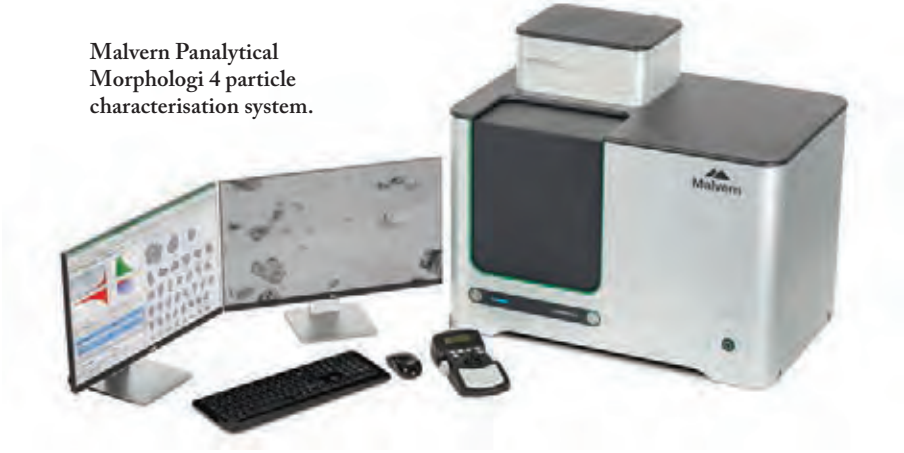
Credit: JaguarLandRover

As 2019 draws to a close there is no doubt change is in the air. Xerox appear serious in their attempts to merge with or take over HP, with clear implications for their AM activities. GKN Powder Metallurgy expanded into polymers with their takeover of FORECAST 3D, UK OEM Gardner Aerospace increased their portfolio by acquiring Lancashire company FDM Digital Solutions, and Stratasys has increased its investment in Xaar 3D to 45% with the possibility of full acquisition.

We've seen some surprises along the way, with the closure of Renishaw's North Staffordshire site, Metalysis going into administration before being taken over by Power Resources Group and voxeljet's decision to close its UK facility.

There remain clear indications of UK growth and sustained excellence. Cookson Gold is strengthening its reputation in AM-related systems with the launch of the ATO Noble precious metal powder production system (in collaboration with Polish company 3D Lab), and Renishaw announced a new collaboration with Sandvik for qualification of metals and alloys. Photocentric's LC Precision 1.5 system won the 3D Printing Industry 'Best Personal Printer of the Year' award, Protolabs have been awarded the Queen's Award for International Trade, and Jaguar Landrover launched their first production car including multiple AM parts. Chris Noble says 'the Jaguar XE SV Project 8, limited to just 300 examples worldwide, was an ideal vehicle for AM. Leveraging the benefits of 3D printing eliminated tooling costs for many parts, whilst simultaneously allowing for unique features on the vehicle to deliver maximum performance. We were proud for the AM work on Project 8 to be recognised recently by the Society of Plastic Engineers at their Innovation Awards, and look forward to furthering our activity across prototyping, manufacturing and production part applications.'

London-based AMFG, producers of workflow automation software for AM, have announced partnerships with EOS GmbH and Autodesk, highlighting the increasing importance placed on more connected process chains, and with improved repeatability becoming key characterisation has become increasingly important. Freeman Technology say this year has seen significant growth in installations of their FT4 powder flow systems



Malvern Panalytical Morphologi 4 particle characterisation system.

into manufacturing organisations typically focused on more traditional techniques, and Malvern Panalytical see increasing use of their imaging and chemical characterisation systems for analysis of powders, including understanding effects of processing and storage.

Post-processing remains prominent, with Dyemansion launching its new Powerfuse S system, offering 'fully automatic loading, connectivity and batch tracking features' to allow integration with the company's Print-to-Product workflow. Sheffield-based Additive Manufacturing Technologies (AMT) Ltd recently unveiled their integrated Digital Manufacturing System (DMS), incorporating unpacking and de-powdering through to part finishing and inspection, and has recently raised £4.2 million from DSM Venturing and the Foresight Williams Technology EIS Fund, to help to accelerate their global growth.

CEO Joseph Crabtree says 'the importance of the funding round goes well beyond the financial implications for us. Equally valuable is the collaborative expertise of our funding partners for materials (DSM) and engineering application development (Williams) which will support our drive towards providing truly sustainable, digitally connected and fully automated post processing workflows for additive manufacturing.'

The UK has a proud tradition of AM research and of investment in people, and this shows no signs of abating. Approximately 10% of UKRI-funded proposals starting from 2007 and featuring some element of AM, have starting dates on or after January 2019.

We can also see investment in collaboration and support for industry; the Centre for Process Innovation recently announced £2.3 million to support SMEs in the North East to develop new products and processes using AM technologies, and the Knowledge Transfer Network AM Special Interest Group continues to host information-exchange and networking events.

Women in 3D Printing (https://women-in3dprinting.com/) is a global initiative promoting and supporting women using AM; its UK chapter has 500+ members across multiple sectors and aims to facilitate connections and collaborations, keep a spotlight on UK AM and to support an ongoing pipeline of talent through working with schools to promote STEM and 3D Printing. UK lead Kadine James says 'Our community continues to grow across the UK and it's so inspiring

STRENGTH IN PEOPLE

ADDITIVE INTERNATIONAL (FORMERLY THE INTERNATIONAL CONFERENCE ON ADDITIVE MANUFACTURING & 3D PRINTING) 2019

241 NUMBER OF ATTENDEES

34 NUMBER OF EXHIBITORS

16 NUMBER OF COUNTRIES REPRESENTED

ACADEMIC/INDUSTRY SPLIT ROUGHLY

35%-65%

ERIN WALSH, DOCTORAL RESEARCHER, THE UNIVERSITY OF STRATHCLYDE

Erin's project aims to develop a workflow to produce pharmaceutical products with complex geometries that control the drug release. The technique couples stereolithography (SLA) with hot-melt extrusion (HME) and injection-moulding (IM). Moulds are produced using SLA, allowing for highly complex and detailed structures at a reduced cost and lead-time. HME allows freedom to formulate polymers with drugs and other excipients and is used to prepare the material for injection. IM is then used to form the HME material into the geometry of the printed moulds. The coupling of these techniques is used to produce tablet geometries impossible through traditional means.

DR KATE OLIVER (WWW.SCHRODINGERSKITTEN.CO.UK)

The more materials that can be printed, the more useful 3D printing is; but new materials need new techniques. Funded by EPSRC, via the Bristol Centre for Functional Nanomaterials, Kate's PhD focused on developing open-source, inexpensive 3D printing technology, in parallel with printable smart materials. The result was an extrusion printer, optimised to process alginate-based hydrogel into shapes that change with temperature. Immersed in water, these soft, jelly-like materials curl, unroll and shrink when heated, and could be useful as synthetic tissues, soft robotics or valves. Printer plans are available freely for others to build on or replicate.

Kadine James –
Creative Tech Lead

to be a part of this worldwide platform that supports the diversity and digital skills agenda by creating more opportunities to bring female talent into our industry. Diverse teams allow organizations to provide environments that cultivate more creativity and new ways of thinking this allows for more innovation and productivity and with no sign of the AM industry slowing down it's becoming increasingly important to deliver change and commit to a bigger vision that diversity and inclusion produce better results.'

A bionic future?

Not so long ago, much of the talk about medical AM seemed like something we'd be more likely to see in a science fiction movie, but we've seen great strides in this area – everything from production of complex surgical guides through to printing of human organs. Georgi Makin, Senior Editor of 3DMedNet, comments that 'from speaking to many people at 3DMedLIVE and working with the wider community with 3DMedNet, it is clear that AM is already making an impact in the medical space. As the demand for personalized care increases, AM finds a niche in the development of practical, customizable solutions in many areas of medicine.'

AM has become well-established as a method of surgical planning; a highlight of this year was a 100-strong team at Great Ormond Street successfully separating conjoined twins Safa and Marwa, joined at the head, over a period of four months. A combination of Virtual Reality and AM was used to determine and practice the most appropriate surgical strategy.

New developments keep coming in AM orthotics and prosthetics. The IMPACT project, led by Iterate Design and Innovation Ltd, incorporates the use of embedded electrical circuitry to produce a personalised 'bionic hand' with articulated thumb and London-based Andiamo have recently launched their clinic offering custom 3D Printed orthoses mainly for children with disabilities.

Renishaw's manufacture of a device for the North Bristol NHS Trust to aid long-term drug infusion for patients with Parkinson's disease was a clear highlight this year. The titanium AM device, which won the TCT Healthcare Application Award, is embedded in a patient's skull to enable delivery of the relevant drug directly to the brain and is expected to have potential for use in other brain-related disorders.

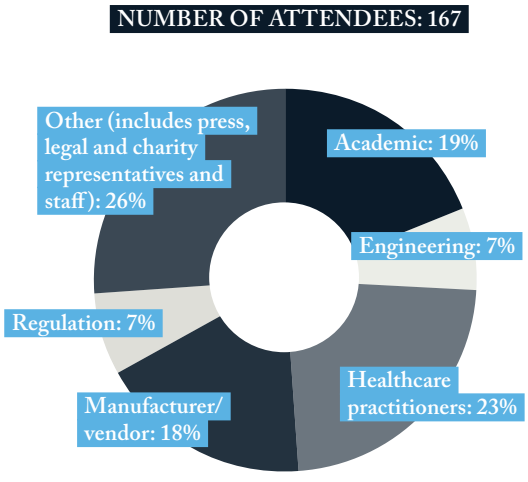
Looking forward we can expect to see many other applications becoming more commonplace in a hospital setting – for example 3D printers to produce accurate implants for or to print skin grafts directly into wounds. And of course, while it may still be a long time before we're routinely implanting Additive Manufactured organs, this remains on the horizon. There can be no doubt that AM will continue to have increasing impact in the medical arena, so watch this space...

'One of the greatest achievements of 3DMedLive 2019 was to create a programme which brought together a diverse group of people who wouldn't normally have the chance to interact with one another. Talks included clinical case studies, practical considerations of running 3D printing hubs in (or associated with) hospitals, the latest on medical device regulations, and ongoing research in pre-clinical trials. The takeaway message was focused on communication between professions, highlighting the considerations surrounding the use of 3D printing, while at the same time showcasing what is technically possible.'

James Wingham, Doctoral Researcher, University of Sheffield

Medical implants additive-manufactured by Renishaw

A BIONIC FUTURE



3DMEDLIVE EVENT

Number of presentations	35
Case studies	9
Talks	15
Panels	5
Roundtables	6
Number of exhibitors	5
plus 14 media partnerships	

4 PREDICTIONS FOR MANUFACTURING IN 2020

Change is buffeting the manufacturing industry from a number of directions. Some changes, manufacturers can and should make for themselves, others are motivated by consumers—all of them offer new opportunities. For example, early adoption of new technologies provides a competitive advantage. While actively responding to consumer driven disruptions, like demand for sustainability, can open-up new market share and unlock additional revenue streams. Here are the IFS predictions for the most significant changes to manufacturing in the coming year.

PREDICTION 01

MORE MANUFACTURERS WILL INVEST IN AI TECHNOLOGY AND IMPROVE PRODUCTIVITY

Most manufacturers already employ some level of automation—not just on the plant floor but in the front office. Dried fruit and snack manufacturer Whitworths is a good example.[1] It has reached a high degree of automation in quality management, moving from period random testing of product and manual recording, to a streamlined process driven directly by the shop order.

While automation streamlines processes, AI will be able to create net new processes. So a company like Whitworths may be able to predict quality problems before they happen, or create new AI-driven flavours to meet an individual customers' tastes, as did distiller Diageo.[2]

Another area that will continue to develop over the coming years is AI-powered demand planning and forecasting. As AIs are trained on the right data sets, manufacturers will be able to align their supply chain with demand projections to get insights that were previously unimaginable.

This in turn brings about a new mindset for manufacturers. Just-in-time, the Toyota Production System concept, will be taken to new heights, in large part because AI allows a manufacturer to ask, "in time for what, exactly?", what event or combination of events should trigger replenishment? —a demand signal, a price drop in the component part or raw material—it could be anything, and the relationship may not be apparent without AI.

1 https://www.ifsworld.com/uk/our-customers/2017/08/17/uk-whitworths/

2 https://www.foodingredientsfirst.com/news/Personalized-malt-scotch-Diageo-launches-AI-powered-whiskey-selector.html

PREDICTION 02

BY THE END OF 2020 THERE WILL BE MORE MANUFACTURING DEVICES CONNECTED BY 5G THAN THERE WILL BE PEOPLE ON 5G NETWORKS

Bernard Marr in Forbes points out the tremendous impact 5G will have when it comes to enabling other technologies.[3] Streaming music, TV shows and movies in an uninterrupted way via mobile devices will indeed be easier and more affordable with 5G. But 5G will be more transformational for devices that drive automated industrial processes than for consumer-facing smart devices.

"These advancements will enable connected cars and autonomous driving," Marr writes. "Smart cities with connected logistics, transport, and infrastructure; enhancement in connected healthcare from robotics to blockchain use cases to wearable telemetry; industrial internet of things and smart factories; and the more extended use of augmented reality, virtual reality and mixed reality."

The ultra-low-latency, ubiquitous connectivity of 5G will power sensors on industrial machines, enabling them to talk to each other and generate floods of data. Through machine learning, this data will unlock new vistas of cost savings and efficiency. China and North Korea are already working in this way, and the US and the UK are likely to spend much of the coming year ensuring they don't get left behind.

Improved communications between machines due to 5G, will also bring the ability to automate more complex manufacturing models, including configure-to-order and make-to-order. And thanks to the high speed of 5G, it will now be possible to automate multivariate production, resulting in custom products, regional mass customisation or highly configured products, all with less human involvement than is currently the case.

3 https://www.forbes.com/sites/bernardmarr/2019/10/25/what-is-5g-technology-and-how-must-businesses-prepare-for-it/#6cae2e1e1758

PREDICTION 03

FOOD AND BEVERAGE MANUFACTURERS WILL NEED TO DELIVER ON SUSTAINABILITY PROMISES TO RETAIN MARKET SHARE

Lumina Intelligence has published a report suggesting that the food and beverage industry has made 905 sustainability promises over the last 12 months.[4] Setting sustainability targets and making promises is commendable, however, there is still work to be done by the industry to turn these promises into deliverables.

One example is single-use plastics, which have in recent years become deeply unpopular, due to their impact on the environment. But take the plastic wrapping away from food and it's more likely to spoil before it even gets to market, and its shelf life will be significantly compromised. So, without plastics or a bio-friendly alternative, food waste will increase.

Nonetheless, retailers are listening to their customers and reducing packaging. In various laboratories, scientists are developing starch and vegetable-based packaging that works well with some food products, but not all. A number of supermarkets such as Waitrose in the UK, have stated their aim of reducing waste of some products to zero, following the example of grocery stores such as GRAM in Sweden[5] and Original Unverpackt in Germany.[6]

Retail buyers also want to buy clean-label foods—products sustainably made of natural, simple ingredients with minimal or no preservatives or artificial colours or flavours. Once a differentiator, clean labels are now the cost of entry for many retail categories, according to a 2019 clean label study by Kerry.[7]

The general trend is clear, consumers and retailers alike are demanding proof of sustainability. Insurgent manufacturers can use this opportunity to challenge CPG giants and eat away at their market share. To compete effectively, manufacturers will need enterprise solutions that can support the tracking, tracing and mass-balance reporting that will be required for compliance.

4 https://www.lumina-intelligence.com/reports/food-drink-sustainability-2019-global-progress/

5 https://grammalmo.se/about_gram/

6 https://original-unverpackt.de/

7 https://www.foodnavigator-usa.com/Article/2019/10/24/Kerry-report-How-are-consumers-perceptions-of-clean-label-evolving

PREDICTION 04

MORE PROCESS MANUFACTURERS WILL ADOPT SERVITISATION

Discrete manufacturers have been adopting servitization for many years, charging for the outcomes their products provide, instead of a product sale. Now process manufacturers are making this change in business strategy, as more of their customers desire a service, over product ownership.

Servitization is recognised as having three levels, starting at a base level; selling products and spares, through to an advanced level; selling just a service. In process manufacturing, an advanced level of servitization is required—selling maintenance and repairs, simply doesn't work for a manufacturer that makes a chicken pie! Here are a couple of ways servitization can be achieved in process manufacturing:

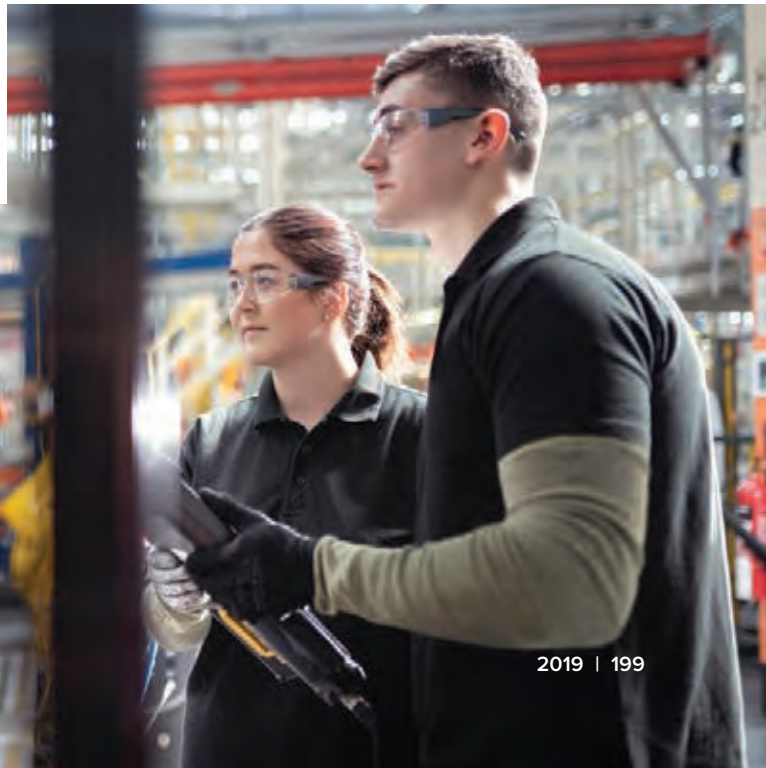
1. Offer a service as well as the product. Luxury paint supplier Farrow and Ball sells cans of paint through retail channels of distribution. The company will also send an advisor to a consumer's home to look at the walls and offer counsel on colours, decoration techniques, and where feature walls might work well. There is then potential to upsell the consumer to a return visit a few years later.

2. Aiming for an outcomes-based fee rather than a per-unit price. Pharma giant Novartis was particularly skilled at this when, in addition to selling tablets by weight or per unit, it offered its drug for congestive heart failure with a rebate on the cost of the drug if patients returned to hospital within a given time. This was a solid contractual clause; if the patient returned to hospital or died prematurely, the hospital received a refund.

Switching to a servitization business model requires a significant shift in thinking for traditional manufacturers. They must change their position from existing just to make things, to seeing servitization as an opportunity for growth. Once a company makes this transition, they will realise the many benefits of a more service-centric approach, including shared risk, improved quality, customer 'lock in' and predictable revenues.

TAKING ADVANTAGE OF CHANGE

2020 is set to be a year of change for the manufacturing industry, driven by technology, sustainability and servitization. Savvy manufacturers can use this disruption to their advantage, automating more of their processes, uncovering new solutions with AI, securing new buyers with sustainable offerings, and working directly with customers through servitization. Those with the right systems in place to seize and react to these changes, will see long-term gains in revenue and growth.



THE SHOCK OF THE NEW

The scope, uses and sheer range of advanced materials seems to be growing every day. It is not just newly-invented materials that are breaking new ground; established materials like are being developed and enhanced with targeted qualities that are designed to improve sustainability. *Lien Ngo, Innovate UK*

In the UK, we have a very healthy community of companies and researchers working to develop new materials, with improved or entirely new properties. Some of these are successful in proving their materials in the pilot stages. Sometimes, this is by finding partners who have the manufacturing expertise and the vision to expand into a risky new material; sometimes, the companies develop the manufacturing themselves.

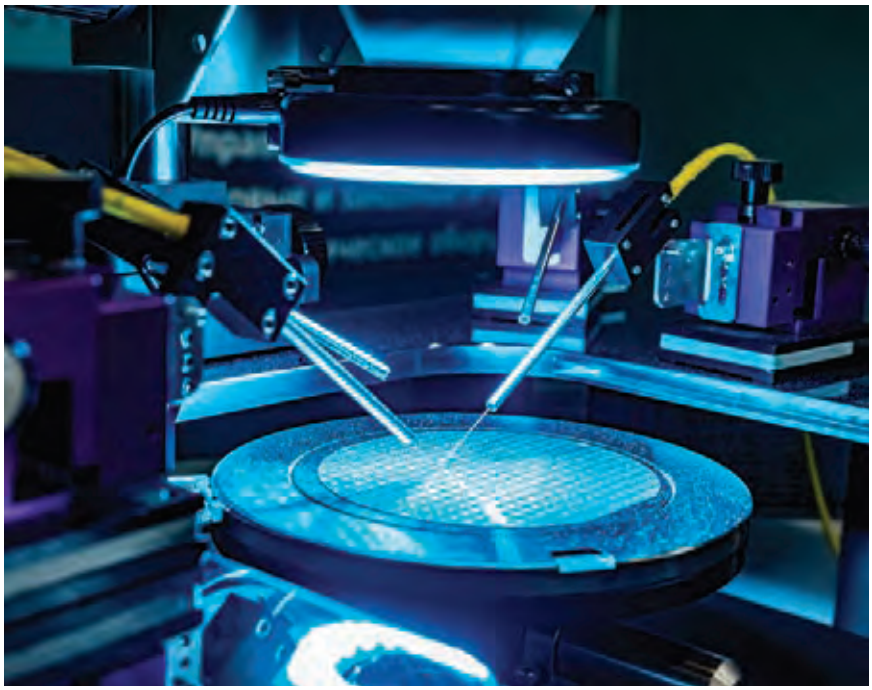
A big challenge for exploiting novel materials is the scale up and manufacturing stage. Every once in a while, there is a call for a general pilot scale facility for materials, but this has always been a difficult proposition.

Too many for a single source

The world of materials is so varied and wide-ranging that the equipment needed for working with each type is very different, and gathering all the various specialist "pots and pans" required in one place would be impossible. For example, semiconductor materials require wafer fabrication facilities, lithography and very precise deposition of nanometer-thick layers of conductors and insulators. Metal alloys and novel powders for additive manufacturing often require extremely high temperatures; new, high tech steels require all the traditional steelmaking and rolling equipment as well as novel additions. New polymers and their synthesis and processing methods are a whole other ball game and have needs more similar to chemicals processing.

This is the point, of course, where advanced materials and manufacturing meet, and it is why the High Value Manufacturing Catapult has seven centres, each having specialism in different kinds of materials and manufacturing. It would not only be too expensive, but impossible to have a pilot manufacturing facility covering every type of material.

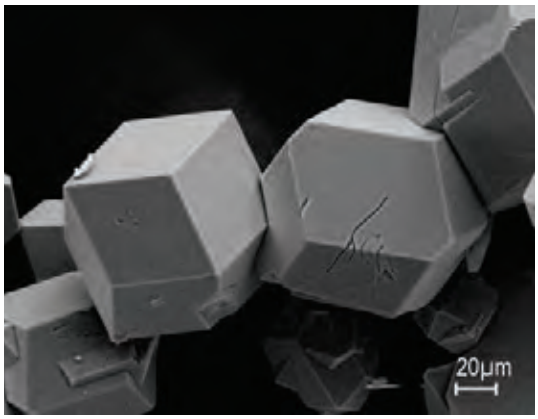
Even the same broad class of materials can require very different equipment to make. For example, carbon fibre composites use very different equipment to metal matrix composites, both in the manufacturing and further processing



Above: Semiconductor materials require specialist wafer fabrication facilities

Right: Primary iron-rich intermetallic in Aluminium alloy.

Left: Powders for the additive manufacture of products like this galvanometer block require extremely high temperatures.



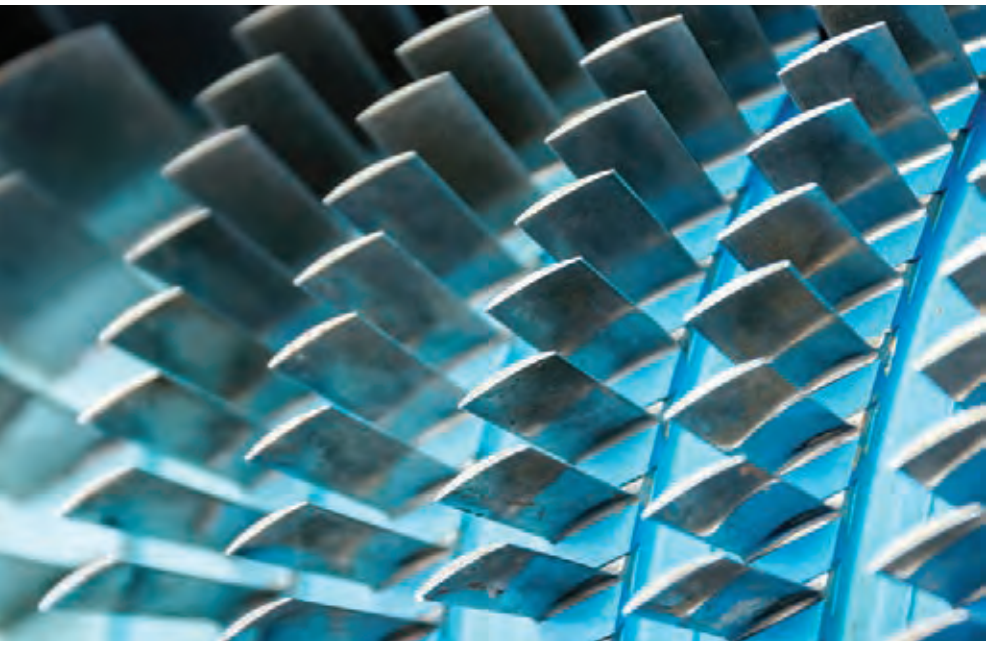
Credit: Brunel University London

Credit: Renishaw

into the final product. Manual lay-up, tooling and autoclaves are required for carbon fibre composites, while hot isostatic pressing is needed for metal matrix composites. In fact, even the same material can have radically different manufacturing processes. That ubiquitous wonder material, graphene, is a great example of this: nanoplatelets can be exfoliated, mechanically or chemically, from graphite sources; large area few layered graphenes can be "grown" in different ways; single layer graphene has to be grown on specialized substrates and then removed to be deposited into their final product-specific places. These all require vastly different equipment. When you get into the tonne (and sometimes even kilogram) scale, the equipment gets very expensive and the expertise more and more rare. When you take into account other 2D materials, arguably the true inheritors of graphene's massive research push, the manufacturing challenges will be even more interesting.

"Nanotechnology, like 2D materials, encompasses a broad and diverse set of materials covering the entire periodic table. In some of these sets of materials, there has certainly been good success in scaling up."

Nanotechnology, like 2D materials, encompasses a broad and diverse set of materials covering the entire periodic table. In some of these sets of materials, there has certainly been good success in scaling up. For example, Promethean Particles was spun out from the University of Nottingham in 2007, with new techniques for synthesizing certain kinds of nanoparticles. I first met them a few years later on a mission to South Korea for small business working in printed electronics. They now have a production site producing nanoparticle dispersions at scale. These metals, oxides and nitrides are used in a variety of applications: electronics, catalysts, healthcare. Now, with investment from EU funding and Innovate UK, Promethean Particles can continuously produce these nanoparticles at a full production scale of 1000 tonnes annually.



Aircraft engine manufacturers are increasingly seeking specialised materials for lightness and tailored properties.

One way in which new materials crosses with a manufacturing challenge is in the field of metamaterials. Metamaterials direct, block, guide, bend, amplify or otherwise modulate waves- generally waves of light or sound. (They are famous as the theoretical basis of an invisibility cloak, where the material bends light around the cloak so you are seeing what's behind it.) Metamaterials are a triumph of structure over substance: their properties come from the arrangement and pattern of the shape- generally the feature size is smaller than the wavelengths the material is modulating- rather than the material itself. So acoustic metamaterials are patterned carefully, but they can be made from many materials which can be manufactured with that pattern. A metamaterial that acts as a lens for sound has been made by researchers at the University of Sussex partly using Lego bricks. In another example, Sonobex, a company spun out from Loughborough University, uses metamaterials to shield areas with heavy plant machinery, neutralizing noise but still allowing light in and air flow for cooling. The metamaterial panels are made from galvanized steel. Optical and electromagnetic metamaterials can be used to shield something from radar detection and as antenna for next generation li-fi communications.

Because the 3D patterning and structure are so important, and because it is vital to be able to tune the feature sizes and spacing to target the wavelengths you want, metamaterials may be one of those applications which can only reach its true potential with additive manufacturing methods, especially for acoustic and microwave applications. The complex structures needed are difficult to manufacture using conventional methods.

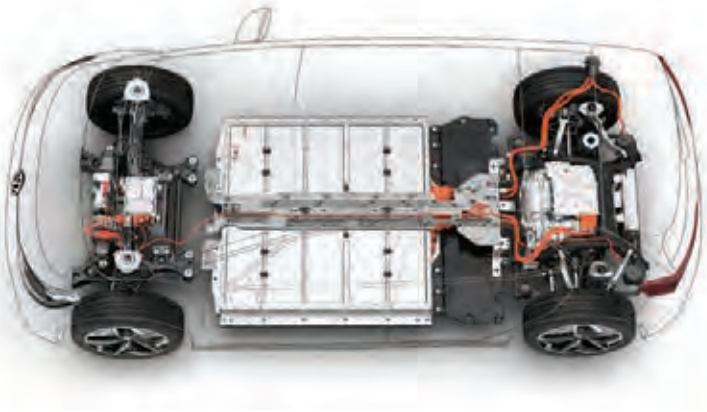
GRAPHENE MANUFACTURING

Left: Graphene , the 'wonder material' is now being adopted by manufacturers and used at scale but making large-area single-layer graphene may be tipping from ruinously expensive to realistic.

Nineteen years after the Nobel Prize in Physics was awarded for the discovery of graphene, nearly all forms of it have moved into manufacturing at production scales and realistic prices. This was not true even a few years ago, but now graphene in nanoplatelets, as flakes or in dispersions, few layer flakes and even large area single layers are available and manufacturing is either already at large production scale or is obviously scalable. Two home-grown companies have had graphene products for some years now: Thomas Swan has a range of graphene nanoplatelet products and have scaled up to a 20 tonne per year production capacity; Versarien, with its Nanene product, sells few-layer graphenes and stakes its reputation on quality, with a Verified Graphene Producer inspection from The Graphene Council.

In the technically tricky (read: ruinously expensive) manufacture of large area single layer graphene, which is what all those superlative performance numbers generally come from, I admit I was skeptical that anyone would ever make it at large enough scale and cheap enough for it to be realistically usable in any application bar some very esoteric, tiny volume uses. However, there is some evidence that modest-to-large scale production processes have been developed which are on target to reduce costs to 30-60USD/m^2 of single-layer graphene made by chemical vapour deposition.

THE POWER POINT



Credit: VW/Newspress

There is no doubt that 2019 has seen a further significant shift underway in the technological transition in the automotive industry from internal combustion engine technology to electrification. This shift is both in terms of production but also consumer attitude and perception that we are moving in this direction. *Tony Harper, Faraday Battery Challenge Director, UK Research and Innovation*

We all know how important the automotive industry is to the UK, and how it is imperative to support the industry through the disruption caused by electrification. We need to drive hard now and invest heavily in the research, development and scale up activities to ensure the battery industry in the UK thrives.

In fact, a recent study by the Faraday Institution and produced with McKinsey Energy Insights and the University of Oxford predicts that by 2040 there will be demand for 8 gigafactories in the UK.

But let's think of things in a different way. In 2025 – a timescale over which many of us will have bought our next car – the report predicts the annual number of new EVs purchased to be approximately 750,000 cars. That's 750,000 individual or family purchasing decisions.

One customer at a time

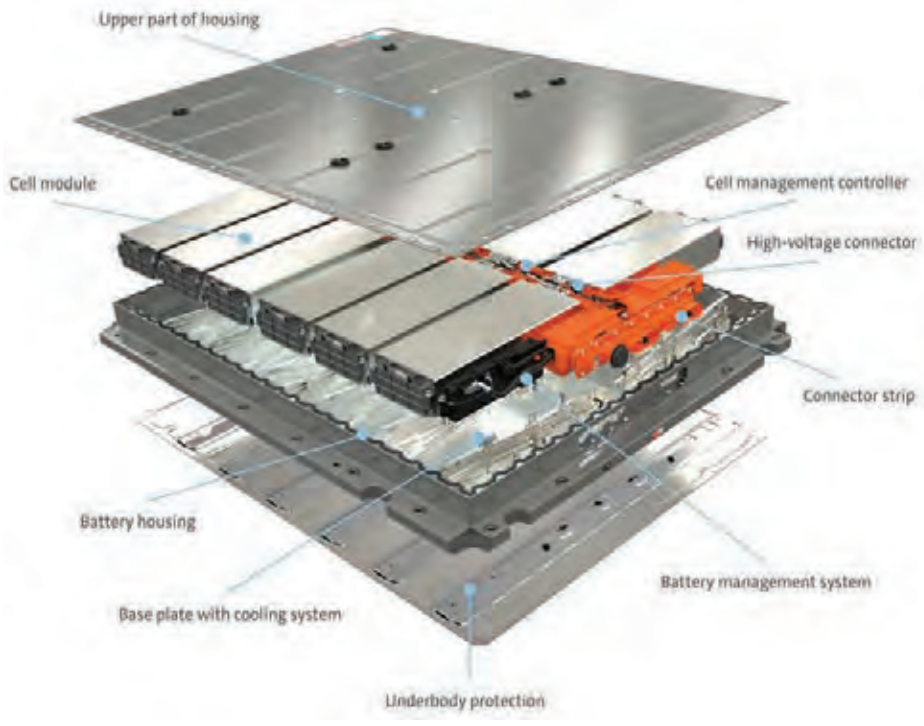
It is imperative that we as an industry don't forget that demand for EVs will be driven one consumer at a time. We need to examine the perceived barriers to EV adoption – whether we in the industry believe they are real or not.

To take one example, a recent AutoTrader study report quotes 99.3% of all journeys made in the UK are with the average range of EVs. Yet the public worries about range.

Further, the gap between public perceptions and commonly held views of the industry may be increasing. There are a multitude of reasons – and surveys – on why individuals don't buy EVs. But time and again common reasons quoted are: cost, range and charge points. These must be addressed.

Structure of the MEB battery

Credit: Newspress



The good news is that the Faraday Battery Challenge is addressing both technical and public concerns through our research agenda.

The Challenge has a huge role to play in developing batteries that cost less,

Credit: Faraday Challenge

The UK Battery Industrialisation Centre is set to open in 2020.

and can support longer EV range, but also increasingly playing a larger role in correcting misinformation and changing perceptions.

The Faraday Battery Challenge is structured around the following three strands of work:

- Fundamental research from the Faraday Institution
- Innovation -Collaborative R&D projects, co-funded with industry
- Scale up - UK Battery Industrialisation Centre – UKBIC

Fundamental research takes time but already after 16 months Faraday Institution funding has resulted in: two patent disclosures, with one to follow and another three or four in the pipeline; fellowship funding to three potential commercial spin outs; over 40 scientific publications – several in top tier journals and multiple industrial collaborations.

And in September the Faraday Institution has selected its new five project consortia in four research areas that it will fund to the tune of up to £55m.

All of these projects will conduct application-inspired research to make step changes in the understanding of battery chemistries, systems and manufacturing methods.

Collaborative research and development projects

Through the Faraday Battery Challenge UK businesses can access grants for feasibility studies and collaborative research and innovation projects that develop new and improved battery technologies that are more cost effective.

Projects to get funding so far include improving battery lifespan and range and the reuse, remanufacture and recycle of batteries at their end-of-life.

The figures on collaborative R&D are impressive - £114 million invested through government and industry funding in 62 projects.

The UK Battery Industrialisation Centre is set to open in 2020 in

ILIKA TECHNOLOGIES: RECHARGING THE ELECTRIC VEHICLE MARKET

Lithium-ion batteries are the most widely used type of rechargeable battery in the world. This is largely down to their ability to produce a relatively high amount of energy and a reasonable cycle-life – the complete charge and discharge of a battery – of about 1,000.

Despite this, it's believed that current lithium-ion batteries have almost reached their full potential. To encourage the adoption of electric vehicles, better, alternative solutions must be found.

"[With lithium-ion batteries] there will only be small increments in energy and power densities possible over the coming 10 years," Dr Louise Turner, Technical Director at Ilika Technologies, explains But Ilika's work in solid-state could see it produce batteries with double the energy density. "It's widely accepted within the automotive industry that solid-state batteries will be a key enabler for the electrification of vehicles and their widespread uptake."

Ilika is currently working on scaling up its solid-state battery technology in a project funded through the Industrial Strategy Challenge Fund's Faraday battery challenge.

Faraday winners Round 2, Ilka Technologies. Left to Right. **Dr Denis Pasero - Product Commercialisation Manager. Dr Louise Turner - Technical Officer. Graeme Purdy - Chief Executive Officer. Elaine Kent - Project Manager.**

The challenge Ilika must overcome is ensuring the material is conductive enough within a car battery to provide the full suite of benefits, in particular, reducing the time it takes to charge the vehicle.

Ilika is working alongside a number of large companies as part of this research and development project. Collaborators include the Centre for Process Innovation, Honda, Ricardo and University College London (UCL).

"But why the need for a UK-based gigafactory? The auto industry is a game of tight margins."

Right: **Williams Advanced Engineering Launches New Battery Technology at Cenex LCV2019.**

Credit: Williams Advanced Engineering/Newspress

Faraday Round Winners ICoNiChem pictured at International Automotive Research Centre Warwick University. L to R: **Beth Middleton, Research Fellow, WMG. Dr Rob Sommerville, Project Engineer, WMG.Emma Kendrick, Reader, WMG. Paul Croft, Operations Director, Iconichem. Dr Vanessa Goodship, Principal Research Fellow, WMG.**

ICONICHEM: RECYCLING RARE MATERIALS IN ELECTRIC VEHICLES

The electric vehicle industry is already growing rapidly, and with the UK government's plan to end the sale of new conventional petrol and diesel cars by 2040, the market is only set to grow.

In turn, demand for critical elements such as cobalt, nickel, manganese, lithium and graphite, commonly used in the production of electric vehicle batteries, will also rise.

Cobalt salts producer, ICoNiChem Widnes, is leading a project to embed recycling and reuse of materials in the electric vehicle supply chain - and tackle some of the problems associated with the sourcing and use of these elements.

"We believe the UK needs to move towards a circular economy to fully realise the green ambitions of electric vehicles," says Paul Croft, Operations Director at ICoNiChem. The circular economy puts recycling and remanufacture at the centre of production, minimising waste and putting materials back into the supply chain. "Batteries don't last forever, and with a lifetime of 8 to 10 years, there will be a lot of waste developed. If we don't, as a country, consider what to do with that waste, then [electric vehicles] won't be as green as we think."

ICoNiChem is working alongside research organisation Warwick Manufacturing Group (WMG), and others, in a recycling and reuse project through the Faraday battery challenge.

Coventry. UKBIC will offer industry, via open access, the opportunity to scale up and commercialise advanced technologies central to the development and manufacture of batteries, initially for the automotive sector but with wider application.

This means, it will be working to perfect production of the next generation of battery systems across electrode, cell, module and pack levels to allow companies to move to full scale, high volume battery manufacturing (i.e. 'Gigafactories') and high volume electric vehicle production as subsequent investments.

But why the need for a UK-based gigafactory? The auto industry is a game of tight margins.

Batteries are bulky and expensive to ship and battery production – at cell, module and pack level – will need to be co-located with EV manufacturing.

This points to the imperative for a UK-based gigafactory. It is likely that, in order to meet the demand by 2025, the UK will need to attract large scale battery cell manufacturing investment from overseas, based on an iteration of known Lithium Ion Technology.

This along with a strong UK chemical supply chain, and indigenous OE demand, creates a demand-driven end to end value chain in the UK.

If you then combine with multi-fold growth beyond 2025, this creates the industrial backbone and market opportunity for a thriving UK intellectual and physical supply chain in new, breakthrough battery solutions at which the UK excels.

THE DIGITAL FACTORY

BY ANDY PYE

Smart factories could add at least $1.5 trillion to the global economy, according to the Smart Factories Report published by Capgemini. This will only be possible if organisations can overcome the scaling challenges.

Manufacturing business models are being disrupted by digitalization and the shop floor is on the front line. Artificial intelligence (AI), Edge Computing and Augmented Reality (AR) are the "key enablers".

"The automation of yesteryear is slowly becoming untenable for realising future needs, driving the evolution of control process automation from control switches and relays to advanced control systems," says Karthik Sundaram, industrial IoT programme manager at market analyst Frost & Sullivan. "Envisioning the future of factories must first begin with a vision for the future of automation, a relatively unexplored approach."

AI opens the door to machines that can sense, process and act in some ways like humans. It encompasses natural language processing, image/object/sound recognition and problem-solving. Machine learning describes a system which can learn without explicit programming.

The need for 'clean data'

The guiding star for all "industry 4.0" technologies is data, which enables companies to identify and resolve

FACIAL RECOGNITION

Facial recognition is a form of biometric identification, such as using someone's voice, iris or fingerprint to identify them.

The more commonly used methods of tracking employees, such as key cards, are easy to bypass and do not provide the level of security required when entering classified areas.

The manufacturing industry could use facial recognition to keep track of where workers are on the factory floor, ensuring their safety in case of emergency.

Facial recognition could help to ensure that employees working at specific stations have had the necessary training to operate a piece of machinery. If the system recognises that the employee's identity does not match the training record, the plant manager could be notified and another member of staff located to carry out the task instead.

LOOKING FORWARD

- **Compared to two years ago, more organizations are progressing with smart initiatives and it is estimated that, globally, one-third of factories have already been transformed.**
- Smart factories could add at least $1.5 trillion to the global economy,
- **Manufacturers currently plan to create 40% more smart factories in the next five years.**
- China, Germany and Japan are the top three adopting countries, followed by South Korea, United States and France.
- **The PwC study, "Digital Factories 2020: Shaping the Future of Manufacturing," predicts that the adoption of machine learning to enable predictive maintenance is expected to increase among manufacturers by 38% because of the ability to increase profit margin by eliminating unscheduled work stoppages.**
- Equipment monitoring and predictive maintenance are the most commercially implemented activities so far, due to the maturity of associated AI models. Another commercial use case currently gaining momentum is defect inspection.

problems remotely. Eventually, machine learning might help plants automate simple engineering jobs.

"However, this future is not yet here," says Stephen Woodhouse Chief Digital Officer at international consulting and engineering firm Pöyry. "To reach this point, we need better access to clean, accessible data streams and we need to better identify where to focus our efforts. We also need to get around practical barriers like the interoperability of these sensors. Although the limits are expanding fast, constraints on processing power, data storage and algorithms mean that the 80:20 rule still applies to data analytics. It is these practical considerations that led Pöyry to co-develop Krti 4.0, a machine learning predictive maintenance framework that works across different kinds of sensors."

The Cloud and the Edge

Cloud data storage is often preferable to and much more sustainable than traditional on-premises storage. But it is not suitable for all forms of manufacturing data. The answer is an emerging infrastructure of so-called "edge devices". With edge computing, computer power is sited exactly where needed – where the information is generated at the edge of the network.

This autumn, in Barcelona attending the Schneider Innovation Summit, I met Ali Haj Fraj the Senior Vice President Machine Solutions within the Business Unit Industry of Schneider Electric. He specialises in Industrial Automation and Controls and Energy Management.

"I see smart manufacturing as the collective benefit of advanced technologies to optimise operations and gain competitive advantage. Smart infrastructures within plants enable more efficient manufacturing processes, allowing for faster responses to dynamic marketplace demands," he said.

"A truly 'smart factory' is one that is completely digitised with

Smart controllers, like the Modicon M262 shown here, are core to smart manufacturing.

a high level of automation and connectivity with its whole supply chain," said Martin Walder, VP Industrial Automation at Schneider Electric UK. "With UK manufacturing industry under increasing pressure to deliver more, at a lower cost, the coming years will see more manufacturers take steps to create a completely 'smart' factory floor. Thanks to recent advancements in IoT technologies, using smart technology is feasible for a greater number of manufacturers."

> "Today's engineers have learned their trade in the last few decades, yet the skills required of them will change in the coming ones"

Core to the smart machine is the smart controller, one built not only to control a process but also capable of communicating and linking to an IT layer. Combined with software analytics, smart controllers enable the smart machine to react in a proactive way to changes that may happen in the future.

IT/OT convergence

OT (Operational Technology) and IT (Information Technology) teams are familiar with their own infrastructures and software. But each needs to have a fundamental understanding of the other's respective stacks, and how changes can impact both.

"Today's engineers have learned their trade in the last few decades, yet the skills required of them will change in the coming ones," says Woodhouse. "In an interconnected, data-driven world, engineers will find they are required to be software and hardware engineers, and even drone operators, as much as they are required to be power engineers. Knowledge and information will be treated as a precious company resource and will be managed and maintained."

FOOD FOR THOUGHT

Left: **Fans and motors are vital within Munton Malt's large-scale production process. It uses Mitsubishi Electric's Smart Condition Monitoring (SCM) system to protect against unscheduled downtime.**

Images Credit: Mitsubishi Electric Europe

At Maintec (30-31 October NEC), Muntons Malt, one of the UK's largest producers of malted barley, explained why it has chosen the Smart Condition Monitoring (SCM) system from Mitsubishi Electric to protect fans and motors vital to its production process. It uses sophisticated control automation and bearing monitors to accurately predict maintenance requirements.

The principles of barley malting are quite traditional, but Muntons relies heavily on automation, electro-mechanical equipment and sensors to provide fine control over air flow, heat and moisture. Fans and motors are critical to the operation: the Muntons processes many tonnes of product at a time, with key operations relying on a steady supply of blown air.

The chosen SCM installation provides condition monitoring for two large 315kW fan sets and a single 90kW fan set. Sensors monitor the electric motor, power transmission coupling and main fan shaft bearing on each fan set. "We now have a clear picture of the health of the fan sets and advance warning of any required maintenance," says Plant Engineer Michael Plawecki. "Remote monitoring and fast diagnosis of any issues has also made us very responsive should the limits on operating parameters that we have set be approached. As promised the system was easy to install and relatively simple to commission."

Mitsubishi Electric's Smart Condition Monitoring system.

DON'T DITCH DC!

Equipment in traditional industries can be integrated into sophisticated multi-function plants – while retaining DC drives.

One of the great advantages of the move to digital technology is that it has accelerated integration of related machines into sophisticated multi-function plants. Individual machines' drives and controls can now be connected through various communication protocols such as Profibus, Profinet, Canbus and Ethernet. This allows them to share operational data and thus optimise overall plant performance.

"The imminent demise of DC drives has been predicted for at least 30 years," stated Sprint Electric Marketing Manager Neill Drennan. "Yet they are still going strong and in selected applications continue to outperform their more fashionable variable speed AC counterparts. With the development of Industry 4.0, we are starting to see drives become predictive and preventative, which should in the long term makes plants more productive and efficient. Plant operators sometimes think that their existing machines cannot be integrated into wide area control systems cost-effectively, particularly if they use DC motors and drives rather than AC. But DC drives can be digital and can be integrated into digital control systems."

Sprint Electric 3200i DC Drive, with cover.

DIGITAL TWINS BRIDGE REAL AND VIRTUAL WORLDS

An objective of artificial intelligence and machine learning is to enable the development of a digital twin of a product development or production environment. Its creation uses model-based systems engineering using the machine learning algorithms and knowledge gained as a foundation.

Konecranes, which specialises in cranes and lifting equipment, has implemented Siemens' digital innovation platform to accelerate its product development process and connect product and performance data together. The company is using MindSphere, the open, cloud-based Internet of Things (IoT) operating system, and the digital lifecycle management software Teamcenter, to construct a digital twin and reduce the number of physical prototypes. This is one of the first implementations of IoT to develop a framework that connects and synchronises the virtual (engineering design, analysis and simulation) and physical (testing and operational reliability) worlds.

"The traditional product design process is based more on the engineer's experience and generally shared assumptions than measured facts from existing products," said Juha Pankakoski, Executive VP, Technology at Konecranes. "These assumptions often lead to non-optimised designs that are over engineered. With an integrated digital twin platform, we see major potential in speeding up the product development process, reducing prototypes, increasing traceability and thus improving quality and reduce development cost."

For decades, the office environment had been on an Ethernet network, the factory floor had operated independently on Fieldbus, and each were happily separate in their operations and needed little contact with one another. Now, with the proliferation of Ethernet on the industrial side and the organization converging into a single data network spanning both, conflict seems inevitable: which department gets overall control of the Ethernet network?

The chasm between IT and OT can be large. The department traditionally responsible for data flow and that responsible for industrial controls are driven by fundamentally different incentives. For OT, availability is king, representing millions of dollars in manufacturing productivity, whereas IT tends not to mind a little downtime, as long as data security can be maintained.

There needs to be an individual capable of communicating with and relating to both departments and ensuring that they work synergistically, as well as an organization providing the proper backing and resources.

5G Technology

Unlike the massive difference that domestic consumers experience between 3G and 4G, which enabled the easy consumption of photos, video and mobile streaming, 5G is less about mobile speed than opening up new wireless applications.

5G use cases are broad in nature: IoT would support the automation of buildings, smart agriculture and smart water metering. Factory floors, now connected with wires, could be reconfigured and entirely wireless and included in real-time information flows.

"Our ambition is to not only provide industrial grade networking hardware, but also to be a strategic partner to our customers as they build secure and resilient 5G industrial networks", says Emma Sundh, product manager at HMS Networks. The company's Anybus Wireless Routers target industrial applications with high-speed WLAN and LTE connectivity.

MEASURED PROGRESS

As an enabling technology, Metrology must constantly develop and evolve along with the fields it serves. *Christian Young*

The rate at which technology is changing in fields such as the automotive and aerospace sectors is driving research institutes, including the Future Metrology Hub, to develop novel solutions to these complex challenges.

The current trend towards higher efficiency and electric vehicles is creating a significant demand for lightweight parts and assemblies, made from composite materials or aluminium castings; these present a number of difficulties in terms of measurement and quality control. A common characteristic of these parts is the incorporation of complex freeform geometries, requiring measurements across a range of scales from micro-scale surface characterisation to macro-scale form accuracy. Whilst this is difficult to achieve using conventional end of process metrology, a greater risk is that of defects and reject parts which could represent a significant cost given the high value of each part.

Above: **Emerging technologies such as Additive Manufacturing require novel metrology products, such as bespoke deflectometry powder bed measurement.**

New processes, different approaches

Other areas, such as the expanding field of Additive Manufacture and an increasing demand for customisable or bespoke products, create further challenges for manufacturers seeking to guarantee part conformity. The old approach of Go/No Go gauges and standardised measurements of a few crucial features is no longer suitable when every part you make is different!

These factors require a different approach, a move away from measurement as an end of process consideration and towards true in-process metrology. It is important to note that this is different to in-line metrology, carrying out conventional measurements at the end of each manufacturing process, and requires the development of new metrology systems capable of being embedded within the manufacturing process.

The approach taken in determining a measurement strategy must also change to fully utilise the capabilities of a network of embedded sensors (often referred to as Sensornets). At present, most measurements are discrete and are often taken on only a sample of parts for large production runs; this makes sense when you have a Quality Control (QC) operative who must physically handle the part and disrupt the manufacturing process to carry out a measurement. With embedded metrology, this disrup-

Above: The era of traditional, post-process, contact measurement is drawing to an end

Above: Machine vision and other non-contact systems are ideal for in-process measurement.

tion, and associated cost, is minimised or eliminated and continuous monitoring is possible. Of course, this approach brings with it new challenges such as the need to process vast quantities of data.

Hands off

Non-contact systems such as optical sensors (which use the properties of light such as interferometry or laser scanning) and machine vision systems (which use software to analyse and evaluate captured images such as photogrammetry) are ideal for use in in-process measurement due to their ability to carry out measurements without having to physically contact the workpiece. Measurement devices using these techniques are widely available and frequently used across many sectors, indeed several automotive manufacturers have featured such systems in adverts as a way of assuring build quality; however, they are often bulky and require skilled operators.

"Nowhere is the term 'revolution' more appropriate than in the field of metrology."

Significant effort is being made across the research community into adapting these techniques for use in a production environment. The adaptions may consist of miniaturising the sensor head or otherwise allowing a probe to be positioned remotely to the main device through the use of optical fibres.

One device, many functions

Other developments include the ability to carry out rapid multiscale measurement using a single device. This significantly reduces the time taken to carry out measurements over a whole part. It is important to note that the capability for rapid multiscale measurements is not just of benefit when measuring the finished part; embedded metrology can also be used to increase the capability of machine elements such as assembly robots and allows for significant improvements in positional accuracy and motion control. Of course, the benefits are not just limited to manufacturing and these devices could be incorporated into any number of autonomous systems including autonomous vehicles.

DIGITAL TWINS

Above: The ultimate aim of the collection of large amounts of metrology data is the creation of true 'Digital Twins'.

Digital Twins take into account all the variables affecting the manufacture of a part to and enable a fully accurate model to be developed, which can be used to simulate the manufacturing process to predict and compensate for any variation. Written down this sounds simple; in practice, however, the need to measure and account for every material, environmental and physical factor and to evaluate the uncertainty of theme measurements in real time presents a challenge that cannot be overstated.

Most people involved in manufacturing will be familiar with the phrase Industry 4.0, the Fourth (and current) industrial revolution. Nowhere is the term 'revolution' more appropriate than in the field of metrology. Measurement is ceasing to be a separate occupation associated with a QC department at the end of the manufacturing process; instead, it will become an integral aspect of production and manufacturing. This will enable manufacturers to achieve greater throughput at reduced cost, while incorporating increased customisability.

Non-contact technologies include laser tracking marker placement

3D vision systems and similar non-contact technologies collect vast amounts of data

Another non-contact technology which is gaining popularity, is the use of X-Ray Computed Tomography (XCT) which is being heavily driven by the pace of developments in additive manufacture. X-rays have been used as a means of defect detection for decades and the ability to see inside an object without the need to open it has obvious benefits. However, in recent years the ability to generate 3D point cloud data from multiple 2D scans has enabled XCT to become viable measurement technique capable of not only visualising features, but quantifying them as well. The method is still in its infancy and significant work must be carried out into developing robust standards for XCT measurement to ensure it is a repeatable and reliable technique for use in an industrial environment.

Managing data

One obvious challenge facing all of these techniques is the need to handle vast quantities of data; orders of magnitude more that can be gathered and evaluated by a single operative. This requires the creation of automated systems that can rapidly process and interpret data and then make decisions about how to use this data to control process, implying the use of Artificial Intelligence or other Smart systems. To enable such a system to function effectively, several challenges must be overcome.

The first is the ability to rapidly communicate data between the collection device and the control unit. Wires and optical fibres are robust and secure but may prove a hindrance to creating networks of embedded sensors while new high speed wireless communication systems such as 5G networks present a possible solution but then introduce the challenge of secure storage and communication of, potentially, immensely valuable data.

A second challenge is need to extract maximal data from disparate and diverse data sources requiring the creation of sophisticated mathematical models which can generate machine readable knowledge which can be used in decision making.

Finally, real-time evaluation of the traceability and uncertainty of the measurements and the control systems is needed, to confirm model validity.

So far, we have looked at many of the technical challenges involved in measurement science. However, the greatest challenge that industry may face, is the need to develop metrology skills in their workforce. Production and manufacturing engineers are rapidly going to find that they need to be much more knowledgeable about metrology practice and interpreting measurement data if they are going to stay ahead of the competition.

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AUTOMATION FOR THE PEOPLE

igus has embraced robotics in its product range and on its shop floor. Now, the Northampton-based manufacturer wants to democratise automation by making it available to a broader range of companies

The march of the robots is well and truly underway, as a growing number of industrial organisations embrace automation as a means of improving efficiencies and lowering costs.

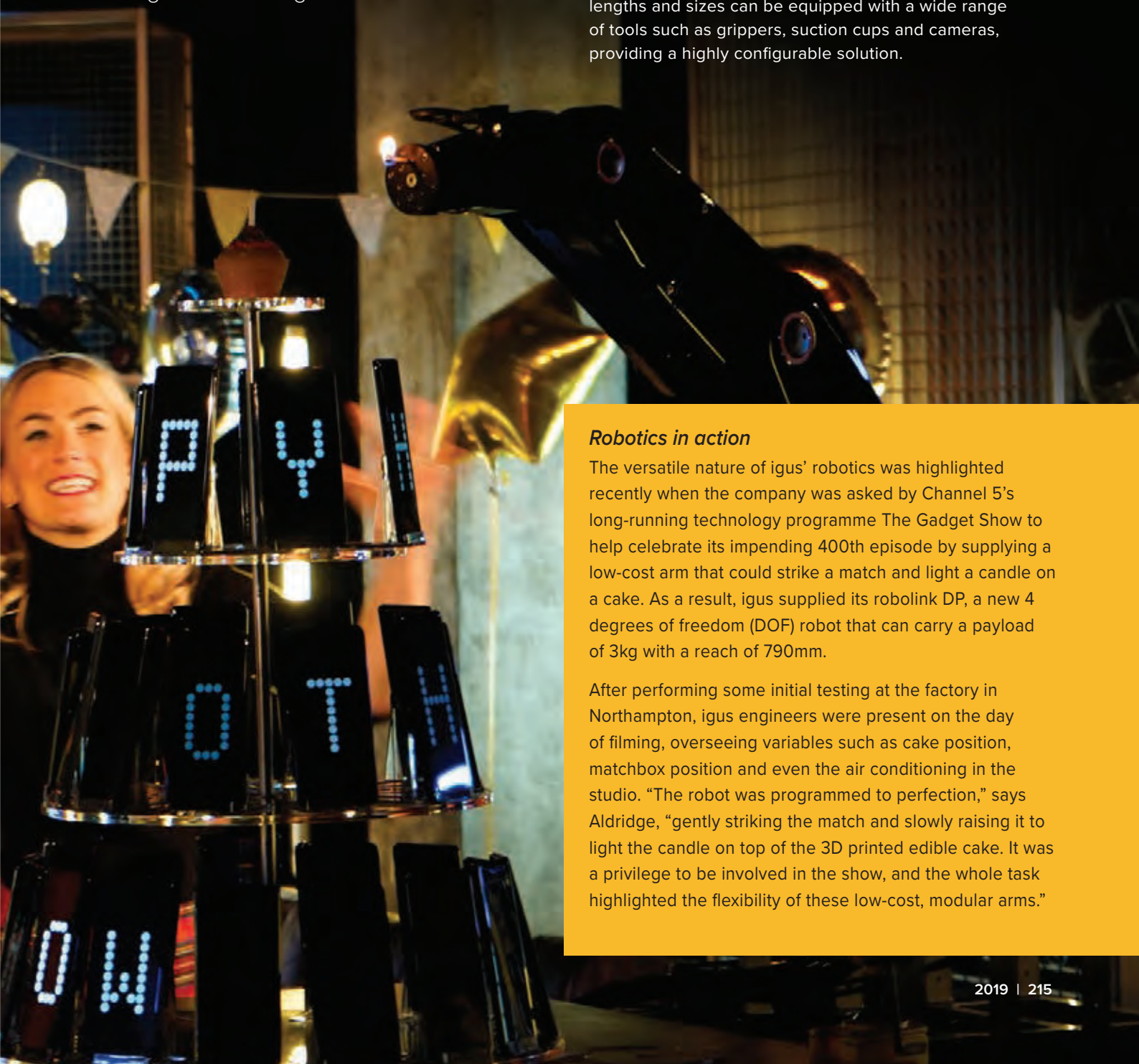
For Northampton-based manufacturer igus, the development of robotic technology has had a dramatic impact in several areas of its business, transforming both the types of products it sells and the way that its production processes are carried out. Indeed, over the past couple of years alone, the company has emerged as a major manufacturer of low-cost robotic arms, while automation has helped it to improve product quality and reduce lead times significantly.

For Matthew Aldridge, managing director of igus UK, the adoption of robotic technology has become a key trend in the manufacturing sector, with digitalisation acting as a primary means of boosting productivity.

"A few years ago, our sole focus was on selling plastic bearings, energy chains and cables with little assembly work. More recently, we have stepped into robotics and automation based on our component parts and are now investing in automation ourselves to enable us to carry out assembly within the UK."

"As a country, we need to invest more in automation to enable us to compete more effectively on a world stage. At igus, we believe robotics can provide a flexible and scalable solution in the era of Industry 4.0, providing manufacturers with a means of creating new value while freeing up employees to perform more added-value tasks."

At igus, the journey to a more automated future has been evidenced by the development of the robolink modular robotic system, which allows companies to automate workflows quickly and easily. Articulated arms in various lengths and sizes can be equipped with a wide range of tools such as grippers, suction cups and cameras, providing a highly configurable solution.



Robotics in action

The versatile nature of igus' robotics was highlighted recently when the company was asked by Channel 5's long-running technology programme The Gadget Show to help celebrate its impending 400th episode by supplying a low-cost arm that could strike a match and light a candle on a cake. As a result, igus supplied its robolink DP, a new 4 degrees of freedom (DOF) robot that can carry a payload of 3kg with a reach of 790mm.

After performing some initial testing at the factory in Northampton, igus engineers were present on the day of filming, overseeing variables such as cake position, matchbox position and even the air conditioning in the studio. "The robot was programmed to perfection," says Aldridge, "gently striking the match and slowly raising it to light the candle on top of the 3D printed edible cake. It was a privilege to be involved in the show, and the whole task highlighted the flexibility of these low-cost, modular arms."

Looking forward, igus is continuing to invest in its range of automation solutions, establishing a new open platform called RBTX that brings together users and suppliers of associated robotic technologies such as end effectors, control systems and pneumatics. This online resource will provide a single marketplace for low-cost robotics, allowing customers to save time and money when sourcing compatible components, says igus.

"RBTX will give customers the confidence to buy robotic solutions for just about any application," says Aldridge. "In every case, the products available on the platform will be fully compatible with igus products, meaning that we can offer low-cost turnkey solutions without any fuss."

Powering new processes

The journey to automation hasn't been restricted to products alone. igus has also been investing heavily in new equipment to allow it to streamline its production processes.

Historically, the company has assembled its readycable range of harnessed cables manually by cutting back the outer jacket, teasing out the shielding, then stripping the jackets off each of the inner cores and adding crimps. This is an intricate, time consuming and laborious process. More recently, the company has installed an automated assembly line at its Northampton plant, allowing it to ship harnessed cables within 24 hours of order placement.

"This type of work had always been done by hand," says Aldridge, "but lead times for harnessed cables had been creeping up across the industry. We spotted a gap in the market for faster delivery and have spent hundreds of thousands of pounds on a bank of machines to automate this process,

cutting lead times from six or even ten weeks down to 24 hours. The chainflex cable is cut to length from our extensive stock, and all common connector components are available ex stock."

The fully automated procedure is not only quicker, but can also deliver higher levels of predictability and reliability, resulting in 100% quality of assembly. With manual assembly, there was always the slim chance of a quality issue, which used to get picked up at the testing stage. But, says igus, with the new automated operations, the quality is perfect every time, and each cable comes with guaranteed service life.

Robots won't replace workers

The investment in the new equipment represents igus' commitment to the power of automation. Yet that belief does not come at the cost of people within its plant. Quite the opposite, in fact. Several employees have been freed up from repetitive tasks and deployed in other areas where they can bring new value to the business.

"It is a misconception that automation always leads to the shedding of jobs as robots inevitably replace people," adds Aldridge. "The introduction of the new automated assembly line has, in fact, allowed us to grow our business in other areas, creating new jobs on the production line. Robots and people are complementary, bringing very different types of skills to an organisation.

That's one of the positive messages around igus' journey to automation, adds Aldridge. "This whole process has helped us to re-shape the business, embracing the advantages of new technology to become fit for the future. Ultimately, automation is a force for good and will help us to build a more sustainable future."

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DESKTOPS, VFD PRODUCTION, PIPES AND BEER

AUTOMATION CASE STUDIES IN 2019

DEMOCRATISING ROBOTICS

Automata has brought a whole new category of affordable industrial robots to market with Eva - the first ever desktop robot engineered from the ground up to be low-cost, lightweight, user-friendly and accessible while maintaining industrial grade performance. Eva has been designed for SME manufacturers with small batch production in mind, enabling them to reduce production costs, remove manual bottleneck processes and improve margins.

Founded in 2014 by architects Mostafa elSayed and Suryansh Chandra, Automata was born out of the need to find a low-cost approach to industrial automation, when the only options available were prohibitively expensive industrial robots costing in excess of £25,000, or basic robot arms sold on Amazon for £2000 that are little more than toys.

Following three years of intense development and iteration of both the hardware and software aspects of the product, they began running a series of customer pilots in 2016 to ensure they stayed on track and remained focussed on solving customers' real-world problems.

"With our team now at 40 people, Automata officially launched commercially in March 2019," Chandra said. "We have already had hundreds of orders and have many happy customers with successful deployments who are already making repeat orders."

Metal components manufacturer Qualitetch has recently benefitted from the Eva robots.

As an ambitious growing business, serving blue-chip customers in new geographies and markets, the company looked for a way to double production capacity without having to double headcount or run second shifts.

Qualitetch deployed an Eva at the start of a pre-cleaning line, to automate the feeding metal sheets one by one into the cleaning machine at timed intervals; a part of the process that had previously been done manually by a member of the team. The robot has doubled the capacity of a bottleneck production line and delivered return on investment in eight months.

COLLABORATIVE ROBOTS BOOST TESTING

In summer 2019 **Invertek Drives** opened the doors to its new 5000 square metre global manufacturing and distribution facility in Welshpool, with the capacity to produce up to 400,000 variable frequency drives (VFDs) a year.

This immense output, along with big variations in product lines and tasks, meant the company needed a flexible automation solution, able to switch between different jobs and part sizes throughout the production process. Part of the solution came through incorporating two UR5 cobots into the testing phase of its production line. By automating this aspect of its operations, the company has improved workflow consistency.

"Our workloads can change every other minute and we can manufacture over 15,000 variations of our products," Peter Evans, manufacturing engineering manager at Invertek Drives, said. "This means we need cobots that can handle the inspection and testing of constantly changing devices, all within a single production line. This is where our UR5s shine. Working 16-hour shifts, they can achieve this and so much more."

During production, live tests of VFDs are carried out and the safety of its employees was a factor for introducing the cobots. Previously, employees had to physically enter the testing area to press a button, which adds time to the testing cycles. The deployment of cobots has also greatly improved work consistency, as they can be stationed to undertake a task at fixed intervals. With work cycles normally lasting around 10 minutes, the company can now do more test cycles per hour.

The cobots also play a big part in quality control, thanks to a specialist end-of-arm unit that was created by Invertek's in-house manufacturing engineering team. Equipped with a Cognex vision system, lighting controls, a fan-speed sensor and robotic finger, the specialised component enables a full range of complex tests, such as visual inspection, to be performed to ensure that the product is operating correctly.

OVERSIZED PLASTIC PIPES MILLED TO PERFECTION

Asset International in Newport, South Wales manufactures plastic pipes several metres in length and up to 3.5m diameter. These oversized pipes are used for applications like gravity-based drainage systems, dewatering, subterranean canals, retaining basin systems, and low-pressure applications.

"Shorter production times have allowed us to boost capacity by more than 50 per cent"

Graham Bennett, Asset International

As part of a pilot project for robot-based automation, KUKA supplied the KUKA 120 R2700 extra HA robot, along with a KL 1500-3 T linear unit, two MG 360 KUKA servomotors for the external rotational axis, and a KUKA CNC controller.

The biggest challenge of the automation project was the reliable and flexible machining of the unusually large components with different contours and shapes. In order to increase flexibility and work safety at Asset International, a modular, integrated and easy-to-operate solution comprising a robot and milling spindle was required.

"The solution has enabled us to significantly increase productivity," said Graham Bennett, operations manager at Asset International. "Shorter production times have allowed us to boost capacity by more than 50 per cent. At the same time, there has been a marked improvement in quality and precision."

The high level of repeatability allowed Asset to achieve improvements in quality as well as to optimise the subsequent production step of welding. In the welding process, both time and materials were reduced thanks to the consistent preparation of the joining gap and weld seam. In addition, health problems ensuing from manual labour involving heavy vibrations have been eliminated and safety has been increased. With a modular design that is tailored to the customer's requirements, the system can be adapted to the needs of Asset International at any time.

CREATING SPACE FOR MORE BEER

Adnams still operates out of its original 18th century site in Southwold, Suffolk, but its traditional brewing methods have not stopped it implementing a modern end-of-line automation solution. Forty different beers are produced at the brewery, including seasonal beers and one-offs. It ships around 100,000 163-litre brewers' barrels a year but fitting a 21st Century brewery into a 19th Century building is a running challenge. Adnams has sought to introduce automation and, more specifically, the use of robotic end-of-line palletising systems to process the beer barrels once they are filled.

"At the end of our main cask filling line – where we put the beer into the barrels – we had an old palletiser, which took up a lot of space," Fergus Fitzgerald, head brewer at Adnams, explained. "We've got a very limited amount of space, so we must be quite creative when it comes to using it as effectively as possible."

The brewery wanted to add a 0.5%-alcohol version of its Ghost Ship Pale Ale but had exhausted all available floorspace. However, by upgrading the old palletiser to a more compact automated solution, they could accommodate everything on the brewery site. To enable this Adnams asked FANUC to design a robotic end-of-line loading system.

To meet the load demands of handling filled 160-litre barrels, FANUC specified its R-200iC/210L six-axis palletising robot. With a maximum payload of 210kg, it could comfortably process the full casks at the required rate of 250-300 barrels an hour and keep pace with the beer as it came out of the filling line. With a compact footprint of 771mm x 610mm and a reach of 3100mm, it can operate within the confined working environment of the brewery. Crucially, the robot body is IP54 rated, to protect it from the residual beer found throughout the cask filling line.

PRODUCTIVITY: SHARING IN GROWTH WINNERS

The companies that have benefitted from Sharing in Growth's transformation programmes range from tube assembly manufacturers to forging specialists.

CW FLETCHER

CW Fletcher, an enterprising aerospace and nuclear manufacturing company located in Sheffield, has signed a record £160 million long term contract with Rolls-Royce PLC - the most valuable secured by the company in its 126-year history. They will supply aircraft engine fabrications for the next ten years. The contract forms a key part of the company's growth strategy, which includes a new 2000m2 facility and secure the future of its 200-strong workforce. Its strategy for sustained growth is based on being one of the first companies selected for the Sharing in Growth (SiG) competitiveness improvement programme.

INDEPENDENT FORGINGS & ALLOYS

Sheffield forging firm **Independent Forgings & Alloys (IFA)** has been selected by SiG to join its award-winning business transformation programme. IFA plans to almost double annual sales turnover, from 2018's £23 million to nearly £42 million by 2024. It received an £8.5m capital investment from Business Growth Fund in 2018 and will work with SiG to focus on leadership, culture and operational capability. Changes will include communication; integrated business development; new product introduction and cost modelling systems; scalable production planning and control process; and a review of supply chain systems.

FERRANTI TECHNOLOGIES

Ferranti Technologies received a Sharing in Growth 2019 best practice award at a short ceremony at its Oldham headquarters. SiG operations executive Malcolm James presented the winner's certificate in the presence of senior managers from Ferranti and parent company Elbit Systems.

The team, led by quality director Nicola Higgins, was congratulated on creating a strong culture based on values as a springboard for business improvement and embracing the importance of sharing best practice through Sharing in Growth All STAR events and STAR days.

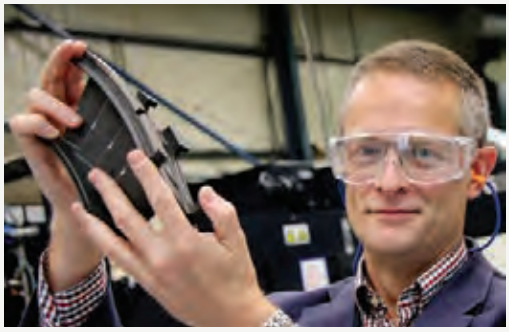
SIGMATEX

Sigmatex, which joined Sharing in Growth in 2015, has won the 2019 Northern Automotive Alliance (NAA) Company of the Year Award 2019, sponsored by Bentley Motors Ltd. It also won a 2019 SiG All STAR best practice prize and the Logistics Excellence Award, sponsored by DHL, for implementing a series of process and product changes that optimised package size and footprint and reduced delivery numbers, resulting in a significant reduction in emissions. It was also highly commended in the Manufacturing Excellence Award category for transforming a loss-making process into one making a sizeable profit.

ATL TURBINE SERVICES

Dundee based **ATL Turbine Services**, a one stop shop turbine component repair facility dealing in both aero and light industrial turbines, specialises in legacy/late life gas turbines and works across the defence aviation, civil aviation, industrial and marine sectors. Exports account for around 30% of sales. ATL's work with Sharing in Growth has helped it to secure a significant five-year contract with a major aerospace OEM, estimated to be worth £5M over the contract term.

JJ CHURCHILL'S



Aerospace supplier **JJ Churchill's (JJC)** SiG-supported improvement programme, begun in 2013, was suspended in 2015 because of market turbulence. A comprehensive diagnostic process identified key strategic themes, generating detailed plans for a total business transformation, aided by £1.1m from the Regional Growth Fund. JJC's £10m-plus investment plan included seven Makino grinders. It strengthened focus on civil aerospace and increased contracts won or retained from £19.14m in 2014 to £32.98m in 2015, returning to growth by 2017. Lost time due to accidents is now zero; productivity up 30%; right first time is 99.7% and OTIF delivery 100%. Cost savings total £2.73m.

G&H GLENROTHES

High tech manufacturer **G&H Glenrothes** has been recognised with a SiG national best practice award for achieving record output. The Fife-based company, part of the global G&H advanced optical engineering and manufacturing group, employs around 70 highly skilled staff making precision optical components. It targeted output increase of 23% in 2018 and worked with SiG to implement world-class and lean manufacturing techniques, such as value stream mapping, waste elimination and continuous flow production. The team beat its target by delivering a 29% increase in output and 200% improvement on year-on-year profits. Improved competitiveness helped the company to secure £16 million in new contracts.

SL ENGINEERING

SL Engineering, of Grantham, Lincs, produces specialised rigid tube assemblies, complex fuel manifolds, core engine pipes and flexi-metallic rigid pipes for some of the world's most demanding fuel, hydraulic and other critical fluid conveyance applications. The company has experienced 87% growth in the last three years, particularly from aerospace. To continue this rapid growth and increase turnover to over £12 million by 2023, the company applied for SiG's support. After a detailed and robust business diagnostic, it has now been accepted onto the programme.

CONTRIBUTORS

The UK Manufacturing Review 2019/20 is built on contributions from a range of professional writers and experts in their fields. They are listed alphabetically here.

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The UK Manufacturing Review is published once a year by Stirling Media. For this edition and back issues, please contact Stirling Media at their registered office:Unit 6, Old Smithy Court, 80 Station Road, Hampton, London TW12 2AX

T:+44 (0) 208 617 9517
M:+44 (0) 7920 179496

MANUFACTURING IS WORTH TALKING ABOUT!

BY EMMA VARNEY-LONG

Many manufacturers believe that simply maintaining their existing client base is enough – but this is not the case! Long-established and valuable relationships can be lost when customers liquidate, are sold or simply get a better offer.

You need focus and ability to market your business, as well as the drive and passion that you feel for your products. Simply providing an overview is not enough; you need to invest time building knowledge and engagement, and ensuring everyone is on the same page – and, as a business owner, CEO or MD, be actively involved.

Sales and marketing are often merged together but they are distinct. They need to work side by side and collaboration is the key. Brand visibility, traffic and sales all are key partners to a successful business.

Getting it right is essential, especially the basics; a logo in all formats, resolutions, and specs; typeface and Pantone colour: these things all save time in the future and provide a focus for future events exhibitions and print – something that still has value. If you don't have content, or images of a good standard, how are you able to put across that you are the best within your industry? How can you and your marketing team create, editorials, good copy, press releases, white papers with just a smartphone snap?

Appearance is everything but if you use an image that shows lack of care, why would a potential client come to you?

The new kid on the block is social media. It allows you to connect with your potential and returning customers.

It's not about likes, it's not about shares it's about being a relevant reference point, up to date and with the correct details.

A good blog requires care and attention. A business needs to post differently on different platforms and invest time on retaining that "viewer".

If you are a PLC or a Ltd company there are different criteria for your websites, and how you market, having to meet certain rules, which it is vital to get right.

Consumers have different opinions. Some will love the look, some will say their feed is filled with your posts, some will not like the new website! You will never please every individual but having someone that will take the information look at it and offer an informed opinion, is a way to (a) review your work and (b) acknowledge it's working, as even critical consumers are looking at your post/site.

As an industry we have so much good news, progress, automation, recycling, new plastics, robotics, collaboration, investments, apprenticeships, training, new design, exports and so much more. The value in sharing this, engaging with others and getting across the message that you are a quality British manufacturer, providing excellent product and customer service – and investing in their staff – could be in reaching that vital person whose purchase or investment changes your business!

Emma Varney-Long is Marketing and PR consultant for www.pce-group.co.uk

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A good blog requires care and attention. A business needs to post differently on different platforms and invest time on retaining that "viewer".

If you are a PLC or a Ltd company there are different criteria for your websites, and how you market, having to meet certain rules, which it is vital to get right.

Consumers have different opinions. Some will love the look, some will say their feed is filled with your posts, some will not like the new website! You will never please every individual but having someone that will take the information look at it and offer an informed opinion, is a way to (a) review your work and (b) acknowledge it's working, as even critical consumers are looking at your post/site.

As an industry we have so much good news, progress, automation, recycling, new plastics, robotics, collaboration, investments, apprenticeships, training, new design, exports and so much more. The value in sharing this, engaging with others and getting across the message that you are a quality British manufacturer, providing excellent product and customer service – and investing in their staff – could be in reaching that vital person whose purchase or investment changes your business!

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