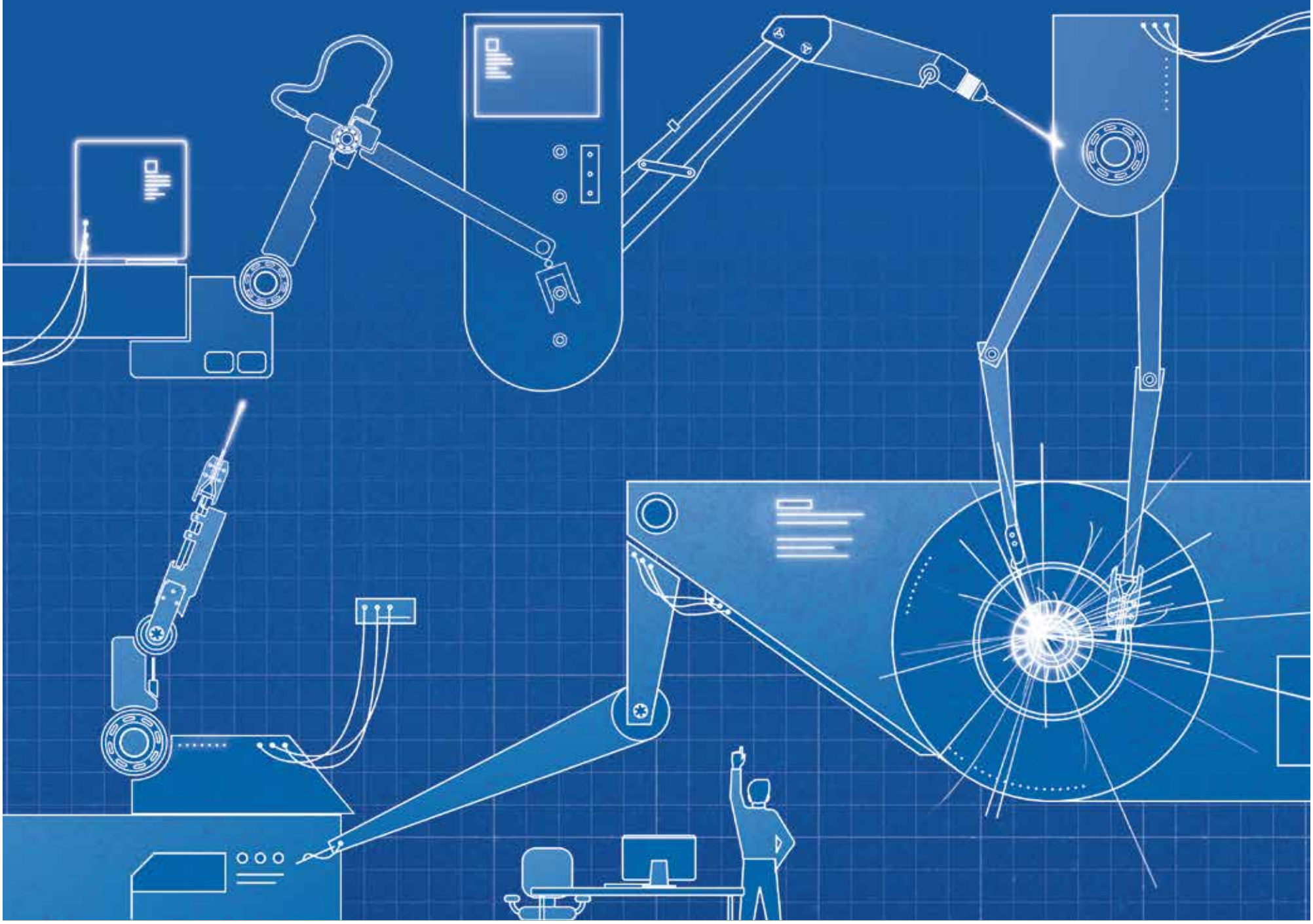
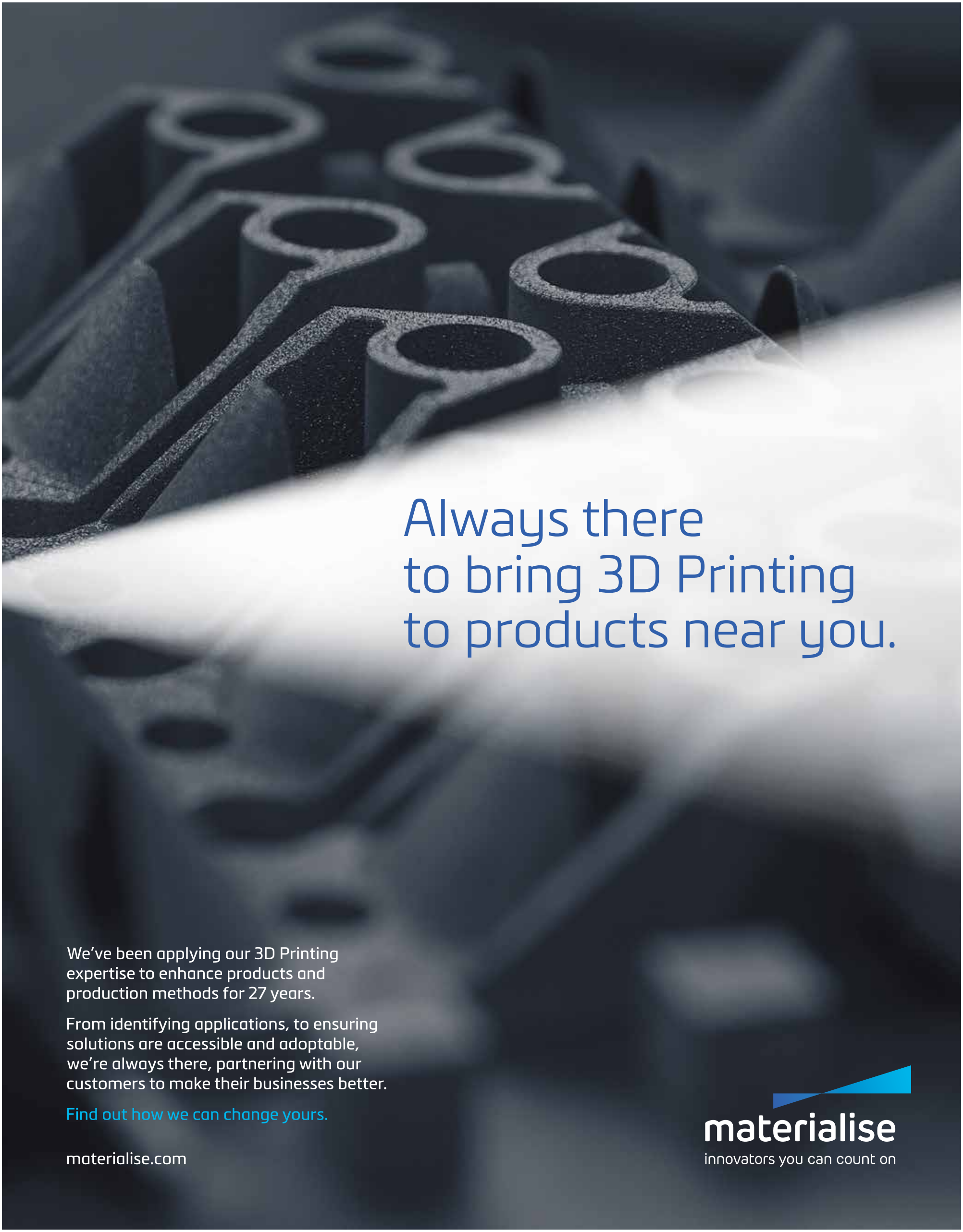
FUTURE OF MANUFACTURING

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FUTURE OF MANUFACTURING

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OVERVIEW

Learning to compete with the best

The UK does not manufacture and export enough, but there are lessons to be learnt which could transform fortunes

CHARLES ORTON-JONES

The falling pound was supposed to remedy the UK's trade deficit. Instead the goods trade deficit widened from £11.3 billion in June to £12.7 billion in July, the widest gap since last September.

The numbers hide a lot of colourful stories. Some UK manufacturers are opening the bubbly. Manchester-based Francis Kirk Group, which makes industrial fasteners, signed chunky deals in the United States and Middle East to take turnover from £4.75 million to £7 million by the year-end. That's what you can do when exports are 40 per cent of sales.

And the whisky industry never seems to have a bad year. Whisky alone now accounts for 20 per cent of all UK food and drink exports. Half of whisky exports are to outside the European Union.

But the truth is the UK isn't reaching its full potential. Germany and Japan are in the premier league of manufacturing. Switzerland produces three times as much per head. Sweden double. What we have is a constellation of superstar performers, such as JCB, McLaren and Jaguar Land Rover, but they are too few.

The question is how can we compete with the best? Arguably, it's not that baffling. Industry veterans know all too well where UK manufacturing struggles. Here are the four main ingredients. Fix these and we'll be giving the Germans and run for their money.

First is training. The failure to produce enough engineers is a national tragedy. The industry body EngineeringUK says the country needs 69,000 more engineers a year just to meet current demand. Naturally, if we produced these engineers then demand would soar as employers thrived, making the real total much, much higher.

When the government investigated why there is such a shortfall, a key reason identified was the reputation of engineering. Only 15 per cent of UK children would consider a career in it and 40 per cent called it "boring". Half thought engineering "dirty". Only 12 per cent of female university students wanted a career in manufacturing.

The sector has thrown dozens of initiatives at the problem, from Ada Lovelace Day to encourage women in STEM – science, technology, engineering and mathematics – to direct inventions in schools.

Simon Dawson/Bloomberg via Getty Images

Employee welding parts at the Brompton Bicycle factory in London

The new apprenticeship levy may be the game-changer we've been waiting for as companies must spend 0.5 per cent of salaries on apprenticeships.

Second, tie-ups with universities must become normal. Knowledge-transfer partnerships, as they are known, are incredibly productive. The University of Edinburgh has been a national leader for more than 40 years. Between 2010 and 2015 it churned out 836 licence agreements from technology developed in-house. It claims 189 spin-outs.

Research parks are a productive way to bring academics and entrepreneurs together. The University of Surrey owns the astonishingly productive Surrey Research Park, a sprawling campus near Guildford. Home to 140 companies, the idea is to commercialise technologies developed in universities from all over the UK.

Third, the focus must be on ultra-high tech. A standout example is the field of graphene. In 2004 researchers at the University of Manchester noticed the bizarre properties of single sheets of carbon atoms, known as graphene. The work led to two Nobel Prizes.

Graphene is the strongest material known to man, 200 times stronger than steel. It's stretchy, able to be pulled to 20 per cent its normal size. Usually hard materials shatter when stretched. And it is electrically responsive. Connect a current and it can be either 200 times more conductive than copper or an insulator with almost no conductivity. Graphene could be the miracle material for computer chips, bullet-proof jackets and anti-corrosive paint.

On this occasion, the UK is investing as it should. A £61-million National Graphene Institute in Manchester aims to capitalise on our expertise in this sector. The model has worked before. The London Institute for Nanotechnology, a joint venture of UCL and Imperial College, develops world-beating technology at the nano-scale. When the UK invests like this the results are almost universally positive.

And finally is the spirit of adventure. Manufacturing needs pioneers, in the most romantic interpretation of the word. The US is teeming with buccaneering figures. Elon Musk is capturing the hearts of a new generation of Americans with his Tesla driverless car. He also has a space project, Space X. And when stuck in traffic, he announced a city-to-city tunnel drilling company called The Boring Company. The low-cost tunnels may make hyperloops possible – vacuum tubes enabling travel from New York to Washington DC in less than 30 minutes.

When Musk wants to brainstorm, he can chat to his friends Larry Page and Sergei Brin, founders of Google, who are also building driverless cars. Or Jeff Bezos at Amazon, the king of retail who is also aiming to become a master of robotics. In the US these moguls are famous. Entrepreneurs such as Sara Blakely, who built a billion-dollar fortune with Spanx underwear, inspire the next generation.

The UK hasn't generated a new celebrity in manufacturing in 20 years. Yet there is no shortage of candidates. Claire Williams is the boss of the Williams Formula 1 team. She's a ready-made role model. Chris Rea of industrial seals brand AESSEAL exports to 104 nations. Demis Hassabis is the founder of DeepMind, which developed a self-learning artificial intelligence engine that beat the world's top Go board-game players. Hassabis is a legend in Silicon Valley. Yet he's barely known here, outside tech circles.

The goal of the UK should be to overtake Italy and France in manufacturing output within a decade. There's no doubt the ingredients are all there. But until we fix these issues, we'll remain in their wake.

MANUFACTURERS' CONTRIBUTION TO UK ECONOMY

10% of gross value added

45% of total exports

2.7m people employed

EEF 2017

CHINA 2025

Could it all be made in China by

China's manufacturing base faces major challenges as the global economy continues to evolve, but Beijing has a master plan

NICOLAS ASFOURI/AFP/Getty Images

Workers building smartphone chip component circuits at an Oppo factory in Dongguan; China wants to reduce its reliance on low-end manufacturing and focus on high-tech industries

NICK EASEN

China may be the world's second largest economy, trailing the United States, but it's by far the globe's biggest manufacturer of every type of product you could imagine from artificial Christmas trees to shoes or solar cells.

Take more than 500 types of industrial product and China ranks first for 220 of them, globally. Yet Beijing isn't satisfied with just being the world's factory for cheap goods.

More than a third of the country's 800-million workforce produce biblical amounts of stuff, generating $3 trillion annually, but China's position is slipping. It's political and economic leaders know the country can't rest on its laurels for long. There are more than a few rivals nipping at its heels, but it has a plan.

On one side, there's increasing competition from developing countries. China's wages are on the rise, especially on its eastern seaboard, its workforce is ageing and there's an oversupply of some goods. At the same time, the five Asian nations of Vietnam, Malaysia, Thailand, India and Indonesia, known as the Mighty Five, are starting to look like a new China in terms of low-cost labour, favourable demographics, market growth and agile manufacturing capabilities.

On the other, more advanced countries have either moved production back home or are outpacing China when it comes to high-end manufacture, innovation and technology. For instance, the US is expected to overtake the Asian giant and assume the number-one position in the *Global Manufacturing Competitiveness Index* in the next three years.

"Germany also averages more than 300 industrial robots per 10,000 industry employees, China only averages 19. China's manufacturing industry needs a push to take it to the next level and avoid being squeezed," says Ricky Tung, China industrial products and services leader at Deloitte.

China's leaders lament how its manufacturers are heavily reliant on core components developed by Western corporations and that so much of the added value for iPhones, laptops and other devices resides overseas, while the low-grade assembly goes on in Guangdong or Sichuan. US President Donald Trump hasn't helped by threatening tariffs on imported Chinese goods and pestering companies such as Apple to stop making products in China.

Rising costs are also reducing manufacturers' profits, causing capital to flow out of China's real economy and into the property market. Its evolving middle class don't want to sweat it out on low-grade production lines. It's a warning sign that the country's manufacturing industry needs a makeover.

"Economies that change and move up the value chain have delivered better working and living standards across the world since the industrial revolution," says David Martin, director of the China-Britain Business Council.

Therefore, Beijing has hatched a plan. It's banking on an industrial blueprint called Made in China 2025 (MIC2025), inspired by Germany's Industry 4.0 and the United States' Industrial Internet of Things, to breathe new life into the sector. It aims to shift China towards higher value, advanced manufacturing dominated by automation, robotics, big data and cloud computing. The key aim is to boost productivity.

> It's a warning sign that the country's manufacturing industry needs a makeover

This plan has even greater impetus as China now hits the middle-income trap, with GDP per capita at roughly $8,000 a year. This term refers to countries who find it difficult to catch up with high-income economies as wages rise and they lose their competitive edge exporting manufactured goods. There's a belief that new technology invested into warehouses from Chongqing to Tianjin could give China the shot in the arm it needs.

"Traditional drivers of growth such as investment in infrastructure are losing steam. China has to go for a new growth model driven by innovation," says Jost Wübbeke, head of program economy at the Mercator Institute for China Studies.

"China's challenge is to incentivise an industry that's used to low-end manufacturing. It now needs to design and produce cutting-edge tech. It will also need to upgrade facilities by using advanced production technology, especially smart manufacturing tools and processes."

The goal of MIC2025 is to boost ten industrial sectors from aerospace to electric vehicles, robotics to medical equipment. It sets out growth targets, research and development priorities and China's future global market share. This scheme from Beijing's ruling elite is both prescriptive and specific in the targets it sets.

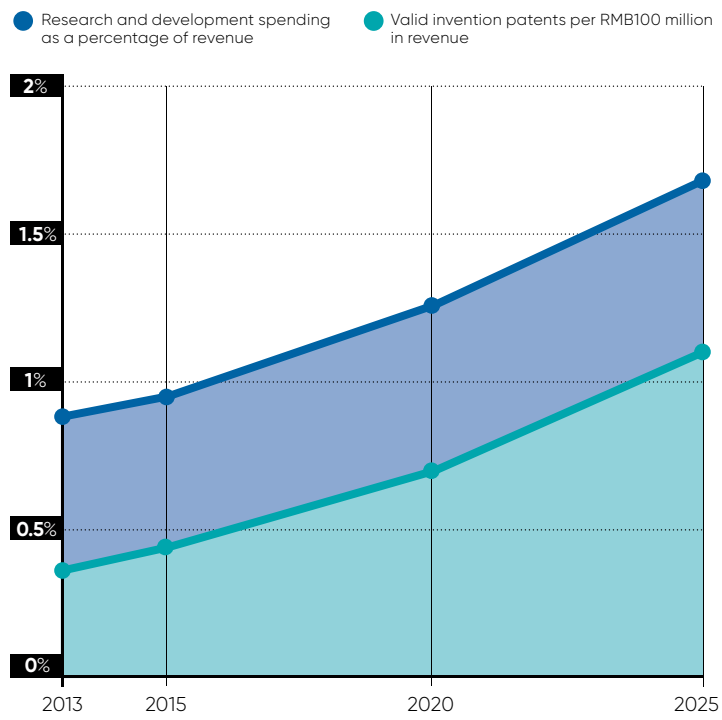
The Made in China concept is not just about branding the country, but about giving its people the toolset and the capabilities so it can thrive in certain sectors. For instance, MIC2025 expects Chinese suppliers of high-tech to reach a domestic market share of 70 per cent within the next eight years.

"The fact that China is attempting to move its manufacturing up the value chain is inevitable; its near neighbours have developed in a similar path," says Mr Martin. "MIC2025 is important in terms of changing the competitive environment and the challenges of doing business with the country. There are also new opportunities for UK expertise to partner with China."

Whether state-driven policy can dictate innovation, which is

INNOVATION IS KEY TO MIC2025 STRATEGY

Forecasts for Chinese research, development and applications for patents



Chinese Ministry of Industry and Information Technology 2015

2025?

INSIGHT

FOREIGN CRITICISM

Made in China 2025 marks a step forwards for domestic innovation and high-tech manufacturing, but the industrial policy initiative has raised concerns in some quarters.

The European Union Chamber of Commerce in China (EUCCC) this year released a major report warning that Beijing's planned subsidies for local manufacturers and limited market access for foreign business could "stoke tensions" with international trade partners. The report cautioned against China's drive for "indigenous innovation", "self-sufficiency" and state-backed investments in foreign manufacturers, saying these policies will "further skew the competitive landscape in favour of domestic companies".

"MIC2025 is in fact a large-scale import substitution plan aimed at nationalising key industries or at least severely curtailing the position of foreign business in them, both as suppliers of key components and finished products," the EUCCC says.

usually a bottom-up, organic process, remains to be seen. However, the country is in a unique position. Already three out of the top five smartphone makers globally are now Chinese corporations in terms of the volume of shipments, according to the International Data Corporation.

China has also broken the patent application record, with more than a million domestic submissions, according to the World Intellectual Property Organisation, more than the US, Japan and South Korea combined.

One option could be for China to continue to buy up know-how overseas. For example, mainland enterprises have already gobbled up Bio Products Laboratory in the UK for $1 billion, London's Black Cabs and Weetabix.

"China is relatively cash rich, therefore looking at international companies with an eye for mergers and acquisitions is the quicker route to moving up the value chain and to leveraging both the skills and brand reputation of the international company," says Mr Martin.

This could also help address the technology gap. Chinese manufacturers still lag behind many leading enterprises from across the globe. Take high-performance six-axis and welding robots; they must still be imported to work on China's shopfloors, as are many other core components for industrial robots.

"Foreign brands represent nearly 70 per cent of the market share of the Chinese robotics market," says Mr Tung. "There is also a lack of talent. This makes it very difficult for many Chinese enterprises to install and use high-end manufacturing technologies."

That's because complex IT processes and computerised machines require detailed expertise in various fields of automation, engineering and software. There is still a question whether the labour force in China can reskill itself. Herein lie many opportunities for overseas corporations.

Another issue that's not been fully addressed is that increased productivity and automation in China's manufacturing industry as MIC2025 takes hold could mean fewer jobs on the shopfloor. However, a record-breaking eight million students will graduate from Chinese universities this year, twice as many as graduate in the US, and there's also been an explosion in engineering graduates.

> There are new opportunities for UK expertise to partner with China

"The potential loss of workforce due to automation is not yet a major issue for the [Chinese] government. However, sooner or later, China will have to face this challenge," says Mr Wübbeke. "The future of work is not only a Chinese issue. Digital transformation, changing social values and worker expectations will be disruptive in China and globally."

What is certain is that the world will see more Chinese corporations entering and shaping global markets. There's no doubt that the Made in China label still has as a firm future.

COMMERCIAL FEATURE

Manufacturers invest in digitalisation as Industry 4.0 nears

A digital revolution, driven by automation, is transforming the industrial world. **Brian Holliday**, managing director of Siemens Digital Factory, examines how manufacturers can stay on the right side of this disruption

Digitalisation is coming. Industry 4.0, the highly digitised environment rich in data and interconnected devices, is ushering in a new era for manufacturers. Seamless and intelligent digital platforms are set to boost productivity, promote flexible production capability, tackle cyber-security concerns, create high-value jobs, aid competitiveness in a global marketplace and drive commercial growth.

Looking at this from the business community's perspective, it is clear that establishing how the UK's manufacturing and industrial sectors embrace and adapt to a highly digitalised future, and benefit from the clear opportunity this brings, will be a fundamental factor in any future economic success.

The current government-supported Industrial Digitalisation Review (IDR), led by Siemens UK chief executive Juergen Maier and including representatives from some of the UK's most prominent businesses, is helping to lay the groundwork for a manufacturing digital future. It will highlight how the design, development and deployment of digital technologies can support and drive the UK's digital industrial revolution. The review report is due in the coming months.

The IDR will set out a clear industrial digital roadmap and offer expert insight into what needs to be done to prepare the economy for the coming waves of technological change. It seeks to ensure that a thriving digital infrastructure supports the growth of digitally enhanced businesses, enabling job creation and a more skilled workforce.

Digital adoption will drive higher productivity levels across our important manufacturing and industrial sectors and, ultimately, the achievement of long-term economic prosperity that will benefit society at large. But there is still some way to go.

According to EEF, the manufacturers' organisation, just 11 per cent of manufacturers think the sector is geared up to take advantage of the fourth industrial revolution. This mindset must be changed through collaboration and communication, so UK companies gain the confidence to embrace digital technologies, including Siemens' innovative MindSphere open cloud platform with data analytics and connectivity capabilities, and are able to overcome whatever barriers stand before them, notably investment finance.

FINANCING FOR THE FUTURE: SIEMENS FINANCIAL SERVICES

In the new world of manufacturing, asset finance will increasingly be viewed as an important investment facilitator due to its ability to accommodate the total cost of ownership approach to key digital technology.

In addition to the technology investment, individually tailored finance solutions from Siemens Financial Services can also cover other costs such as installation and maintenance. Industrial financing solutions enable a high level of transparency of costs over time and allow businesses to assess appropriately the cost-benefit ratio of the acquisition right from the start.

Industrial financing solutions not only offer reliable financial planning but also contribute to the calculation of production cost per unit. Payments can be arranged to align with expected cost-savings or improved productivity delivered by the newly acquired technology. As a result, the costs of technology acquisition or upgrade can be fully offset by the financial gains generated by the deployment of the machinery and technology.

Investments in digitalisation and automation can take place in a financially sustainable way. As well as extending the available volume of financing, the speed and ease of the financing decision and arranging asset finance can be a key enabler allowing manufacturers to act fast to seize market opportunities.

It is imperative the benefits of digitalisation are promoted, reinforced, understood and accepted by all businesses across the entire value chain. Supporting the UK's manufacturing base, from small and medium-sized enterprises right across the entire supply chain, with enabling financing options can help ignite a step-change in digital technology adoption and the undoubted payback it will bring for all.

For more information please visit www.siemens.co.uk/fom

GOOGLE GLASS

Workers at agricultural equipment manufacturer AGCO use Google Glass Enterprise Edition to view assembly instructions, make reports and get remote video support

Seeing a future for Google Glass 2.0?

Google Glass has now been targeted at manufacturing and other enterprise uses, but will it succeed second time around?

FINBARR TOESLAND

The launch of business-focused Google Glass Enterprise Edition comes two years after the original Google wearable failed to connect with consumers and was withdrawn from sale. Google worked with industry to create this new version of Glass, in an effort to meet the demands and expectations of enterprise customers, with enhanced battery life and power among the improvements.

Futurist and trends expert Jim Carroll believes these changes may be enough to make the new Glass EE a success. "It's long been a rule that the first generation of a product is hard to do, but what comes from that effort is invaluable insight for the second generation. This is probably the case with Google Glass," he says.

"It's perfectly positioned for alignment to accelerating manufacturing trends, such as virtual welding and other capabilities that involve an increase in 'spatial manufacturing capabilities'. We're witnessing a lot of fast-paced trends with virtual and augmented reality, and it ties into those trends."

> It's perfectly positioned for alignment to accelerating manufacturing trends

A number of manufacturing companies have already introduced Google Glass EE to their assembly lines with great success. One of the central advantages of Glass EE is its ability to simplify industrial processes, by speeding up the time it takes to complete repetitive but vital tasks. Agricultural machine manufacturer AGCO managed to reduce machinery production time by 25 per cent and inspection times by 30 per cent thanks to Glass making access to instructions and checklists easier.

Glass's capacity to provide hands-free, visual access to all types of information to workers will be received well in the manufacturing industry, where efficiency and safely are paramount. "Today, we're already seeing manufacturers use graphics pads to link operational machinery with visual data in the moment. Gone are the days when operators will have to sift through log after log of metrics to uncover a machines' operational efficiency," says Martin Walder, vice president, industry at energy management and automation specialist Schneider Electric UK and Ireland.

"Instead, this connected technology will pull in data and analytics instantly, informing the individual in real time. The addition of a tool such as Google Glass has the potential to take that one step further, freeing up the operator's hands and allowing them to interact with the machinery and the information simultaneously. This opens up several doors of opportunity in productivity, downtime management and even electrical distribution."

The new and improved Google Glass Enterprise Edition not only faces intense competition from Microsoft's HoloLens, but the product will also have to shake off the much reported failure of its predecessor. So will enterprises be as hesitant to embrace Google Glass EE as consumers were to accept the original?

Dr Vaggelis Giannikas, research associate at the University of Cambridge's Institute for Manufacturing, welcomes the industry-friendly improvements in the new version, but believes there's a long way to go before widespread industrial use, due to practical issues as well as hardware limitations and software challenges.

"Some users are not willing to wear a device with a camera and mic at all times due to privacy concerns, with confidentiality issues potentially arising from the fact that augmented reality devices can capture photos or videos from proprietary operations and data," says Dr Giannikas, who worked on the previous version of Google Glass for industrial applications.

> A challenge that Google, and indeed the industry at large, faces over the short term is price

Glass EE may have the potential to gain efficiency savings over more traditional solutions, but this device will not exist in isolation, with manufacturers needing to see that it can easily integrate with existing operations and IT systems.

Bas de Vos, director of IFS Labs at software company IFS, believes that after the lacklustre consumer response to Google Glass, Google must create a device with the same type of wow factor as Microsoft did with HoloLens.

"A challenge that Google, and indeed the industry at large, faces over the short term is price. Google's initial sales of Glass EE to businesses were between $1,300 and $1,500 per unit. Although at around half the current cost of Microsoft's HoloLens, this pricing is still a prohibitive factor for many smaller manufacturers," says Mr de Vos.

The recent *Digital Change Survey* from IFS found that, compared to other sectors, the manufacturing industry has one of the lowest levels of satisfaction around funding for transformative digital projects. "It is therefore likely to take some time before we see the widespread adoption of innovations such as Google Glass in enterprise," he adds.

Mr de Vos maintains that while many manufacturers are now ready to utilise augmented reality technology solutions, like Google Glass, it will not happen overnight. "Until the cost falls to a similar price to that of a smartphone and once there are sector-specific applications that can work with the technology, widespread adoption will remain prohibitive for most businesses," he concludes.

COMMERCIAL FEATURE

The key to Industry 4.0: how ERP can unlock the value of the IIoT

Industry 4.0 will fail to deliver without the right business management systems

Fragmented systems and outdated ways of managing data mean British manufacturing is failing to take advantage of the opportunities on offer from the industrial internet of things IIoT), often because business leaders do not understand the need to invest in new technology, according to David Watts, Sage UK and Ireland enterprise vice president.

Enterprise resource planning (ERP) has revolutionised the way in which organisations are managed. Increased data has become more readily available and manual systems have been automated, saving time, reducing costs and minimising human error. But now ERP is itself being revolutionised by the arrival of the industrial internet of things.

Andrew Spence, UK and Ireland solution consulting director at Sage, the market leader in business management systems, says these innovations combined provide an opportunity to manage suppliers, purchases, resources, employees and customers more effectively than ever.

"The industrial internet of things is about connecting machines and people, and creating large volumes of data," he says. "But something has to orchestrate that data so it can be used by organisations to execute business processes more efficiently, such as ERP. It's the central nervous system of an organisation."

He points out that machines have been talking to each other for decades, but recent years have seen accessibility via mobile increase significantly. "Everyone now has a mobile device whether they're providing, sourcing or viewing information and this improved connectivity has been a massive driver for ERP."

However, many companies are still missing out on the benefits offered by this new world of IIoT-enabled ERP. "Most manufacturing businesses in the UK struggle because of fragmented systems that don't talk to each other," says Mr Spence. "Information is entered and transferred manually, meaning that it's often out of date or incorrect."

This very often comes down to misperceptions of the cost of technology and a limited view of its role. He says: "Although cost is a major factor for consideration, we also need to educate the leaders of our manufacturing organisations so they understand that technology can be used as an enabler for developing new business and improving outcomes."

Rather than seeing software as an end in itself, business leaders should regard it as a provider of information that they can use to improve their business. They might invest in expensive machine tools, but often these investments don't follow through into their business systems.

"If you buy a new machine tool, it's very easy to justify it with a cost-benefit analysis, but the calculation is more complex with an end-to-end business process. You need confidence and a more strategic way of thinking," says Mr Spence. Businesses also need to consider the "soft" benefits such as improved customer service and management of suppliers.

This strategic view is one reason why a growing number of companies are looking to Sage for an ERP system that is ready for the changes the IIoT is introducing.

> "Everything from interacting with customers to paying suppliers can be done in a seamless process

"Our payments, payroll and people systems are pervasive in most organisations, but now we're really driving innovation with the breadth of the capability of our ERP platform and its connectivity," says Mr Watts. "You can connect devices to our ERP systems. Everything from interacting with customers to paying suppliers can be done in a seamless process."

Available as a public cloud, privately hosted cloud or on-premise solution, Sage X3 is accessible from any device, and is scalable for growing and global businesses due to its flexibility.

The architecture of X3 is constantly being updated to handle increased volumes of data and speed of use, says Nana Fifield, head of product development, X3 manufacturing, at Sage.

"We're improving user experience and the ability to bring out useful insights from data," says Ms Fifield. "We're looking at how we can take real-time data and integrate it into X3, so customers have all the information that ERP offers at their fingertips."

As an example of a true smart supply chain, Ms Fifield points to retailers that are introducing smart shelves to provide real-time information on stock levels. Similarly, medical services can use monitoring and mobile devices to enable faster testing and data analysis of patients before ordering drugs and treatments accordingly.

"With the next-generation supply chains offering end-to-end visibility and control, Sage X3 will be able to take orders for parts and products and, using the power of devices and other forms of data, it will be able to make decisions about different transport options by proactively monitoring environmental conditions and cost factors," she says. "These supply chains will also be able to access data from products on the ground to see how machines are responding to environmental conditions."

> "Something has to orchestrate data so that it can be used by organisations to execute business processes more efficiently"

> "Companies also appreciate the flexibility that Sage solutions such as X3 offer; as they grow it grows with them"

As businesses come to terms with the practicalities of Brexit and the risk of increased regulation, X3's global reach means it's already prepared for these challenges.

In this world of faster and more unpredictable economic and political change, X3 benefits from the agility and flexibility offered by the cloud to develop automation and robotics more quickly, bringing solutions to market much faster and receiving customer feedback more rapidly. It also allows companies to update their legacy systems in line with their budgets and other constraints.

When Sage unveiled the innovations offered by X3, the company was taken aback by the response. "People were telling us they were suddenly aware of what X3, in conjunction with the IIoT, could offer them," says Ms Fifield. "We had clients from sectors as varied as manufacturing, sales, pharmaceuticals and agriculture, who could suddenly see the benefits of the IIoT integrated with ERP to their businesses. It was a revelation, but only a taste of things to come."

COMMERCIAL FEATURE

The time to invest in digital is now

Sterling's fall has provided a welcome boost for UK manufacturing exports. And it is while things are looking rosier that manufacturers need to invest in the digital technology and transformation, which will secure long-term customer loyalty

ANTONY BOURNE
GLOBAL MANUFACTURING INDUSTRY DIRECTOR, IFS

Things are good right now for manufacturers that export. While you shouldn't change for change sake, I believe that it is easier to invest for the future when times are good. You only have to look at what's happened in the oil and gas industries, and the thousands of jobs lost as a result of the market downturn.

Nobody wants to see manufacturing go the same way and, when things do change, be it Brexit or exchange rates, we don't want a reaction that inflicts damage on the industry. To secure the future of manufacturing, my advice is to embrace digital transformation now.

Earlier this year, a survey carried out by IFS and Raconteur of 750 companies revealed the number-one reason for adopting digital transformation is to improve internal efficiencies. This is always going to be one of the primary drivers of change. Another is to improve customer satisfaction and this is where the clever manufacturers are looking, at how they make their customers happier and give them compelling reasons to stay with them and continue to buy their products or services.

In the context of digital transformation they are finding ways to apply some of these new technologies to make their customers happier and build a long-term future for their company, regardless of what happens with Brexit or the exchange rate.

Fundamental to this is establishing an omnichannel support contact centre, from the customers' point of view, effectively combining all the channels through which they voice their opinion, including their satisfaction, or lack of it, from e-mail to social media, into a single channel.

As well as the interactions they have with their direct customers, manufacturers must listen to and manage the chatter taking place in other areas. The way that consumers buy products is changing and, in increasingly digital world, manufacturing has to respond accordingly by using different technology to help listen to consumers and apply feedback to their products and services. Crucially, they must make that investment now while they have the opportunity.

> To secure the future of manufacturing, my advice is to embrace digital transformation now

Yoh4nn

Inevitably there will be challenges. A lot of manufacturers don't fully understand the different technologies that are driving transformation – the internet of things (IoT), cloud, 3D printing, servitisation, augmented and virtual reality – and don't know where to start. The scale of the transformation process can be overwhelming, so my advice to customers is to start with a small project and run it for a few weeks with a small team. Your aim is to win the trust and belief in what you are doing that you will need to take it to the board. Whether it is an IoT or servitisation project, by doing it on a small scale, on a single production line, you can assess the results and understand how it can be used to improve the business on a much larger scale.

One IFS client, a furniture manufacturer, has really grasped this concept by adding cloud services to their offering. As a result, this very traditional manufacturer is now providing consultancy services, fitting out entire offices, by selling or offering for rent the furniture they produce. They made the effort to really understand what it was their customers were aiming to do. Consequently, they have moved up a gear and also moved the value their customers receive, away from purely the product they are making.

Another great example of a manufacturer using technology to engage customers more closely is a paint company that produces paint for ships' hulls. By adopting IoT technology, they now introduce and can guarantee performance savings for their customers, by placing thousands of sensors on the hull, which generate data on drag as the vessel moves through the water. Based on this data, they can recommend the best time to repaint the hull to improve efficiency and guarantee a payback within 12 months.

They are no longer just selling paint; they are selling the capability to improve shipping performance. These things weren't possible a few years ago. With the rise of the cloud and IoT they are a reality.

Servitisation is a way of securing long-term customer engagement. A company that we work with that manufactures hand-cleaning gels now makes and sells the gel dispensers. They now offer their customers a complete cleaning solution.

The principle in all these examples is that the manufacturer has clearly understood what the customer is trying to do with their product. If you are asking 'how can this digital technology help me as a chair manufacturer?' you are coming at it from the wrong direction. You need to look through your customers' eyes, walk a mile in their shoes and see what are they trying to do? Work with your customers, help them achieve their objective and you'll get that longevity of their loyalty.

Not all the new technology available today will be adopted by manufacturers, but nevertheless they must be innovative enough to show their customers what is possible. With its wealth of experience and industry knowledge IFS is working with manufacturing clients all over the world, helping them make that transition. We have the investment in technology and proof of concept, and want to share our experience and knowledge with manufacturers, and help them to secure a better and faster return on their investment.

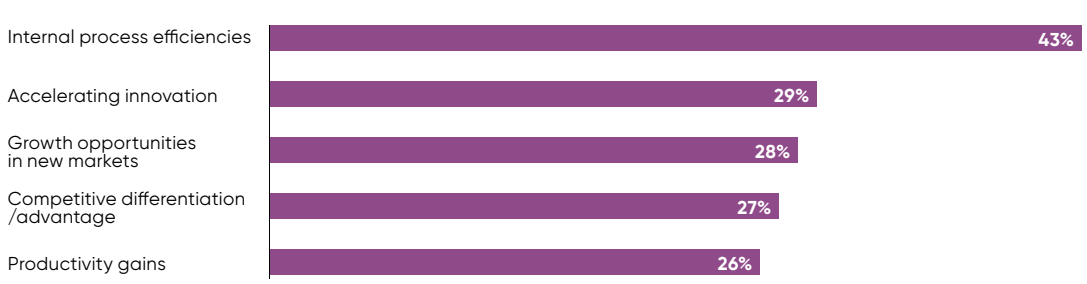
Who knows what the next digital technology development will be for manufacturing? Robotics and automation have been around for some time, but how will they evolve? Progress has been fairly slow with 3D printing, but the aerospace industry is already starting to manufacture lighter or better components than those produced by conventional manufacturing processes.

The future of manufacturing rests on companies being more competitive, more efficient and more innovative. Will your company be around in the next five, ten or fifteen years? The answer to that will depend on how well you apply the digital technologies that are available to finding out what your customers want to do, almost before they themselves are absolutely clear about it – and delivering on it.

For more information please visit www.ifsworld.com/times, call 01494 428900 or mail info.uk@ifsworld.com

TOP DRIVERS OF CHANGE GLOBALLY

ACROSS ALL INDUSTRIES SURVEYED



IFS/Raconteur *global digital change* survey; commissioned in Q2 2017, researching 750 industry professionals

AUTOMATION AND POLITICS


Ralph Freso / Stringer via Getty Images

Where's the rage against machines?

Jobs lost to automation is a political issue, but one that US President Donald Trump seems to be ignoring, despite voters' concerns

SHARON THIRUCHELVAM

Returning American manufacturing jobs to US soil was a headline cause for the Trump presidential campaign. Now, as then, President Trump rails against the culprits he sees as standing in the way of "American jobs for American people" – large trade deals, global outsourcing, competition from China and immigration. But rarely, if ever, does he touch upon automation.

"Automation was the secret Rosetta Stone of this election," says Mark Muro, senior fellow and policy director of the metropolitan policy program at the Brookings Institute. "It didn't determine the outcome, but the economy is the overwhelming backdrop to what happened."

Researchers at the Oxford Martin School, in corroboration, have found evidence of a relationship between electoral districts' exposure to automation and their share of voters supporting Donald Trump, strongly suggesting, as they put it, that "the presidential election was a riot against the machines by democratic means".

The past 200 years have seen increasing automation, vastly improved global living standards, but "creative destruction" – famously described by economist Joseph Schumpeter as accompanying technological change – brings with it winners and losers. Since the computing age began in the early-1980s, growth has failed to trickle down to ordinary Americans. From 1979 to 2013, productivity growth was eight times faster than growth in workers' hourly compensation. As productivity grew by 64.9 per cent, hourly compensation grew by only 8.2 per cent for 80 per cent of the American workforce, while the top 1 per cent of earners saw cumulative gains in annual wages of 153.6 per cent.

A vote for Trump may have represented a vote for change, but it is far from clear whether the Trump administration fully apprehends the drivers of voters' grievances and the actions required to mitigate them or whether it is expediently ignoring them.

David Autor, economist at MIT, believes automation is already responsible for greater manufacturing job losses than outsourcing or trade. Yet meanwhile, Trump's treasury secretary Steve Mnuchin has declared automation "not even on our radar screen" and that the problem is likely to be "50 to 100 more years away".

For the time being, some job losses to automation will be held off by upfront costs that are at present too prohibitively large for most large and medium-sized companies. But over the next decade, Boston Consulting Group predicts, the price of industrial robots and their enabling software will drop by 20 per cent, while their performance will improve by 5 per cent each year. Given the private sector's openness about automation and the public's palpable anxiety, why is the Trump administration not giving the issue the attention it requires?

Thomas Davenport, author of *Only Humans Need Apply: Winners and Losers in the Age of Smart Machines*, argues in the *Harvard Business Review*, that Trump, in his business-style and as supposed author of *The Art of the Deal*, "clearly has a penchant for sparring with opponents in highly visible negotiations... but automation-related job loss is more difficult to negotiate". Mr Davenport surmises: "It's a complex subject that doesn't lend itself to TV sound bites or tweets."

President Trump may be able to get away with trade protectionism, but protectionism against productivity is not an option. Ever since the British jumpstarted the Industrial Revolution by doing what no other nation had before dared, sacrificing their citizens' employment to productivity, the marriage between politicians in Western economies and productivity has been sealed. Productivity is the ultimate goal of automation and an important factor in long-term economic growth, a measure by which the US economy has been unimpressive over the last decade.

Trump's focus on the repatriation of US manufacturing could indeed see US factories benefit from the falling price in robotics, which may undercut emerging and developing countries' former competitive advantage, which was founded on comparatively low labour costs. Also, more US companies are beginning to recognise that through offshoring they lose out on higher-level design learning, which cannot be completely divorced from the production process. "Manufacturing amounts to about 60 to 80 per cent of industry R&D – it's an innovation sector," concludes Mr Muro.

At present, the US workforce lacks the skills required to undertake the highly technical and specialist work of future manufacturing. Political will and investment will be crucial for the US government, working hand in hand with universities and companies, to train the next generations of manufacturing employees. US spending on public and private training currently trails behind its industrial competitors at less than 1 per cent of GDP.

The Trump administration has made job creation a central focus and dismissed the threat that automation poses to the American blue-collar workforce

> Automation is already causing political polarisation and swings to the left and right

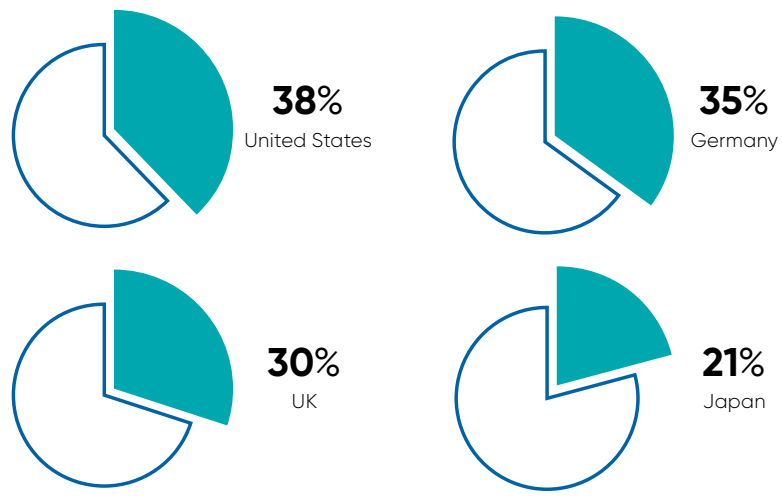
What of the older, low-skilled workers, who will be gradually and silently managed out of the workforce? Mr Muro proposes a "universal basic adjustment benefit", a package of measures including wage insurance, job counselling, relocation subsidies, and other financial and career help that would aid individuals to transition from unemployment or retrain. It will be a hard sell, he acknowledges, given Republicans' traditional opposition ideologically to all permutations of welfare, but even conservativism, Mr Muro argues in a forthcoming paper, is demonstrating the potential to be "disrupted by technological disruption".

As the digital revolution makes dislocation and job insecurity the new normal, conservative parties for whom the idea would have until recently been anathema are again embracing the idea of an industrial strategy and long-term planning to ease the pains of transition.

Researchers at the Oxford Martin School have found that automation is already causing political polarisation and swings to the left and right. Voting behaviour is begging for bold answers. Lest we forget, at the beginning of the first industrial revolution, frustrated weavers burned down the factories containing the equipment that replaced them; by its end, their grievances had been rationalised into a more coherent objection, *The Communist Manifesto*.

SHARE OF JOBS AT POTENTIAL HIGH RISK OF AUTOMATION

BY THE EARLY-2030s



PwC/Office for National Statistics/OECD 2017

The rise of digitally Made in Britain

A network of technology and innovation centres is helping UK manufacturers accelerate into the digital age

The UK is leading the charge as a global technology powerhouse. It's already Europe's runaway digital nation with £6.8 billion of digital tech investment in 2016, some 50 per cent higher than any other European country. In fact, UK digital technology received more investment last year than the next four countries, France, Germany, the Netherlands and Denmark, combined according to Tech Nation.

But it's in manufacturing specifically where investments in technology can be translated into a positive impact on the UK's economy, with a focus on high-value sectors such as aerospace, automotive, pharmaceuticals and chemicals. The fourth industrial revolution or Industry 4.0 is now at the top of everyone's agenda and no business wants to be left behind in the race to develop the factory of the future.

"The digital age of manufacturing is upon us," says Professor Sam Turner, chief technology officer at the High Value Manufacturing (HVM) Catapult, a network of advanced manufacturing technology and innovation centres.

"It's a critical time now for countries that have a strong manufacturing base such as the US, South Korea, China and France. Corporations, large and small, are trying to work out how best to unlock value in this age of digital manufacture or Industry 4.0 as it is commonly referred."

Britain was the birthplace of the first industrial revolution, led the second and was an early adopter of the third. "We have the opportunity to determine our own fate with the fourth," says Professor Turner. "We shouldn't default to thinking that this means businesses must implement expensive and all-pervasive IT systems to stay competitive. We have already developed a portfolio of digital applications that make improvements in productivity and growth achievable for even the smallest of manufacturers.

"Revolutions are generated by disruptors. We don't have a huge manufacturing base anymore, so we're looking to be disruptive, so the UK can leapfrog other nations and gain competitive advantage. We certainly have the drive, the ingredients and the appetite for this next industrial revolution."

Part of that picture is investment in digital manufacturing and is the reason why the HVM Catapult now operates more than £600-million of open-access research and demonstration facilities in the UK. Already it has worked with more than 7,500 companies, nearly 50 per cent of which are small or medium-sized enterprises. The aim is to help innovations from all sectors fulfil their economic potential. It has become the go-to place for advanced manufacturing technology in the UK.

"Many digital manufacturing solutions scare companies because they involve huge investments. This is the route Germany has taken. There is often a backlash against this approach. We're looking at plug-and-play digital solutions that can cost as little as £1,000," says Professor Turner.

That's because many manufacturers have legacy systems that can't be replaced by a high-spec digital factory overnight. This would require eyewatering levels of investment. Companies may be excited by Industry 4.0, but many solutions are costly.

"The issue in this country is an underlying reluctance for manufacturing companies to invest in new technologies. For many UK manufacturers, there needs to be a direct and real need before investments are made, rather than faith in the future. There's certainly a 'make and mend - why change it' mentality," says Professor Turner.

"That's why we look at real problems in the marketplace and try to come up with technological solutions. We answer the question, how do you start to digitise an existing manufacturing process? The fact is many businesses are keen, but confused about this."

> We're looking to be disruptive, so the UK can leapfrog other nations and gain competitive advantage

The aim of HVM Catapult's seven technology and innovation centres is to bridge this gap by accelerating the activity between concept and commercialisation. The centres are national assets offering access to cutting-edge equipment and expertise in a collaborative environment.

"We demonstrate what technology can do for companies in a risk-free setting. We show people what the factory of the future looks like. Many businesses want tangible results when it comes to digitisation. They ask the question, 'I want to be a leader, but what about my return on investment?' We try to offer quick wins and tangible benefits," stresses Professor Turner.

"The key thing is to get started and demonstrate the benefits. It's about embedding data analytics and embedding intelligence into existing systems. It is also about digitising processes not parts."

The HVM Catapult is key to driving the future growth of advanced manufacturing in the UK. It's already generating net benefits of £15 from every £1 of public funding. The long-term goal is to stimulate growth and to create a competitive advantage for UK manufacturing.

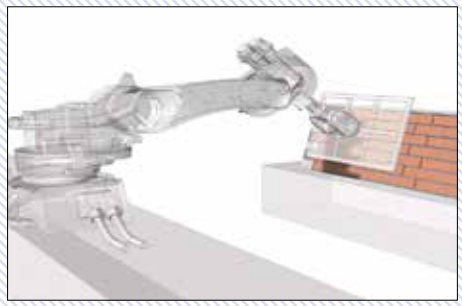
The HVM Catapult's main strength is its joined-up approach. An open-access and collaborative workspace enables technologies developed successfully in sectors such as aerospace or automotive to be rapidly transferred to other industry sectors.

"Currently we're also world leaders in financial technology and gaming, we're now looking at how these sectors could benefit digital manufacturing processes – there are lots of opportunities," says Professor Turner.

Get it right and digital manufacturing could deliver a double-digit productivity improvement by 2035, generating an additional £91.6 billion to the UK economy and creating more than 300,000 new jobs. The stakes could not be higher.

For more information please visit hvm.catapult.org.uk

MANUFACTURING IN CONSTRUCTION



Laing O'Rourke is a leader in off-site, modular manufacturing. The multi-national construction company embarked on an ambitious plan to build a "state of the art" factory.

"We're good at innovating," says David Brass, general manager of the new plant. "But we knew we had to draw on best practice from the aerospace and automotive industries if we were to maximise the benefits of digital manufacturing."

The HVM Catapult's Advanced Manufacturing Research Centre helped Mr Brass develop technologies for the new factory. Computer-aided design and lasers were used remove a bottleneck in the production of a wall product, producing a time-saving of 60 per cent, and augmented reality, using Microsoft's Hololens, has delivered big efficiency gains in the testing of electrical cabinets. The centre is now developing the process of robot brick laying.

SUSTAINABLE FASHION

Saving planet Earth is more than a fad

Brian Ach/Getty Images for H&M

01

The clothing industry has struggled with excessive and wasteful production, but sustainable manufacturing is at last topping the agenda

LEO KING

The dire handling of materials, chemicals, water, emissions and waste poses a serious problem for the fashion industry. Each year the sector uses enough water to fill nearly 32 million Olympic swimming pools and emits carbon dioxide levels equivalent to 230 million cars, according to the *Pulse of Fashion* report. Meanwhile, consumers annually dump 92 million tonnes of clothing that could have been recycled.

"Projections show that in the worst case, the fashion industry will face distinct restrictions on one or more of its key input factors, leaving it unable to grow at the projected rate, and in the long run unable to continue its current operating model," warns Eva Kruse, chief executive of non-profit Global Fashion Agenda, which authored the report with Boston Consulting Group.

The industry has taken a long time to acknowledge its impact. Sandy Black, a London College of Fashion professor, who authored *The Sustainable Fashion Handbook*, explains that while things are changing, the challenge for companies has been measuring their damage. "It's not feasible to carry out a life-cycle assessment on the volume of products being produced in fashion, unlike other industries with slower change and fewer products," she says.

Some brands have begun initiatives to solve the measurement challenge, most notably the Sustainable Apparel Coalition, whose members include Primark, Marks & Spencer, Walmart and Nike.

"The era of wilfully ignoring environmental impacts in fashion is coming to an end," says SAC chief executive Jason Kibbey. The organisation's *Higg Index*, used by nearly 40 per cent of the industry, enables greater scientific benchmarking of the impact of designs, material, energy, water, chemicals and distribution.

High street chain H&M, an SAC member, is targeting using only sustainably sourced materials by 2030. The key to its success could be in its aim to become completely circular, so clothes are made entirely from reused materials. Its stores already allow collection of clothes and the company amassed nearly 16,000 tonnes of used clothing last year.

"Ninety seven per cent of all clothes, textiles and shoes that we collect can be repurposed, and 3 per cent goes to energy," notes Catarina Midby, sustainability manager at H&M UK and Ireland.

Cyndi Rhoades, chief executive of circular fashion company Worn Again, which is collaborating with H&M and Puma to find new ways to recycle material, says clothing reuse will help deliver the drastic changes needed by the industry and consumers.

> The era of wilfully ignoring environmental impacts in fashion is coming to an end

Sebastian Reuter/Getty Images for DER BERLINER MODE SALON

02

"There is a new generation of textile-to-textile recycling technologies that will enable raw materials, like polyester and cellulose from cotton non-rewearable clothing, to be recaptured, restored back to virgin equivalent quality and reintroduced back into the supply chain," she says. When this becomes cheaper than using untapped materials, it will be impossible for brands to ignore.

A number of other manufacturers are tackling sustainability and material usage head on. Levi Strauss has saved more than a billion litres of water since 2011, including slashing usage in cotton farming and how it finishes its jeans. Nike, which began by using more environmentally friendly materials and production with knitted uppers on trainers, has gone on to halve its manufacturers' energy usage in the last decade.

Many of the large firms, nevertheless, can be stuck in their ways and it is innovation by startups that holds great promise. "Customisation and manufacturing on demand is one way to make less volume of product speculatively and provide only what is ordered," notes Professor Black. She cites customised clothing business Unmade, which has created such a model with interactive tools for consumers to order exactly what they want.

Success in sustainability, of course, relies upon consumers wanting environmentally friendly items. With clothes buying expected to increase by 63 per cent by the end of the next decade, according to the *Pulse of Fashion* report, many fashion brands are encouraging consumers to change their buying habits.

"We want to communicate with our customers how to consume fashion sustainably, offering a diverse assortment to create their own personal style form rather than fast-changing trends," says Ms Midby.

Persuading consumers to change will be tough and governments need to play their part. Melody Le-Hew, a professor at Kansas State University, who says education and increased awareness will be important in changing habits, explains that consumers "must understand how human actions contribute to global warming and what the consequences will be if our consumption habits do not change." She adds that businesses equally will need to get to grips with the importance of making changes now.

The immediate incentive for any change, barring saving the planet, will no doubt be the bottom line. Businesses risk a 3 percentage point slide in their margins by 2030 if they do not embrace sustainable production, Ms Kruse warns. "If no action is taken," she says, "fashion brands will find themselves squeezed between falling average per-item prices, deeper discount levels, rising costs and resource scarcity along the value chain."

Change in clothes production is more than a fashion – it's essential.

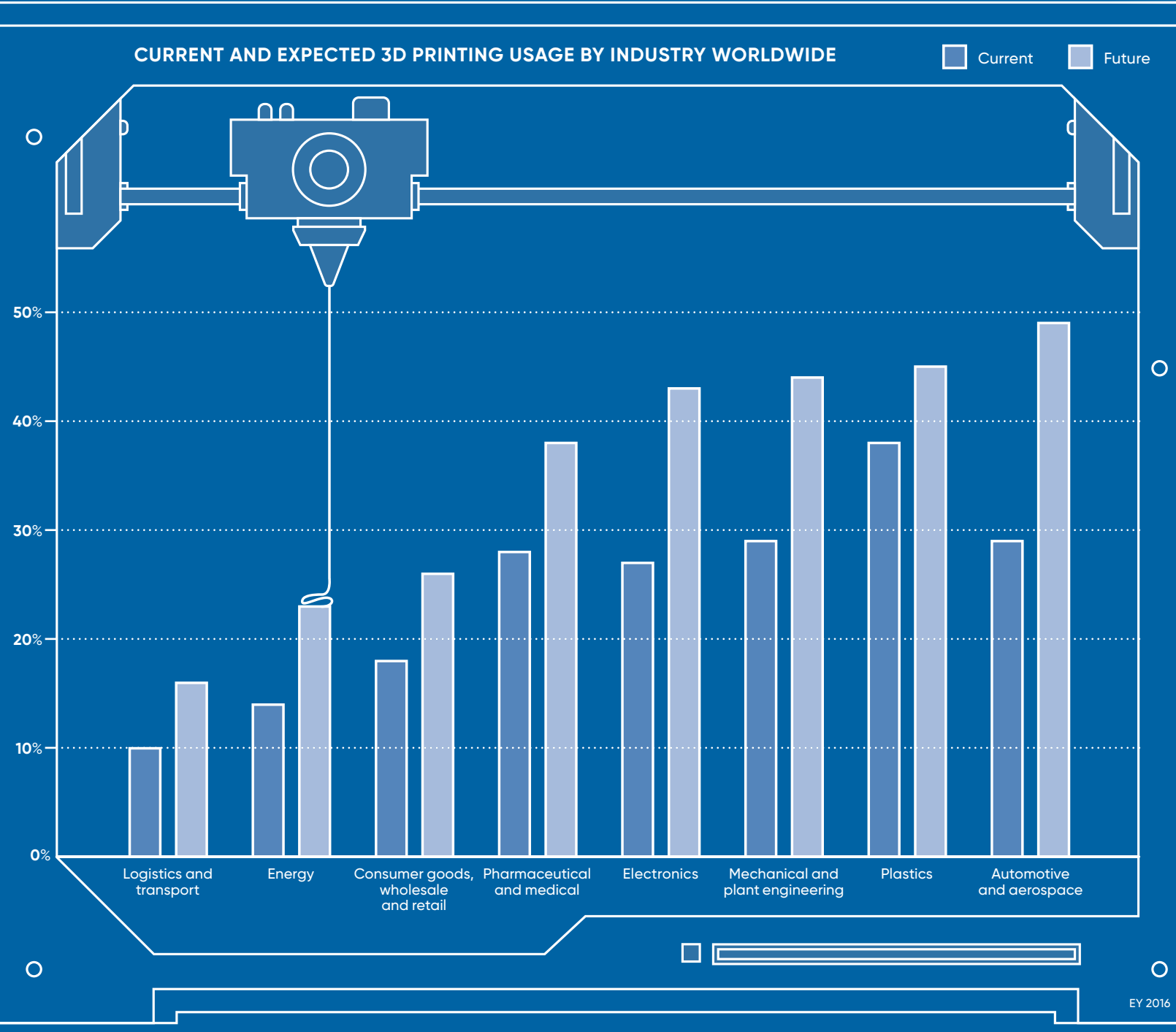
01
H&M aims to use only sustainably sourced materials by 2030

02
Stella McCartney, whose name is now synonymous with eco fashion, was one of the first big designers to promote sustainability and an environmentally friendly supply chain

WORLD OF 3D PRINTING

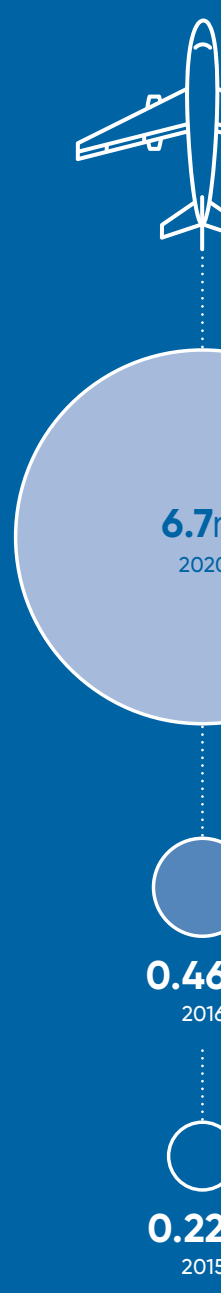
3D printing or additive manufacturing has the potential to transform manufacturing dramatically and permanently. But while take-up has hitherto proved slow - the technology has been under development since the 1980s - the 3D-printing market is beginning to mature as companies continue to increase their spend and technological knowledge. This infographic explores how 3D printing is no longer reserved for science fiction, but permeating every industry, from automotive to pharmaceuticals

CURRENT AND EXPECTED 3D PRINTING USAGE BY INDUSTRY WORLDWIDE



EY 2016

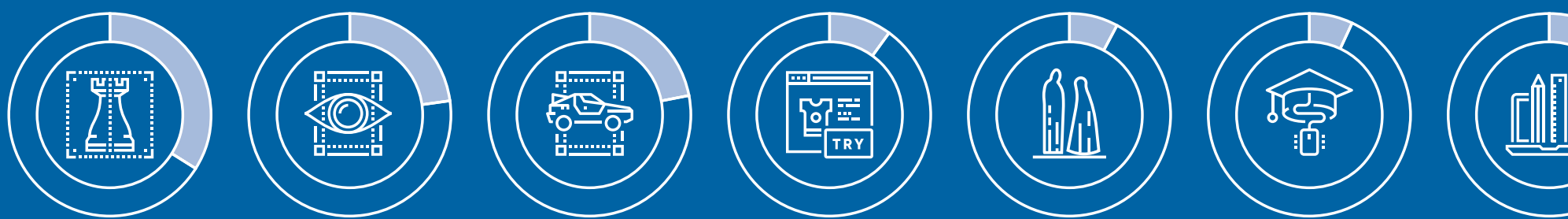
GLOBAL SHIPMENTS OF 3D PRINTERS



Gartner

3D-PRINTING APPLICATIONS

SURVEY OF GLOBAL COMPANIES USING 3D PRINTING



34% Prototyping

23% Proof of concept

22% Production

10% Marketing samples

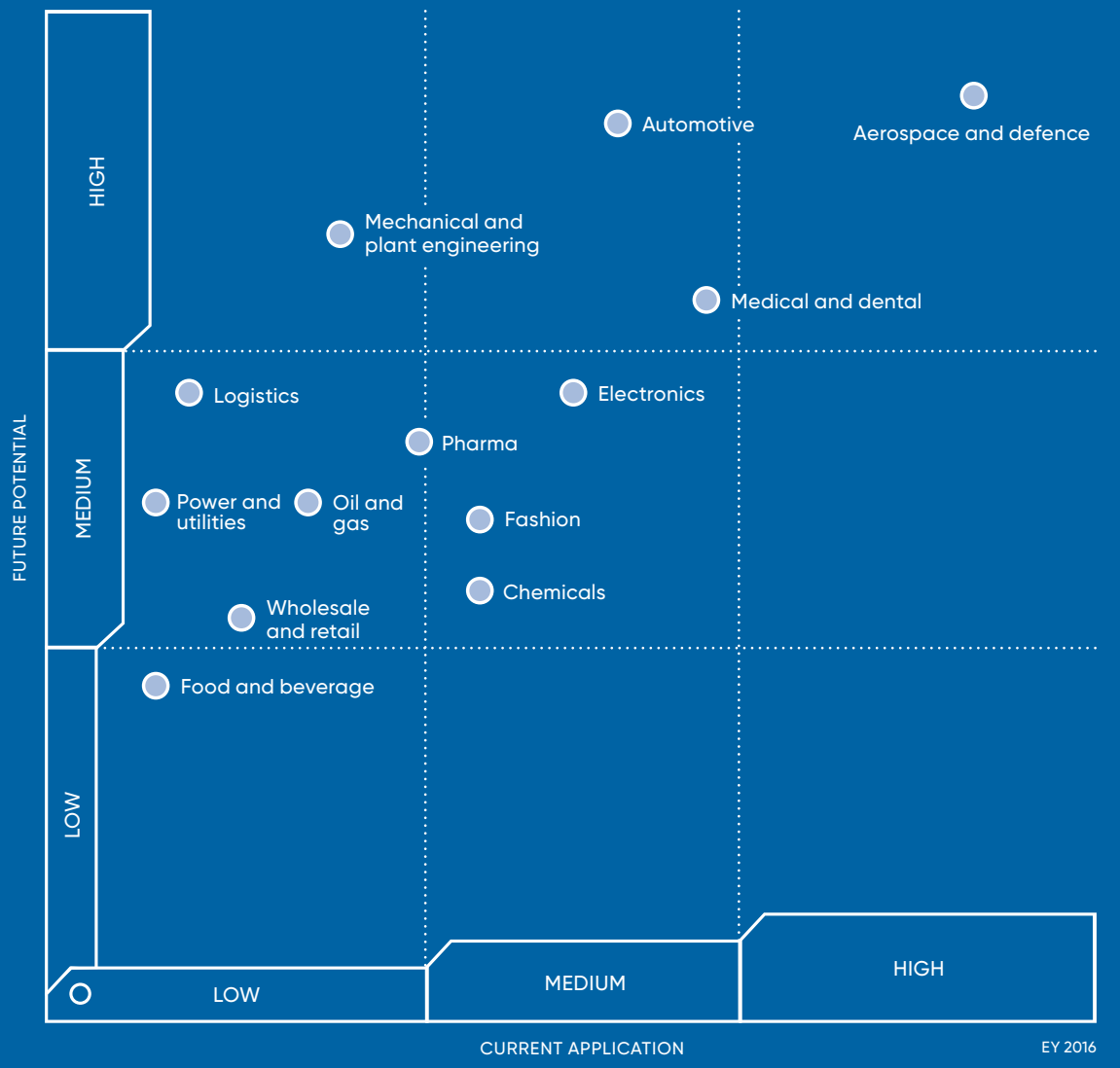
8% Art

7% Education

5% Hobb

Sculpteo 2017

CURRENT APPLICATION AND FUTURE POTENTIAL OF 3D PRINTING BY INDUSTRY



MOST USED 3D-PRINTING MATERIALS

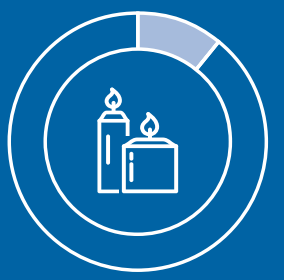
SURVEY OF GLOBAL COMPANIES USING 3D PRINTING

88% Plastic

35% Resins

28% Metals

15% Multicolour /sandstone



11% Wax

8% Ceramic

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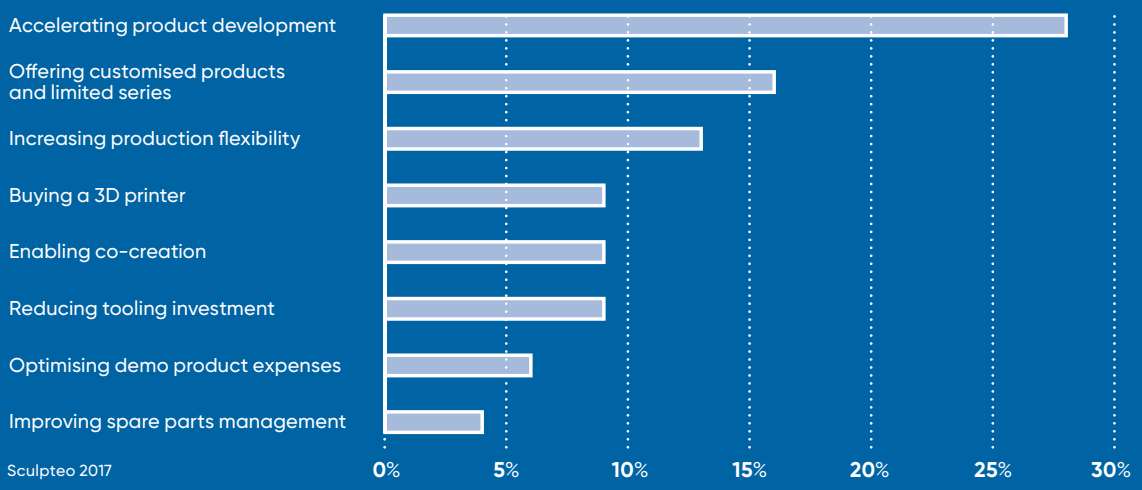
TOP PRIORITIES FOR 3D PRINTING

SURVEY OF GLOBAL COMPANIES USING 3D PRINTING



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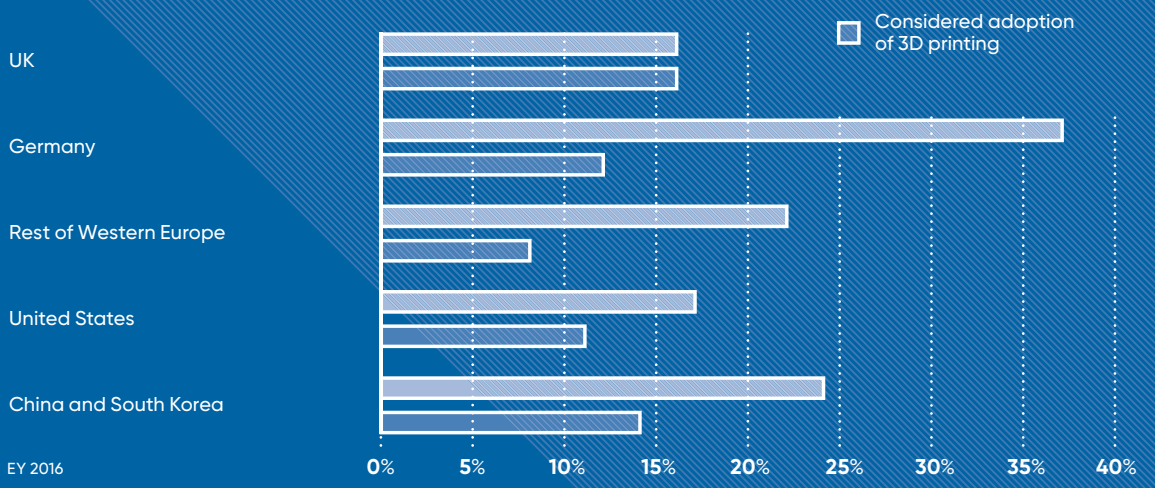
CURRENT AND INTENDED ACCEPTANCE OF 3D PRINTING

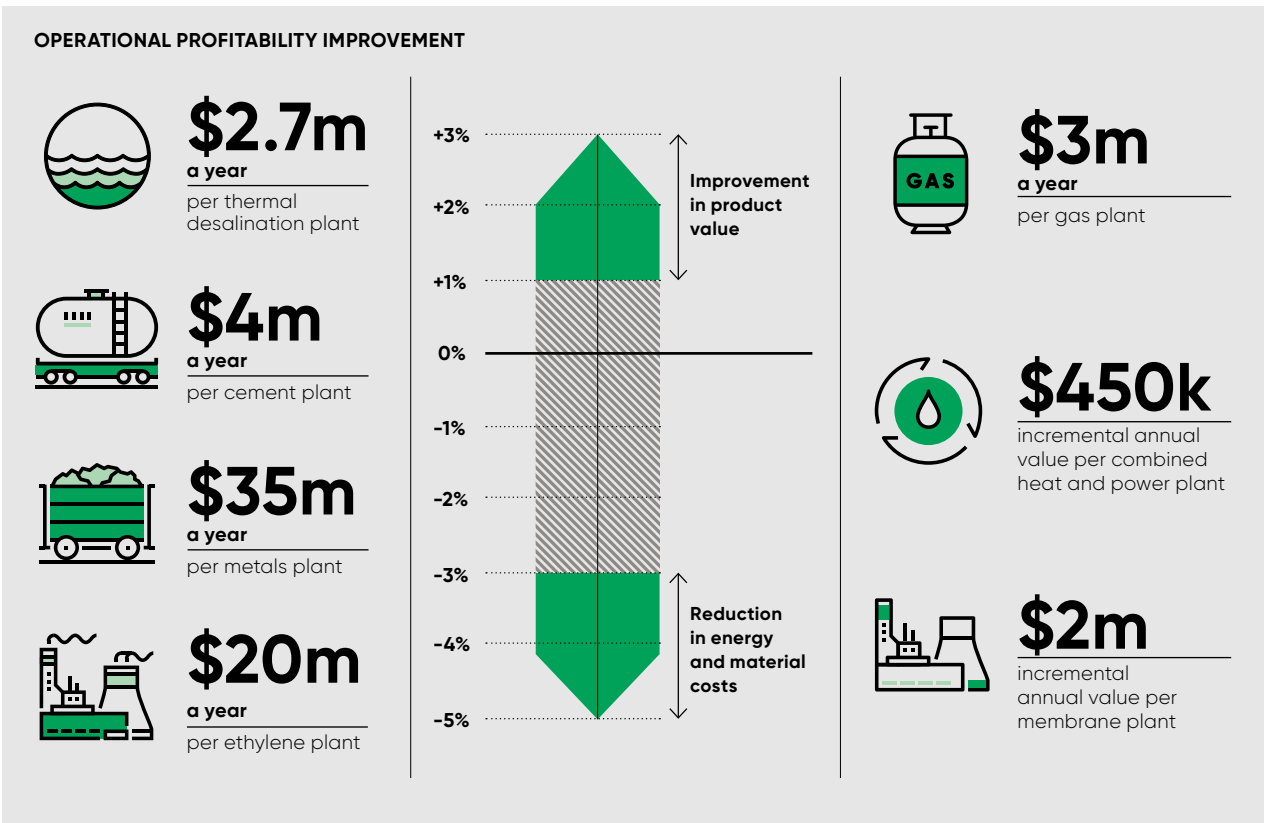
PERCENTAGE OF INDUSTRIAL COMPANIES IN SELECTED COUNTRIES WORLDWIDE



EY 2016

Industrial automation: now it's all about profitability

Automation has transformed safety, efficiency and reliability of manufacturing, but now it's also being used to focus on the heart of any business – profitability



Life Is On | Schneider Electric

Over the last few years, manufacturing companies have greatly improved the efficiency of their operations through the use of automation. This has enabled them to control variables such as temperature, pressure and chemical compositions as well as manage the performance of an operation.

However, companies have noticed that driving efficiency in one area has a knock-on effect on others. Improving efficiency, for instance, has often involved pushing assets and plant equipment to their limit. This impacts safety so real-time control has been used to improve this too. In addition, driving equipment hard can have a detrimental effect on its reliability so this has also been drawn into the expanding remit of real-time control.

Now a new factor is being improved by real-time control, alongside efficiency, safety and reliability. It might be a newcomer, but it's the most important aspect of any business.

"For 100 years or so industry has been ignoring the fact that profitability rather than efficiency is really at the heart of the manufacturing or production process," says Dr Peter Martin, vice president and Edison fellow at Schneider Electric, where this new chapter in process control is being written.

"We're discovering that now, with the latest developments in technology and in control theory, we're able to apply control beyond just efficiency, safety and reliability, but to profitability as well. We call it Smart Control."

The speed at which industry is operating is accelerating rapidly, Dr Martin points out, and he cites electricity as an example.

"Some 20 years ago, you'd negotiate an agreement with your electricity supplier to fix the price for, say, a year in advance. Today, with open power grids, the price might change every five to twenty minutes. The cost of other inputs such as natural gas and raw materials can vary just as quickly," he says. "This variation is equally evident at the consumer end. Thanks to Google and Amazon, the price of a product can change between morning and evening."

Traditional enterprise resource planning (ERP) systems tend to focus on closing the books once a month. However, as prices change every few minutes, the monthly snapshot that managers see doesn't give them the information they need to make the right decisions.

Dr Martin and his team have discussed this problem with more than 1,000 executives. "We realised that by using sensors in a plant we could model real-time accounting at each cost and value point in the process, and these measurements would allow us to provide profitability control, pulled together with efficiency, safety and reliability," he explains.

Operational profitability can be measured in real time as key variables change faster than monthly and this information can be used to control profitability in a manufacturing operation.

So how does Smart Control improve profitability in practical terms?

Dr Martin gives the example of a mineral processing plant, producing copper and bronze from base materials. Typically, in this linear process, ore is crushed and then ground to a sand-like consistency before a concentrator separates the metals from the ore. A smelter evaporates the water to leave the metals that will then be refined.

"Here you have ore and electricity entering the crushing circuit, and ground materials coming out. Three factors affect profitability – energy and material costs at the time consumed, and the value of the final product at the time it is produced," he says. "You need to calculate these three variables and put them into the control system. The traditional control algorithm will, say, open a valve or manage the speed.

"But with real-time accounting, an algorithm will calculate the production value at each stage for each particular time period and put that value into a historian for storage and future analysis. As a result, you have a day-long list of values at every point where cost is incurred."

Managers can check these costs and work out how to improve profitability in a way that is considerably more sophisticated and more accurate, working as it does, on a second-by-second basis, rather than traditional monthly accounting methods that just use the average cost factor. This real-time accounting information can be used to empower the workforce to make better real-time decisions to drive the greatest operational profitability.

According to Dr Martin, a group of about 50 companies are already benefiting from this new Schneider Electric technology and that number is growing rapidly. Using the latest technology, such as EcoStruxure™ Profit Advisor, implementation is faster than ever.

"We've started to deliver this new process control as a service using a big data analytics tool," he says. "Instead of a couple of months to do a full analysis and implementation, we can do it in a week. We can also extrapolate backwards, using historical data to look at when profitability was good and not so good. With this we can help our clients to replicate the circumstances that delivered the best profitability."

A benefit of using Smart Control to improve profitability is that it can be implemented bottom up rather than top down, as is the case with most ERP systems. "We say to clients 'pick a small section and try it on that first'," says Dr Martin. He argues that rather than just jumping on the latest technological bandwagon, this new approach to controlling critical business variables answers the question "should we?" rather than just "could we?" In other words, it's about practical benefits.

The whole concept of industrial automation systems design will go through a major transformation over the next five years, he predicts. "We're a conservative industry and so the items that we're selling today will still work in 20 years' time, but there'll be more of a focus on asset performance. Each and every asset will act as its own autonomous system. After all, if we can make autonomous cars, we can make autonomous compressors and reactors," says Dr Martin.

"More connectivity and computing power, smarter, connected products, like those compressors, will be able to control, monitor and secure themselves. The data and information the assets provide will enable the industrial workforce to extend that better, automatic real-time control to every industrial asset, all the way up the enterprise value chain. That is the epitome of Smart Control and it will enable manufacturing companies to move from trying to manage their business month by month to controlling it in real time.

"This will enable manufacturing companies to develop from managing their business month by month to controlling it in real time and ultimately turn their industrial automation investment into a profit engine."

For more information please visit www.schneider-electric.com

MARINE SERVITISATION

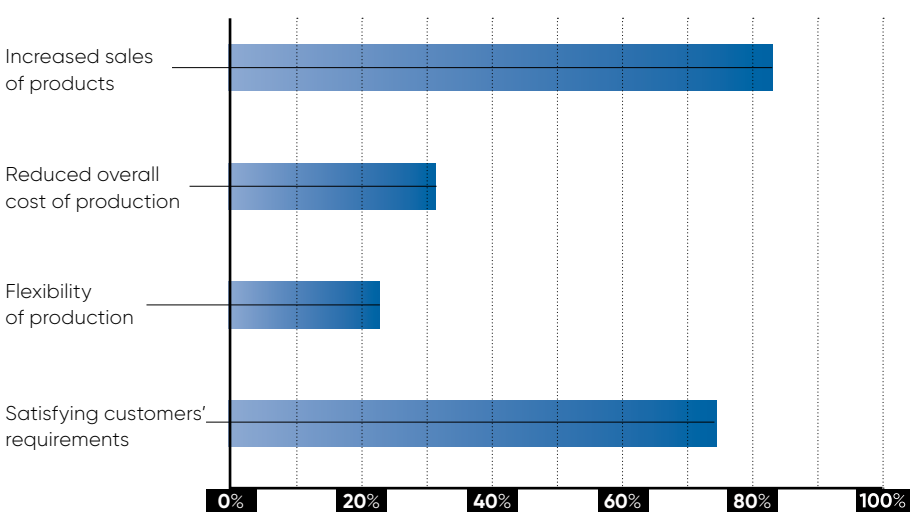

Monty Rakusen/Getty Images

Charting new waters for the shipping industry

Servitisation is at the heart of the manufacturing industry with businesses developing new capabilities to provide services and solutions that support their products, but the maritime sector is playing catch-up

BENEFITS OF SERVITISATION

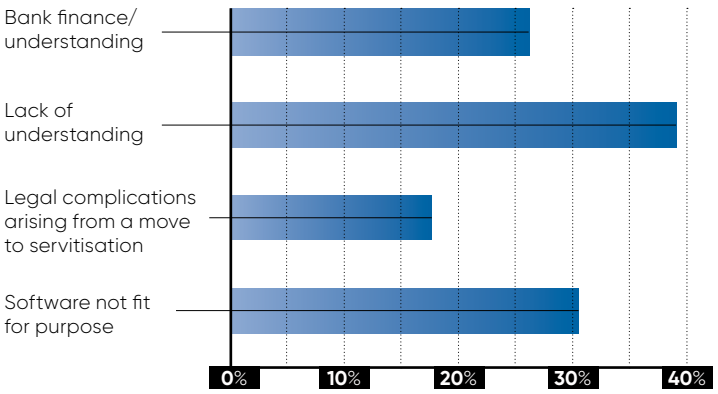
PERCENTAGE OF UK MANUFACTURERS WHO EXPERIENCE/EXPECT TO EXPERIENCE FROM SELLING SERVICES ALONGSIDE PRODUCTS



The Manufacturer 2017

BARRIERS TO SERVITISATION

PERCENTAGE OF UK MANUFACTURERS EXPERIENCING BARRIERS PREVENTING/DELAYING A MORE SERVITISED APPROACH



The Manufacturer 2017

ALISON COLEMAN

The marine industry faces considerable challenges as vessels spend most of their time at sea and, when in port, commercial pressures demand a fast turnaround with minimum downtime.

The problem is compounded by the existence of data silos and resistance to change, as Tim Schweikert, president and chief executive of GE's Marine Solutions, explains.

He says: "Traditional methods of managing data have created data silos and islands of automation, making it difficult to optimise operations across a vessel or systemise across the fleet. Moreover, as marine operators are traditionally expertise dependent in their operations, they are often resistant to embracing the changes that come with digital transformation and servitisation."

The pressures of market oversupply, low oil revenues for the offshore marine industry, rising costs and increasing environmental regulations have conspired to force the industry to embrace digital technologies, such as cloud, artificial intelligence (AI) and internet of things (IoT), that create opportunities for transformation through disruptive innovation, servitisation and smarter use of data.

"In the marine industry, data is most commonly used for post-incident analysis, offering retrospective insights and solutions to problems once they have occurred, leading to significant dry dock costs and loss of revenues," says Mr Schweikert. "Today, investors no longer have the patience to wait several years for their money to deliver dividends, but expect to see returns much faster."

Through real-time analysis of data, potential problems can be predicted before they arise, enabling operators to shift from prescriptive to predictive maintenance, ultimately reducing the amount of maintenance required.

This will also create greater operational efficiencies for shipping operators. UK-based software company QiO has helped shipping operators to overcome the challenges created by the retrofitting of sensors that produce masses of data that are manually retrieved and only assessed when the journey is complete.

QiO's mobile responsive web application deployed in a secure cloud environment creates a system that can not only detect anomalies, but also relate them to historic, current and predictive insights for a single ship or across the entire fleet, based on real-time sensor data. The outcome is improved fuel efficiency and hundreds of thousands of dollars in annual cost-savings per vessel.

Long-term asset management and maintenance are a priority for maritime manufacturers and operators, since downtime directly affects overall results, so the IoT can facilitate servitisation in this area.

> Servitisation will present maritime operators new opportunities to sustain competitive advantage, with manufacturers able to offer evermore impressive service level agreements

Songa Offshore is an international mid-water drilling contractor with a strong presence in the North Atlantic basin, operating a fleet of seven semi-submersible rigs. To monitor asset performance, the company has connected IoT sensors to 600 assets on each of four of its rigs that will capture usage metrics.

To improve maintenance effectiveness and operationalise IoT data, the company has implemented the IFS IoT Business Connector, which enables it to capture asset condition readings that form the basis of planning and optimising maintenance work. This also forms a vital part of their strategy for documenting a rig's condition.

Antony Bourne, global manufacturing industry director at IFS, says: "With the increased level of automation, Songa Offshore's objective is to reduce the time needed for yard stays for the rigs, which means significant cost-savings, and at the same time dramatically shorten the unplanned downtime of each rig, due to better control of the equipment's condition. The result is enhanced asset reliability, longer times between service intervals, longer asset lifespans and cost-savings."

Through the use of digital technology, servitisation will present maritime operators new opportunities to sustain competitive advantage, with manufacturers able to offer uptime guarantees in the form of evermore impressive service level agreements. By utilising big data and the IoT, AI can analyse trends to develop the best service plan for maritime assets, says Marne Martin, chief executive of ServicePower.

She says: "For example, to manage engine maintenance, AI-backed software can recognise previous service events and suggest an appropriate plan, while locating the best resources for the job. It can then send a message to the appropriate engineer to co-ordinate the job's next steps. This saves time on creating the service plan, contacts the most qualified available technician and provides instant insights to ensure project success.

"AI will also help manufacturers combine thousands of variables, like ship size, asset performance, cargo, even the weather, to over time continually improve performance. This means assets will sweat harder to considerably improve the reliability, timeliness and even green credentials of maritime organisations."

The marine industry is at the start of its digital journey into servitisation, but as technology solutions continue to evolve, the future for maritime manufacturing looks bright.

Mr Schweikert concludes: "Building digital capability and eliminating silos can help ship owners and operators to derisk decisions, bringing practical, actionable insights into vessel and fleet performance. It also opens up opportunities for industry collaboration and brings a focus on changing processes, not just products."

3D PRINTING

Third dimension adds to manufacturing

3D printing is set to have a transformative impact on manufacturing processes, but barriers remain before it can truly disrupt the industrial sector


Maxim Grigoryev\TASS via Getty Images

Russian firm Apis Cor is able to print a 400sq-ft concrete house in just 24 hours with no wastage

BEN ROSSI

Known as 3D printing because the machines often resemble office printers, additive manufacturing is the physical realisation of digitally designed ideas through the layering of material. It is one of the core innovations transforming the industrial sector as manufacturers embrace the fourth industrial revolution.

The technology involves the breakdown of a computer-designed 3D model into cross sectional layers. Each layer is then rendered by a 3D printer sequentially to build up the part originally designed.

Unlike many other forms of manufacturing, 3D printing is not subtractive; it does not involve removing material from a mass nor the melting and reforming of material. Instead, it only uses the amount required to produce a part.

Building in layers allows all kinds of unique geometries to be created, making 3D printing ideal for producing bespoke or tailored parts. The current output is generally geared towards very specific and specialised requirements.

"Using traditional mass-manufacturing techniques could prove very expensive in these situations," says Duncan Smith, director of industrial and production solutions at Canon UK. "3D printing is ideal when the outcome of your project is highly specified and low in volume."

3D printing was first developed as a rapid prototyping technique in the early-1980s, but the machines were expensive and complicated. It underwent a series of developments throughout the decade, including the patenting of stereolithography and selective laser sintering processes.

The early-1990s saw commercial adoption as the technology continued to mature, followed by a wave of hobbyist, cheaper 3D printers in the 2000s and growing hype as the technology became mainstream in the industrial sector. In recent years, the products have shifted into the "prosumer" market.

> This is a transformative technology that will play a key role in enabling the new world of advanced manufacturing

In the last ten years, in particular, the cost of a 3D printer has reduced drastically, from up to £14,000 to around £300, placing it firmly on the radar of manufacturers around the world. IT analyst firm Gartner expects 3D printer shipments will more than double by 2018, increasing end-user spending to $13.4 billion. McKinsey predicts an economic impact of up to $550 billion by 2025.

Two-thirds of manufacturers are already using 3D printing in their production systems and 42 per cent expect to adopt it for mass manufacturing in the next five years, according to PwC. Major brands, including BMW, Nike and Johnson & Johnson, are eyeing it up as a means to produce custom parts, while research from Boston Consulting Group anticipates the aerospace, automotive, and medical and dental industries will account for around half the market in 2020.

Perhaps the most well-known adopter of additive manufacturing is multinational conglomerate General Electric, which last year spent more than $1 billion buying controlling stakes in two leading manufacturers of industrial 3D printers, Sweden's Arcam AB and Germany's Concept Laser.

GE is using laser-powered 3D printers and other advanced manufacturing tools to make parts and products that were thought impossible to produce using traditional technology. The company is developing the world's largest laser-powered 3D printer that prints parts from metal powder.

"This is a transformative technology that will play a key role in enabling the new world of advanced manufacturing," says Mohammad Ehteshami, vice president and general manager at GE Additive.

"Additive manufacturing allows customers to achieve improvements in quality, efficiency and performance of manufacturing operations, and reduction in waste and material consumption. Traditional discrete manufacturing is worth over $15 trillion – if the additive industry replaces just 0.5 per cent of that, it could be a $76-billion opportunity."

Manufacturers seek several benefits when deploying 3D printing. The advanced capabilities of the technology facilitate the realisation of parts with complex features and geometries previously considered impossible to manufacture.

For a business case, the key selling points are time and cost-savings. Product development time is saved through the immediate realisation of prototypes, which can be produced as functional end-use parts.

With parts produced almost as the finished product, the production of bespoke tooling is no longer required. Continual iterations of a design are also more easily achieved, so testing is completed before any investment in tooling.

Damian Hennessey, director of global sales operations at Proto Labs, a manufacturer of 3D-printed custom parts, also points to the associated environmental benefits. "There can be less wastage of material compared to other manufacturing techniques," he says.

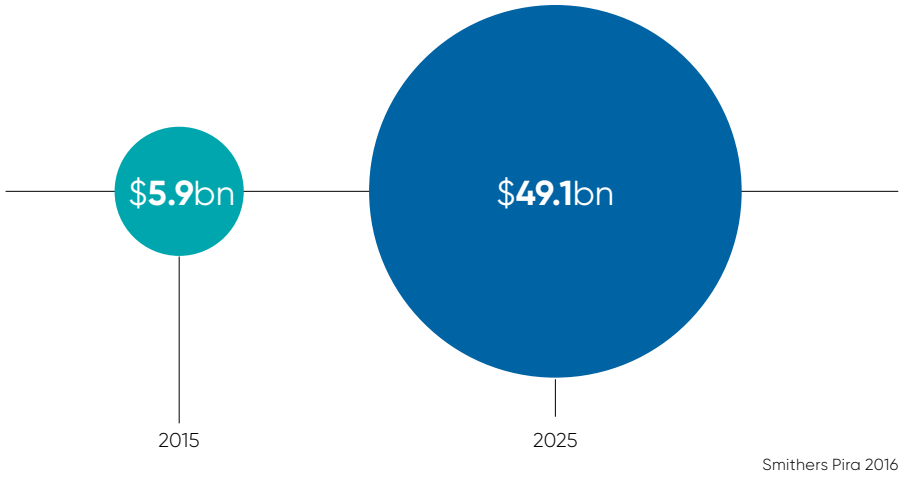
3D printers must now overcome their own hype and up their speed if mass manufacture is to be achieved. Until then, companies are more likely to complement their current manufacturing facilities with one or two 3D printers, rather than overhaul their processes.

A gradual adoption allows manufacturers to build the knowledge required for large-scale use. "The majority of engineering courses still offer very little, if anything, in way of additive manufacturing content and that needs to change," says Philip Hudson, UK managing director at Materialise, a 3D-printing solution provider.

This gap in additive manufacturing skills will have to be filled before the true potential of 3D printing is realised, but until then it will continue to gain momentum for producing parts in low volume for specialised applications.

GLOBAL 3D-PRINTING MARKET FORECAST

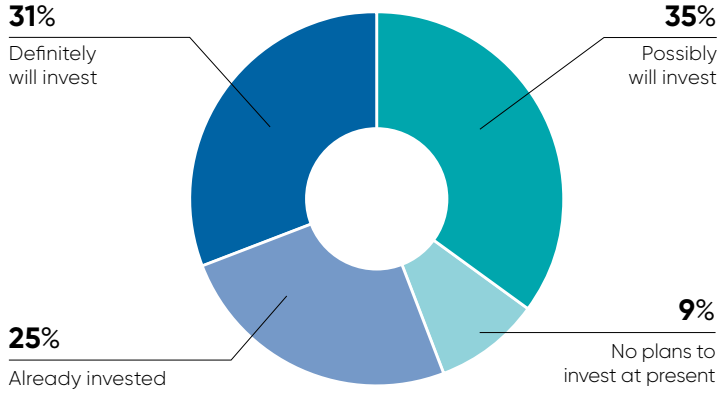
Projected size of the 3D-printing, materials and associated services market



Smithers Pira 2016

3D-PRINTING RESEARCH AND DEVELOPMENT INVESTMENT

Percentage of global manufacturers investing in 3D-printing research and development in the near future



KPMG/Forbes 2016

CASE STUDY 01

MOUNTAIN BIKES CUT TO SIZE

3D printing is helping cycling enthusiasts overcome an issue that has long existed in the manufacture of high-end mountain bikes, most of which are made from carbon fibre-reinforced resins. The frames have to be moulded, so even the most expensive bikes are typically made in only two or three sizes.

The size of a mountain bike in relation to its rider is one of the most important influencers of quality, and cyclists rarely enjoy the optimum performance and comfort of the product they purchased.

Mountain bike manufacturers are increasingly turning to 3D printing as a solution to this problem. UK-based Robot Bike Co uses additive manufacturing to produce every one of its bikes to match the size of each customer.

Customers can input their body measurements on Robot Bike Co's website to generate a bespoke design that matches their needs. The parts are then manufactured at a solution centre by FTSE 250 engineering firm Renishaw.

"Additive manufacturing enables each frame to be designed to suit the body shape and riding style of its owner," says Marc Saunders, director of Renishaw's global solutions centres. "Each frame is unique and uses a double-lap bonding method to join the titanium lugs to the carbon tubes."

CASE STUDY 02

ADDITIVE GOES OUT OF THIS WORLD

Another emerging method of 3D printing is in the manufacture of certified parts for military and civilian jet engines. Nasa has deployed 3D-printed parts, produced on Earth and flown to the International Space Station.

The method offers the possibility of using lunar or Martian dust combined with water and a binding agent to print buildings and other structures in situ. By using minerals mined and refined on site, metal 3D printing can produce spare parts and other implements without the need for lengthy and costly space transport.

Printable files can reside on computers with modifications and improvements simply transferred to the end point. 3D printing in metals is well on the way to being established as a major part of the manufacturing process.

"Methods involving multiple lasers offer the potential to build larger items, as do techniques like laser metal deposition in the welding process," says Dr Michael Wilson, technology director at the 3M Buckley Innovation Centre.

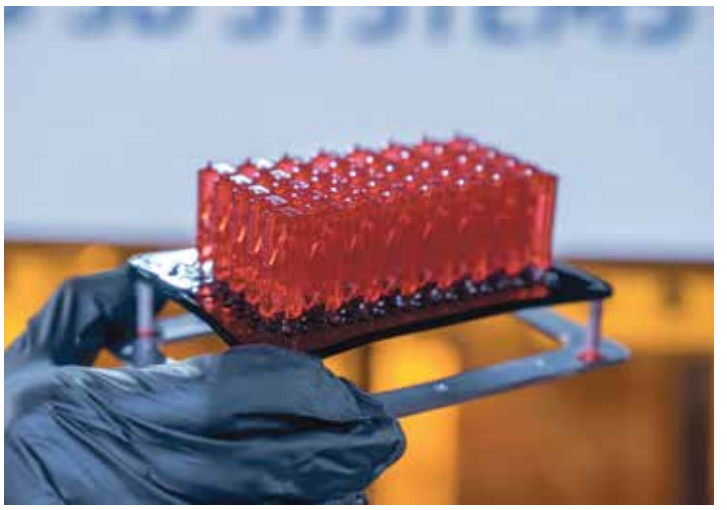
Printing in structural materials such as concretes is not only of interest to Nasa, but also to disaster relief agencies for rapid build and deployment of medical facilities and housing in emergency situations.

COMMERCIAL FEATURE

Making 3D production a reality

As a society we have come to expect digital in nearly every aspect of our daily lives

3D SYSTEMS



These days our information, communication and entertainment are all delivered digitally, often in a timeframe that would have been thought impossible just a few years ago.

Digital is light, quick, clean and, above all, convenient; attributes not often associated with an industry like manufacturing. Manufacturing is tactile and has a weight to it. There are time and labour costs involved in delivering physical parts that have put it in a category of its own while the digital revolution rages on.

Indeed, for more than 150 years, injection moulding has been a linchpin of the manufacturing world, making it economically possible to deliver large quantities of the exact same part through precise tooling. But while this manufacturing approach works well for the applications it is suited for, it is not well suited for all.

First and foremost, the design must not be so overly complex to rule out tooling. Further, the design cannot evolve or else the tooling must also change, triggering added expenses in downtime and rework. And, finally, the total quantity of parts required must be high enough to recover the immense costs in time, resources and physical space that are inseparable from tooling.

> This new additive manufacturing platform can be integrated into automated assembly lines and scaled with ease in any configuration of printing modules

3D printing continues to drive digital technology further into the manufacturing arena, reshaping the process and economics of delivering production parts. Frequently referred to as rapid prototyping, due to its widespread use for quick prototypes, 3D printing is also known as additive manufacturing; a succinct label that defines the process of building geometries layer by layer.

This additive process is of central value to design and engineering teams, as it frees them from the persistent constraints of tooling to enable greater design complexity and efficiency than ever before. Yet the floodgates restraining custom products and efficiency-enhancing designs have given way only slightly, and are still being held up in the three key areas of speed, cost and materials.

Now, though, a new production platform for additive manufacturing has solved all three, introducing a radical departure from the 3D printing and manufacturing technologies that have come before it.

The Figure 4 platform from 3D Systems, based on a 30-year-old stereolithography (SLA) configuration patented by the company's co-founder Chuck Hull, combines the design freedom of 3D printing with speed, throughput, effective total cost of operation, and capacity to deliver greater agility and capabilities to mass custom manufacturing.

This new additive manufacturing platform can be integrated into automated assembly lines and scaled with ease in any configuration of printing modules. Secondary processes, such as material recovery, washing, curing, finishing and inspection, can also be integrated and optimised with downstream workflows.

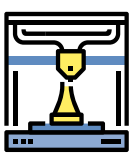
Up to 50 times faster than current 3D-printing systems – in benchmarking tests an automotive vent achieved a cycle time equivalent of 95 seconds – the platform is also modular and can be fully automated, allowing for the production of unique configurations from a single print engine to high-volume production systems comprised of many multiples of engines.

These part production speeds, along with features such as automated material delivery, in-line manufacturing capabilities and integrated post-processing, present a disruptive alternative to traditional injection-moulding manufacturing without the exorbitant cost of tooling. The Figure 4 platform also enables the use of more reactive plastic resins, which allows the platform to create parts in hybrid materials with properties that rival traditional injection moulding.

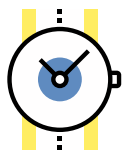
With high throughput, leading total cost of operations and expanded material options that can serve a broader range of end-use applications across industries, 3D Systems is now working with strategic partners and industry experts to develop specific solutions to benefit a wide range of sectors, including the healthcare, aerospace, automotive and durable goods industries.

"Productivity, repeatability, durability and total cost of operations are top of mind for our customers," says Vyomesh Joshi (VJ), president and chief executive of 3D Systems. "We believe our breakthrough Figure 4 platform will deliver real 3D-production solutions and competitive advantages to answer our customers' needs, and transform manufacturing of both mass customised and complex end-use parts across key verticals and applications."

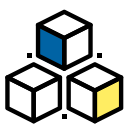
To find out more about the Figure 4 platform please visit https://www.3dsystems.com/



+20x
faster
3D print 20 times faster



92
minutes
Deliver time to first part in 92 minutes or less



10,000
parts
Produce 10,000 parts before injection mold tooling can even be produced

PROTECTIONISM

Farewell to the EU and free trade?

Brexit and Donald Trump's protectionist America raise the spectre of higher tariffs and restrictions imposed on international trade

JESSICA McGREAL

Your television is broken. You spend hours online and pop in and out of shops browsing for the best deal for a shiny new TV. But during this search it's unlikely you spend any time thinking about how the product was made – the sourcing of raw components, the robotic and human processes needed for its manufacture, and how it ends up on the shelf or boxed up on your doorstep.

Manufacturing supply chains are complicated processes that have gone global over the last 30 years. The percentage of global manufacturing that takes place in South-East Asia has rocketed from 24 per cent in 1990 to 45 per cent by 2015. In the same time period, manufacturing in Europe has dropped by 16 per cent, according to United Nations data.

A reduction in tariffs and regulations since the Second World War has internationalised supply chain routes, while technology has made processes more sophisticated. Together, this has allowed trade to grow rapidly, economies to flourish and standards of living to increase.

However, the rise of protectionism across the world, notably the UK's vote to leave the European Union and US President Donald Trump's pledge to put America first, has brought both economic and political uncertainty. Manufacturers need to rethink production as potentially increased trade tariffs and regulations could spell disaster for global supply chains, and higher prices for end-consumers.

And global supply chains are even more complicated than you may think.

John Glen, economist at the Chartered Institute of Procurement and Supply (CIPS), explains: "The notion that a particular part that goes into a car will travel from Germany into the UK and be put into the car isn't true. In reality, that part will travel from Germany into the UK, then to France and back to the UK, and then to Belgium and back to the UK, before it ends up in the final product. So, it will cross the border multiple times."

Brexit and a protectionist mandate throw a spanner in the works of supply chains like this. As a result, 32 per cent of UK businesses that use EU suppliers are now looking for British replacements. And it's happening across the channel too, with 46 per cent of European businesses expecting to reduce their use of UK suppliers post-Brexit, CIPS research has shown.

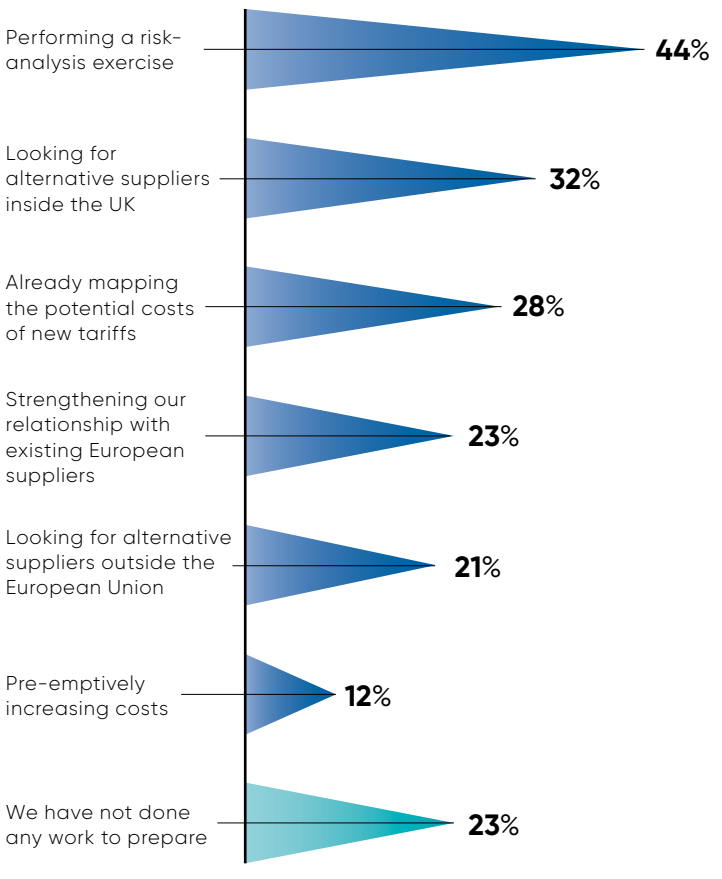
Looking further afield, Mr Glen points out: "Everyone is holding out for this fabulous trade deal with Donald Trump. Don't get me wrong, North America is an incredibly important nation for the UK. Approximately 16 per cent of our exports go there. So it's not an insignificant market, but it will in no way make up for what we lose in Europe. It's hard to imagine a better free trade deal in North America with a president who has said 'America first'."

> Brexit and a protectionist mandate throw a spanner in the works of supply chains

Ian Forsyth / Stringer / Getty Images

Protectionist policies across the world could present major headwinds for companies operating international supply chains

HOW UK SUPPLY CHAIN MANAGERS ARE PREPARING FOR BREXIT



CIPS 2017

In the short term, UK manufacturers are still in Brexit limbo. Without knowing the terms of the UK's exit from the EU, companies can only attempt to be more economical to combat the fall in the value of the pound and work on a scenario basis to begin future planning.

Rob Williams, founder and logistics director of clothing manufacturer Hawthorn International, explains how his business has changed the way it works with raw materials because of Brexit. "We tried to minimise our losses with Brexit before it happened," he says.

"A few months before we decided to bulk buy fabric which lasted seven months. However, from January this year we had to repurchase fabrics. Now we try to be more economical in our processes. Now we are paying more for fabric, but getting more items out of each piece to balance out the additional costs."

Despite the new economic realities and continuing political uncertainties that in the short term have damaged, and even destroyed, some manufacturers, protectionism may allow these businesses to reap rewards in the longer term.

Many manufacturers hope breaking away from strict EU regulation could boost growth, as the government can help industry invest in innovative technology and support the export of goods. Martin Walder, vice president, industry at Schneider Electric, argues: "The one thing that can happen post-Brexit is that the government can help manufacturers invest in technology. We're not doing as much as Germany, France and Sweden. That in itself will allow the UK to be more competitive on the global stage."

On top of improved government support and funding, there are numerous ways for manufactures in the UK and United States to overcome the challenges protectionism presents, from implementing automation to cut money spent on wages, to onshoring previously outsourced suppliers to cut transportation costs and avoid increased border tariffs.

Benjamin Wootton, co-founder and chief executive of consultancy Contino, says: "Trump's crackdown on H-1B [non-immigrant] visas will encourage 'American jobs', which will certainly stifle the influx of technology and engineering experts from low-cost geographies who can add real value. However, recalling that in-house technological capacity is the key to competitiveness, it will allow large organisations to invest in their own people, take ownership of their technology stacks and bring balance to their most-likely ageing workforces, by driving recruitment that focuses on hiring candidates in the 21 to 30 demographic."

> If new trade deals aren't quickly negotiated post-Brexit, exporters could be hit with high tariffs and tighter regulations

Yet, Jonathan Gibson, associate director at supply chain consultants Crimson & Co, warns: "[Re-onshoring] results in shorter supply chains potentially being more responsive to the local market, but also means that costs are likely to go up, either through the employment of higher priced local labour, or still importing but paying tariffs. The end result of this is likely to be an increased emphasis on automation in the re-onshored factories to try and reduce labour costs."

Protectionism will also impact exports. Although the pound's plunge is a good thing for UK exporters, if new trade deals aren't quickly negotiated post-Brexit, exporters could be hit with high tariffs and tighter regulations.

However, Mr Walder sees this as a good opportunity for UK brands to find new customers in the global market. "The interesting thing is where we head with the broader economies around the world, especially the emerging economies. The size of the middle classes with spending income is growing rapidly in China, India and Indonesia. With that comes demand for consumer goods. UK manufacturers will be looking for the growth opportunities in these economies," he says.

Yet, despite the opportunities protectionist policies can present in-country manufacturers, the Brexit vote and Trump administration are causing global economic uncertainty and business upheaval. This increases the complexity and cost of global supply chains, a price that will be passed down to consumers.

Will Lovat, vice president, Europe, Middle East and Africa, of supply chain experts LLamasoft, concedes: "There's inevitably going to be pressure on prices caused by wage inflation and cost inflation of imported raw materials, and people are worried about that."

Better buy that TV sooner rather than later.

FOOD AND BEVERAGE

Tech innovation is the UK's meal ticket

Latest advances in technology offer the opportunity to improve efficiency and quality in the food and drink industry


Martin Barraud / Getty Images

NICK EASEN

Let's face it, when we look at the manufacture, supply and production of goods across all industries, the UK's food sector is up there as being one of the least digitised. You're more likely to see pen and paper than scanners and barcodes, a phone call rather than an electronic order. Yet the tide is turning.

There's an increasing realisation that our food supply chain could benefit from a 21st-century technological makeover. Digitisation and automation have made incredible inroads in aerospace and electronics, so why not food?

"We're starting to see plenty of interest across all aspects of the supply chain regarding innovation in this area, but without any significant breakthroughs in acceptance yet," says Keith Thornhill, business manager for food and beverage at Siemens. "I'm confident this will change as the consumer demands for price, quality and customisation continue to put pressure on industry."

There's agreement that elements of the UK's food supply chain aren't agile enough to respond to the modern consumers' needs. At the same time, there's still intense pressure on prices, which in turn dampens down investment in state-of-the-art systems.

"Food will be a big area for tech innovation in the next decade; the potential is enormous," says Rob Haward, managing director of Riverford. "With more investment, I'm sure that plenty of, as yet, unknown innovations will become feasible. We will unquestionably continue to see huge innovations in last-mile logistics. The main area of change will also be convenience."

Supply chain tracking and tracing foodstuffs throughout the manufacturing process is one area showing promise. "In the past 12 months, we've received enormous interest in transparency and traceability tools," says Jessi Baker, chief executive of Provenance. "A growing number of businesses now use technology to link with their supply chains and make the origin of products available to shoppers."

Provenance have recently used blockchain tech to design one of the world's first interactive certification marks for the Soil Association. This provides information about a certified product. Hover a smartphone over the mark and you get live information gathered throughout the product's journey from farm to supermarket, with key data stored on the electronic ledger.

"With blockchain, we see innovation happening firstly with premium foods like meat and liquor or any product with claims to prove about origin," says Ms Baker. This tech has potential for organic food, Fairtrade goods or monitoring the social impact of supply chains.

However, the internet of things has yet to deliver a killer app in this sector and radio-frequency identification (RFID), basically smart food labelling, has yet to reach a price point where it can be applied holistically to the supply chain. Therefore, companies that make investments could gain competitive advantage.

"The industry needs only look to the automotive sector where each car produced on a line has already been sold and is unique with a plethora of customised options. High levels of digitisation and automation have made this economically viable," says Alexander Hill, co-founder of Senseye.

"Many companies are interested in Industry 4.0 [automation and data exchange], but remain baffled as to how it can help them. There's a tremendous opportunity to improve efficiency and quality. Consumers are demanding huge quantities of quality, healthy and inexpensive food, traits which don't naturally align, so efficiencies outside of the 'normal' supply chain must be sought."

Fresh food supply chains are becoming shorter and faster in a bid to retain product life. Innovations now abound, including intelligent packaging with biosensors indicating freshness. The aim is to reduce waste and provide useable data.

"We expect machine-learning will eventually enable manufacturers to incorporate demand in real time," says Colin Elkins, global industry director for process manufacturing at IFS. "Food manufacturers will be forced to innovate concerning the volume and frequency of orders, increased variation or rapid product development."

There's good news for local food producers and manufacturers. As the capability of supply chains increases then we could see an explosion in small producers in the same way we have with Amazon marketplace.

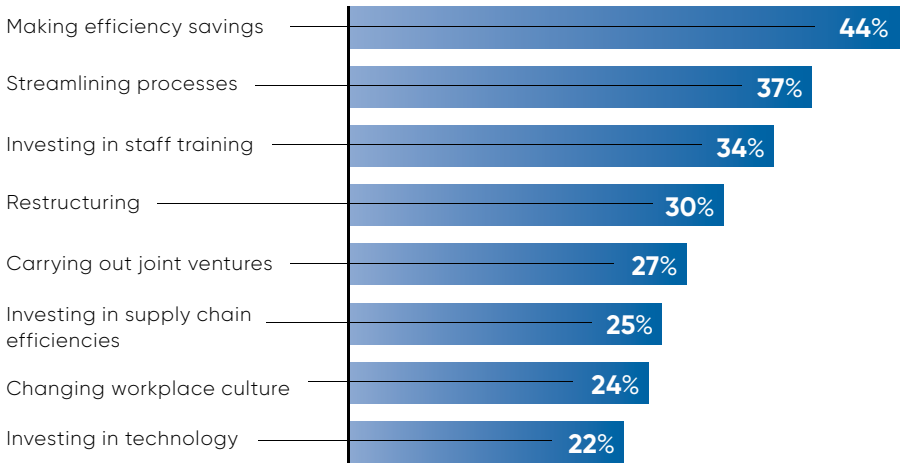
"Will consumers order steak from their favourite local farm, cheese from another and wine from an organic French vineyard to be delivered direct by 6pm, and will they be prepared to pay a premium?" asks Geoff Lockett, senior consultant at Dassault Systèmes Quintiq.

"Many will and if the technology and integration barriers can be overcome then this is likely to become reality and maybe the shift online we've seen for many retailers will move into food too."

There's a thought.

STEPS MANUFACTURERS ARE TAKING TO IMPROVE PRODUCTIVITY

SURVEY OF UK FOOD AND DRINK MANUFACTURERS



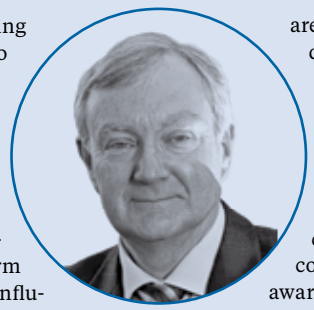
Lloyds 2016

> We could see an explosion in small producers in the same way we have with Amazon marketplace

OPINION COLUMN

‘The fourth industrial revolution is upon us and the future of manufacturing in the UK and globally is digital’

TERRY SCUOLER
Chief executive
EEF – The manufacturers’ organisation



The future is getting increasingly hard to forecast, with economic growth in the UK clouded by Brexit and increasing political uncertainty across the globe. In manufacturing, near-term prospects will be influenced by household spending power, commodity markets and investment cycles.

The list could go on but, of one thing we can be entirely sure, the fourth industrial revolution (4IR) is upon us and the future of manufacturing, in the UK and globally, is digital.

Technologists describe this as one system which links physical and cyber networks, allowing real-time information flow. This will enable intelligence and product insight to be discovered and acted upon quickly, boosting the value add to customers.

Manufacturers talk about 4IR in terms of using new technologies such as sensors, robotics and data analytics to gain insights into product use, improve productivity and improve competitiveness. This will usher in new techniques that will change the products, processes and relationships involved in every aspect of industry.

This is more than fancy factory jargon. Better customer experiences, higher levels of efficiency and more highly skilled jobs will be part and parcel of the 4IR journey. The opportunity is clear, but with this will come disruption to traditional business models, new models of supply-chain engagement and the need to also take employees on the journey. The UK cannot, however, opt out.

Manufacturers are taking steps on their 4IR journey. EEF’s *Manufacturing Ambition* survey published earlier this year showed that growth ambitions in the coming years will be underpinned by the development of new business models, including new services. There will also be greater focus on innovation, in both new products and processes, along with closer collaboration within supply chains and investment in new technologies.

That’s not to say that all companies are embracing the new technologies. The application of 4IR technologies is an area where many companies are still trying to understand how best to apply it to their own businesses with three distinct phases having been identified.

The first phase – conception – is when companies become aware of what it can offer and how it could apply to their business. The second phase – evolution – is a period when there can be some advancement on current practice. Concepts and off-the-shelf solutions can be

implemented and tested, further optimising current processes and putting in place new solutions. The third, and final, phase – revolution – is when the step-change occurs in terms of how value is derived, and how interaction with customers and suppliers is delivered.

For those at the conception phase, optimising processes and supply chains is where some early wins will be found. The evolution of manufacturing processes and the revolution of the product and service offerings to customers will follow, but are likely to take place in fits and starts.

Sharing of best practice and encouraging its imitation will generate a lot of learning, and EEF is helping manufacturers navigate the complexities and challenges presented by 4IR and to take advantage of the many opportunities it will afford. EEF has launched Be Business Ready to help manufacturers explore and understand what 4IR is and what it means to them.

In addition to manufacturers adapting their own processes to meet this evolving challenge, there is a role for government. Industrial strategy has to play a part in enabling companies to learn, adapt and adopt more quickly; not just to keep pace with competitors, but to propel them to the head of the league table.

Sector deals, such as that led by Professor Juergen Maier on industrial digitalisation, should help inform this, particularly the deployment of new innovation resources from the Industrial Strategy Challenge Fund.

Despite the political turbulence and potential uncertainty, this is a very exciting time for industry in the UK and the economic gains are enormous.

SHENZHEN

Challenging China's citadel of capitalism

Shenzhen is the manufacturing capital of the world. Whatever you want, it's there. Motherboards, custom silicon, transistors, touch screens – a stroll through the bazaars takes you past it all

CHARLES ORTON-JONES

Connected to Hong Kong by subway, Shenzhen has grown from a fishing village of 30,000 residents in 1979 when Chairman Mao died to a 12-million-strong citadel of capitalism.

And Shenzhen has a dirty secret. At the heart of its manufacturing boom is a near-total disregard for intellectual property rights. Knock-off iPhone 7s are on sale for £100. The performance of the dodgy unit is phenomenal, almost Apple quality. Want a counterfeit tablet or music system? It's all here. If not, a back-street genius will cobble it together for you at the right price.

Locals think of forgery and hacking as an ethos, not a crime. If you can't innovate faster than the copycats can copy, then frankly you deserve oblivion. This way of thinking has propelled Shenzhen to the pinnacle of innovation in the "maker" industry – small-scale manufacturing for things like drones, internet-connected devices and other consumer electronics.

Back in the UK, our manufacturers have to play by the rules. Lawyers are seen as strategic assets for the way they block rivals. James Dyson built his multi-billion-pound empire with the support of the courts. He hit Hoover with a lawsuit at the turn of the millennium, won the judgment and gained years of advantage over his chief rival.

But the question is this: how can UK manufacturers compete with Shenzhen when the Chinese break the rules so flagrantly? If the Chinese can create what they want, free-riding on the expertise of others, it's an unequal battle. Sure, we can keep the knock-offs out of the UK, but we'll lag in terms of pure innovation. Won't we?

We are seeing the emergence of an answer. The UK can compete. The solution lies in a clever mix of old-fashioned intellectual property defence and open source manufacturing. The mixture is the rocket fuel behind the explosive growth of our own maker industry.

Huaqiangbei electronics market in Shenzhen, the epicentre of the surging makers' movement in China

Open source is software or hardware for which the code and design are open for anyone to access, use, change and share. Android software for smartphones is an example; the code can be read and modified by anyone. Other open source examples include the LibreOffice document suite, the Firefox internet browser and the Raspberry Pi micro-computer.

UK innovators are using open source to leapfrog legal obstacles and compete head to head with innovators in places like Shenzhen.

Liverpool offers a fine example. The city is ready to open the gleaming new Sensor City, a collaboration between the University of Liverpool and Liverpool John Moores University. Sensor City is a playground for inventors in the fields of sensors and the internet of things.

"We cut the ribbon in October," says executive director Alison Mitchell. "We have an open collaboration space, a hackathon space, technical space, lots of hot desks and shared desks, and offices. We have a mechanical workshop, electrical workshop, 3D printers, an optical workshop and the ability to print circuit boards. It's a national asset, a community of like-minded people working together in one place."

Open source thinking is the dominant force. Ms Mitchell's colleague at Sensor City, Dr John Kenny, explains: "Open source allows you to accelerate the development of your product. Users can feedback and your community can even fix issues for you. You can use other open source ingredients in your product."

Old hands may point out that open source has been around for years. Which is true. But we are seeing it thrive in manufacturing and design. Some of the most important products in tech are being released open source. A new processor architecture called RISC-V is entirely open source, offering a breakthrough for startups and larger developers.

Andrew Back, who runs the Wuthering Bytes tech festival in the Pennines, says it's a sign of how advanced open source has become. "You can build your own

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RISC-V processor and pay no royalties. With a licensed design from, say, ARM you might need to sell £10 million of products to make it worthwhile. That's a high barrier to entry. Open source reduces this to £100,000," he says.

Another implementation of open source is with the Large Hadron Collider at CERN in Geneva, where the mysteries of the Higgs-Boson particle were uncovered. "CERN use open source instrumentation, such as for the timing," says Mr Back. "It means if one supplier is no longer the cheapest, or goes bust, CERN can go to an alternative supplier. Peer review is another reason."

The growth of open source designs means UK manufacturers can draw on a galaxy of pre-existing designs, software and equipment to use and modify in their inventions. A 4G cellular base station produced by Lime Microsystems in Surrey is a great example. Lime used open source ingredients to build a cutting-edge product, and is working on research with the likes of Vodafone and EE.

> The rise of open source means even law-abiding Brits can compete

Naturally, there is an objection to the open source movement: if designs are accessible to all, and copying is easy and free, then what is the motive to innovate via open source? There are three main reasons.

Firstly, innovators may not be able to make money from their direct contribution to the open source project, but they can get far more back via affiliated products and services. In the Linux world, Red Hat is the leading services company, designing systems such as operating system for the US Navy's USS Zumwalt stealth destroyer. It has a turnover of $2.4 billion.

Secondly, open source gives you a universe of pre-built units to plug together. The open source database Libraries.io offers data from 2.4 million projects. By contrast, the proprietary route is cripplingly slow. Mandi Walls, technical community manager of automation platform Chef, says: "Instead of every manufacturer solving the same problem from scratch, developers can start with the basics already covered, and put their efforts and energy into building code that breaks new ground."

Third is the community. Building things takes the talent of many of people. Dave Shuman, manufacturing leader at big data analytics company Cloudera, explains: "The real advantage of open source is the community that creates it. The community is global – no single organisation could hire all the smart, motivated people worldwide that collaborate on open source projects."

The ethos attracts the very best people. Mr Shuman continues: "Talented engineers gain membership in a community where the price of admission is creativity, talent and a willingness to bring the code. No matter where you live, regardless of your background, if you have the talent, you can join the club."

Even the Chinese are on board. Mr Shuman points to the driverless car initiative of China's main search engine Baidu. "The reason behind this changed approach to both using open source within Chinese products and services, and making Chinese-developed software available via open source, is to cultivate and leverage a community of developers who will use their talents to enhance said software in ways that will better scale to meet the needs of the extremely large Chinese market," he says.

Open source is changing the rules of manufacturing – anyone can enter and collaborate. The innovators of Shenzhen may flout intellectual property laws to get ahead, but the rise of open source means even law-abiding Brits can compete.

THE WORLD OF MAKING IS CHANGING.

As a result of pressures from consumers for better experiences, the world of manufacturing, already transformed by waves of technology and globalization, has a new goal, across all markets: mass customization and quick delivery to an on-demand generation of consumers. The traditionally very fragmented manufacturing of yesterday will simply not do anymore.

Speed and agility in industrial manufacturing operations will require complete synchronization and integration of operations, from digital manufacturing and manufacturing operations management to supply chain planning and operations. Not only will this enable faster manufacturing, but also the modularity and predictive analytics for the agile manufacturing needed to meet consumer demand efficiently.

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