FUTURE OF MANUFACTURING

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TECH INVESTMENT

Tech investments are a constant balancing act

Great mechanics need great instructions, and manufacturers upgrading to smart factories will need to balance their investments in both hardware and software to stay ahead of the competition

Rich McEachran

Engineering firm BGB Innovation, based in Grantham, Lincolnshire, recently opened a state-of-the-art testing facility to make its product development process more flexible and responsive. Faced with competition in the wind energy sector, from low-cost and low-price competitors in southeast Asia, the company realised it had to increase investment in its research and development (R&D) to ensure the business continues to attract global customers.

"Investing in a hardware facility has enabled us to implement a high level of prototype evaluation and quality control," says Paul Holdsworth, programme director at BGB. "Although the overall aim is to test hardware prototypes, software has been key to making sure the product development process is effective."

Mr Holdsworth adds that, with increasing levels of automation, it will ultimately be the software which drives the new testing facility and R&D forward.

Smart manufacturing and smart factories are expected to have driven a 27 per cent increase in efficiency in the manufacturing industry between 2017 and 2022, according to a report by global professional services firm Capgemini. While every manufacturer will be unique in how it operates, they'll all be working with the same universal goal in mind: to optimise processes, move faster and, most importantly, deliver products and services to customers seamlessly.

The speed at which a factory moves will largely depend on R&D teams being given the flexibility and freedom to innovate. For innovation to occur, investments need to be made in hardware and software. Getting this balance right can be tricky.

"Investment priorities are individual to each company. Generally, though, manufacturers need to consider both hardware and software," says John Mapother, principal analyst at R&D tax specialists The MPA Group. "Despite software being seen as the more newsworthy and fashionable of the two, it often needs adequate, accompanying hardware to reach its full potential and vice versa."

To illustrate his point, he gives the example of a manufacturer investing in the most brilliant piece of robotics to help assemble goods. Without the robotic arm – hardware – fitted or installed with the relevant technology – software – its data is of no value. Likewise, without software to monitor and track the arm's performance and efficiency, the hardware is redundant.


GEOFF CADDICK/AFP/Getty Images

Martin Walder, vice president of industry at Schneider Electric, which specialises in energy management and automation solutions, agrees. He insists: "Good mechanics can't perform without good software."

Underlining the need for robust hardware, Robert Sinfield, vice president of product for Sage Business Cloud Enterprise Management, argues that hardware should be seen as the heart of any manufacturing operation. It shouldn't be overlooked.

"Hardware is essential to the core business; better machines make better products," he says, adding that there is a caveat. "However, hardware can't tell you what's working and what's not. It can't give you the insight you need to understand operations better."

If hardware is the heart of a company, pumping the innovative blood around the metaphorical body, then software can be seen as the nervous system. Its role is to check all parts are operating correctly and send signals when it detects that something's wrong.

"An enterprise resource planning (ERP) solution acts as the nerve centre. It's fundamental for informed decision-making and means business strategies can be based on facts, not hunches," says Nick Castellina, director of industry and solution strategy at software company Infor. "Without the right insight being generated by a suitable ERP solution, investment in machinery can be counterproductive and cause more headaches than it does help [to soothe]."

With manufacturers under increasing pressure to deliver and ship products faster, with some assembly lines running around the clock, even the slightest delays or downtime can eat into the bottom line. For this reason, manufacturers can't risk machinery or equipment failing.

Thanks to built-in artificial intelligence, software solutions can learn about every asset's performance, health and lifespan. This means red flags can be raised and interventions taken before any notable impact on production occurs.

"Software's ability to connect devices to centralised asset management systems means that it can now warn of impending failure," explains Mr Walder. "This allows repairs to be planned and carried out in a controlled manner outside scheduled production runs or replacements ordered ahead of time."

Cinzia Giannetti, senior lecturer at the College of Engineering, Swansea University, and an expert in smart manufacturing and sensors technologies, believes that because software enables predictive maintenance to be carried out, it might not always be necessary to upgrade hardware or buy new machinery and equipment.

"It may be more viable to retrofit existing [hardware] with sensors, communication and computing capabilities," says Dr Giannetti. "By deploying technologies, such as edge computing, you help to optimise data transmission and processing in the factory. In turn, this allows for enhanced equipment utilisation."

Deciding between hardware and software is a constant balancing act. The way manufacturers should determine what to invest more in, argues Mr Walder, is to work out which of the two is going to deliver the higher return on investment for the business strategy.

"The latest hardware offers a quick win, helping to ensure the production line works as quickly and efficiently as possible," he says. "On the other hand, software offers long-term value; investing more in software is effectively future-proofing the business.

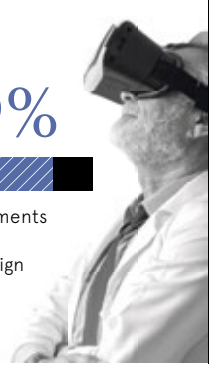
"You must remember, software is the key to unlocking the productivity puzzle, but it needs to work alongside hardware on the factory floor, which itself needs to be capable of running reliably."

87%

of manufacturers in the UK say they are ready to invest in new digital technologies to boost productivity

83%

say these investments will accelerate innovation in design development and processes

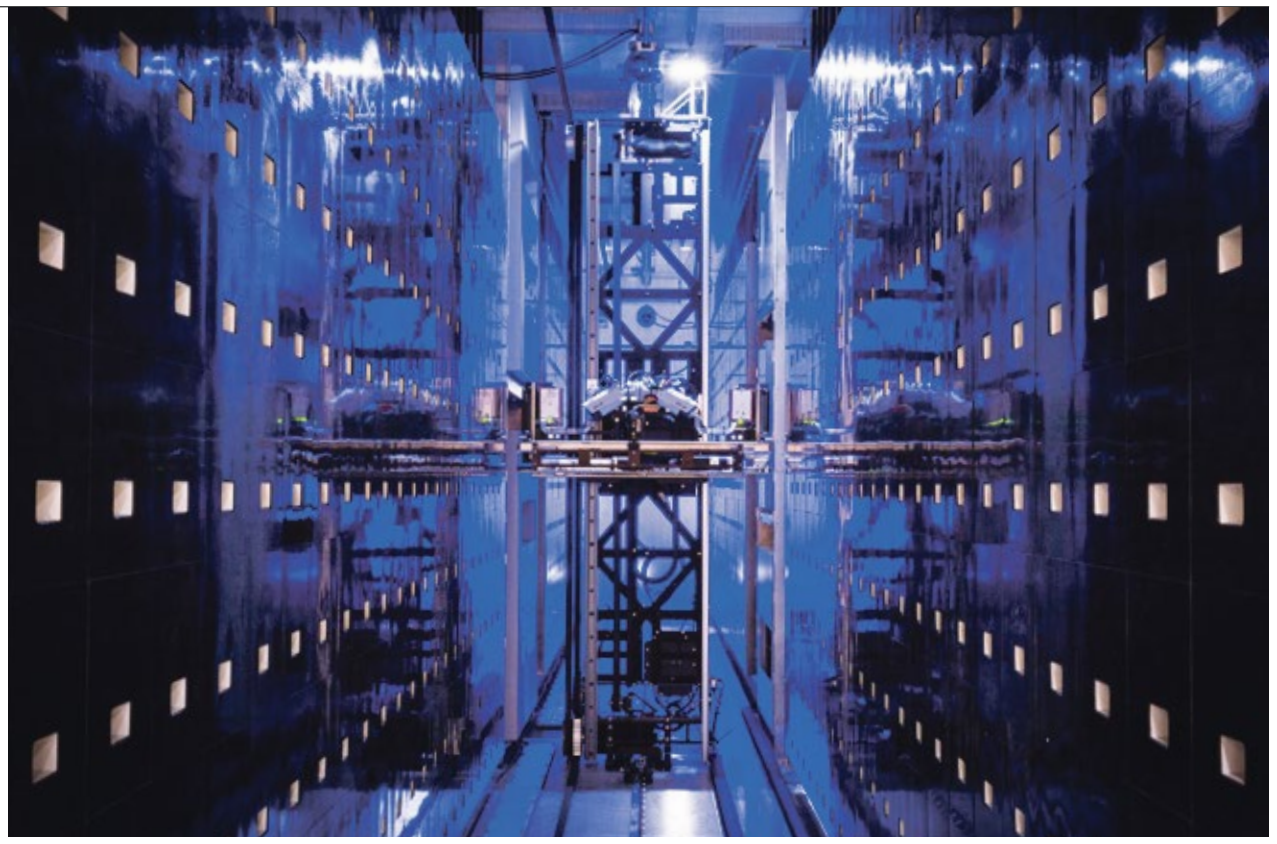


PwC/*The Manufacturer* 2018

Commercial feature

New digital dawn for UK manufacturing

Digitisation of manufacturing is key to unlocking future wealth for the UK economy



The BioStore™ II automated sample management and biological storage system, at Brooks Life Sciences in Manchester. Photograph taken by Greg Harding, winner in the Professional Future Technology category of the Make UK Photography Competition 2018

Manufacturing is a moneymaker for the UK. Contributing some 11 per cent of total economic value, the sector makes more than £1 in every £10 going into the nation's pocket.

What's more, the public know this to be true: some 70 per cent agree the UK cannot tackle future problems without a strong manufacturing sector, according to a survey carried out for Make UK, The Manufacturers' Organisation.

For all its success, however, manufacturing in the UK needs to develop and change, if it is to continue as a driving economic force for future generations.

The good news is that the sector is not short of ideas. Visiting hundreds of manufacturing businesses over the last 12 months, Make UK chief executive Stephen Phipson has been struck by the level of clever innovation happening all around the country. "Whether big or small, every enterprise has an innovation story to tell. How they have survived and thrived is often down to thinking differently about both product and process," he says.

"As a result, this differentiator comes through very strongly for the UK in our brand reputation within export markets. Innovation is our unique selling point; innovation in everything we do."

Manufactured goods account for about 44 per cent of total UK exports and this revenue stream is a magnet for inward investment. It is why so many household global names are here.

The latest figures put the UK ninth in the world for manufacturing by value of output; however, this story is not well understood by the general public. In fact, the same survey respondents, who consider the sector important to the nation's economic future, actually guessed the country came as low as 56th in the rankings, a position currently held by Kazakhstan.

Indeed, problems with public perceptions of the manufacturing sector are proving a significant obstacle to progress in the UK. For instance, only 17 per cent of people surveyed realise average earnings in manufacturing exceed those in the wider economy.

This failure to communicate carries potentially serious consequences in terms of human resource. Manufacturing already employs around 2.7 million people in the UK and rising demand for engineering skills could mean as many as 265,000 new recruits a year through to 2024. Getting and keeping sufficient skilled bodies on board, therefore, calls for significant uplift in attraction and retention of talent, plus retraining.

The challenge begins with the education system, right from primary school level upwards, argues Mr Phipson. "We need to attract young people into this profession. However, over the last couple of decades, design and technology in schools has almost disappeared, with the system skewed towards getting more and more people into university. The upshot is a gap in intermediate technician-level skills," he says.

"This skills gap has largely been filled by the free movement of labour from Europe, with a lot of the 300,000 EU nationals currently employed in manufacturing working as toolmakers, machine-setters, CNC [computer numerical control] programmers and the like."

With Brexit on the horizon, however, availability of this supplementary skills resource hangs in the balance. Therefore, manufacturers are increasingly looking for learners with a combination of vocational and academic profiles, which is what makes degree apprenticeships so attractive.

Complicating recruitment matters more, though, gender balance has also been a workforce issue in manufacturing, historically. National statistics show women only make up 24 per cent of employees, barely one in four. They represent just 11 per cent of engineers and 15 per cent of engineering graduates.

While the sector itself is responding, greater urgency is needed, as well as a more systemic approach to working with educators and policymakers to address structural issues.

The recent *Reinventing the Manufacturing Workforce* report from Make UK revealed the majority of manufacturers, some 72 per cent, are introducing or continuing formal apprenticeships to help secure the skills for the future. Slightly more are offering agile ways of working to retain existing employees, plus over half offer flexible forms of employment.

Altogether, developing a modern, youthful, diverse and appropriately skilled workforce fit for 2019, Brexit and beyond calls for something of an image makeover on the part of UK manufacturing. Spearheading this charge will be Make UK, pioneering a proactive stance to update perceptions and broaden appeal.

Core to a new vision for the sector is the positive impact of the fourth industrial revolution (4IR). Digitisation is transforming much of manufacturing already and its influence will only continue to disrupt the world market, in a good way, explains Mr Phipson. "Overwhelmingly, 4IR provides a fantastic opportunity for the sector in the UK. In truth, we have lagged behind somewhat on digitisation, but that future catch-up factor only serves to make the size of the prize even bigger," he says.

"Digitisation is not just the domain of major players, though. Investment of £1,000 in smart sensors on a CNC machine could harvest data and double SME [small and medium-sized enterprise] productivity within a month.

"Change at scale and pace will, however, require substantial reskilling of an existing workforce new to such areas as data analytics. Therefore, we are very pleased that government policy under the Industrial Strategy is supporting this with the Made Smarter initiative and £147 million of allocated budget to help technology diffusion become a reality up and down the supply chain."

Make UK research suggests 43 per cent of manufacturers have moved beyond the initial conception phase on 4IR into the evolution phase, where current business practice is optimised with new technologies. In short, they have moved from thinking to doing. That still leaves a majority yet to invest. For UK manufacturing to remain a future moneymaker, however, 4IR is a must. The future is inescapably digital.

Mr Phipson concludes: "The effects of digitisation are going to touch everything. Instant mass customisation of products means manufacturing in real time, on demand, using state-of-the-art technology, such as 3D printing. It will revolutionise the way we make things.

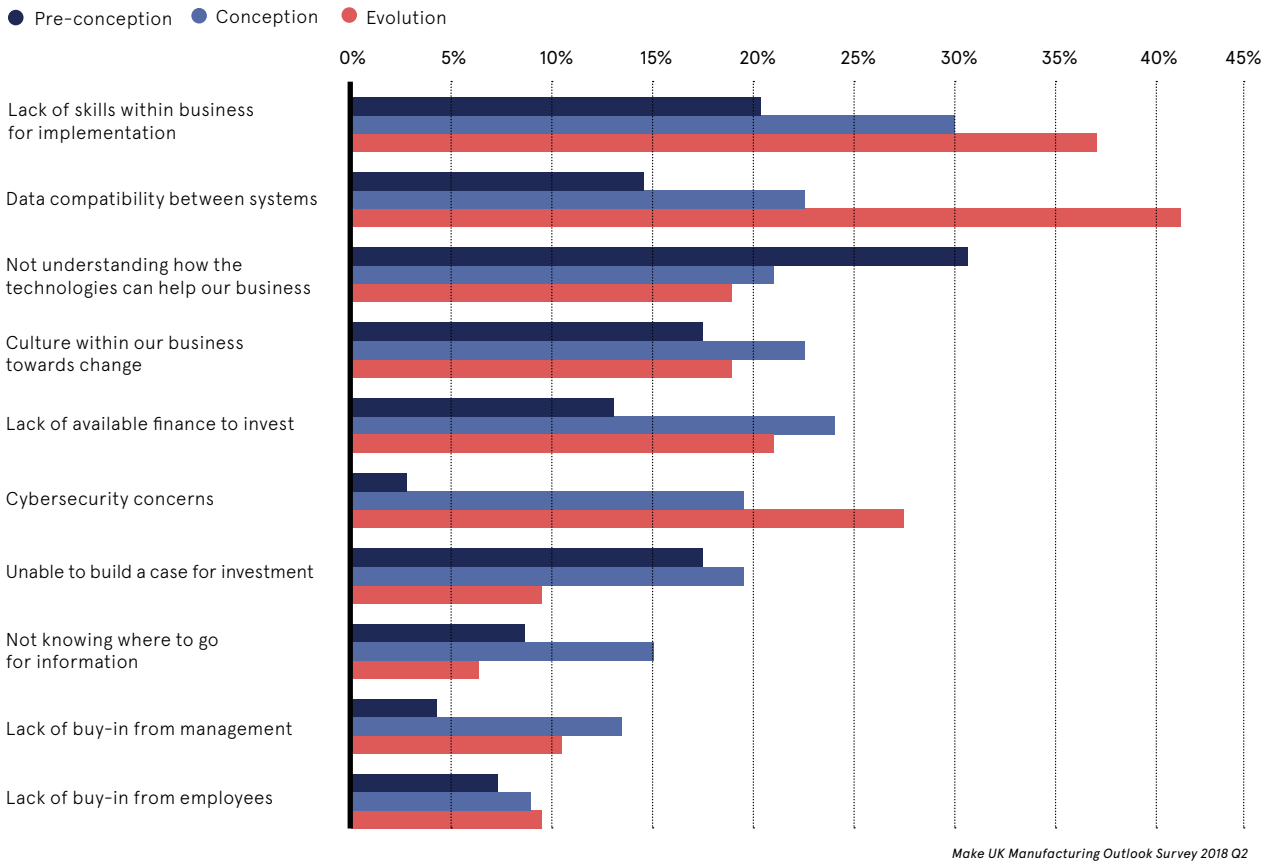
"While the risk is real, the opportunity is huge. With our genius for innovation, backed by a consistent policy framework, plus an image makeover, 4IR is a new dawn for manufacturing in the UK."

For more information please visit makeuk.org

MAKE uk
The Manufacturers' Organisation

4IR BARRIERS DEPEND ON WHERE FIRMS ARE ON THEIR JOURNEY

Barriers companies have experienced, or anticipate experiencing, when adopting 4IR technologies and techniques

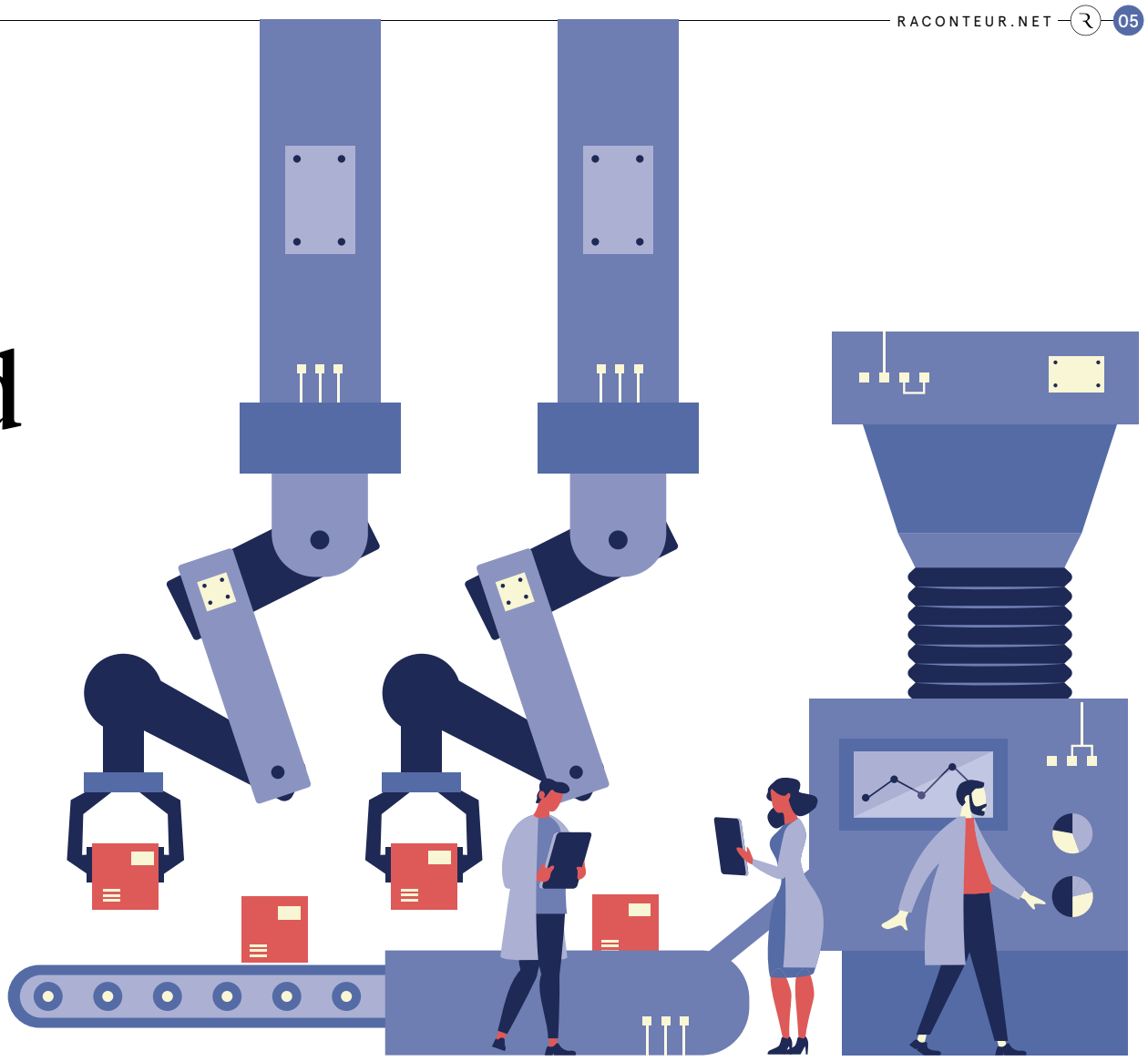


Make UK Manufacturing Outlook Survey 2018 Q2

TRANSFORMATION

Why firms need to rethink how they digitise

Digital transformation without the right culture is meaningless and companies that fail to appreciate its importance risk stumbling at the first hurdle



Emma Woollacott

From the very first days of the Industrial Revolution, British engineering and manufacturing industries were in the vanguard of change. These days, however, they may not always seem to be the earliest adopters.

Data from management consultancy Russell Reynolds Associates shows that only 48 per cent of industrial manufacturing firms have a digital strategy, compared with 62 per cent of automotive firms and 56 per cent of companies in consumer products. "They seem to be a little bit behind some of the other sectors," says consultant Catarina Abrantes.

But while engineering and manufacturing may not be leading the charge in terms of digital transformation, there's a lot going on behind the scenes.

"Many manufacturers have been embracing digital technologies and techniques for years, through gradual evolution, and many are actively taking steps to determine the ways in which they can incorporate these steps," says the manufacturers' association Make UK.

Research carried out by Oxford Economics in 2016 revealed that revenue related to digital capacity in the manufacturing industry was growing at 3.2 per cent a year, putting it behind only tech services, retail and construction. Manufacturers told the researchers that they expected more than 4 per cent of new jobs to relate to digital technologies over the following two years.

"Robotics is such a promising area; it increases our speed, quality, and minimises errors," according to the chief information officer of a mid-sized manufacturer based in Yorkshire and the Humber.

However, there's a great deal more to digital transformation than simply buying new kit. It also involves a complete overhaul of an organisation's processes and creating a corporate culture to suit.

This, says Make UK, is harder for some engineering organisations than others. "Medium-sized companies have the highest instances of issues relating to a lack of culture in the business towards change and not understanding how the technologies can help their business," Make UK says.

Last year Boston Consulting Group (BCG) assessed around 40 digital transformations and found that the proportion of companies reporting "breakthrough or strong financial performance" was five times greater – 90 per cent – among those focusing on culture.

"A healthy culture provides the guidelines – the tacit code of conduct – that steer individuals to act appropriately and make choices which advance the organisation's goals and strategy," says BCG's Jim Hemerling.

> **The key is communication, with the most successful transformations involving regular input from employees at all levels**

However, businesses need to be sure this culture permeates right the way through the organisation.

"I think there are some things that need to be top down as without the right leadership, nothing will change. But there also needs to be empowerment at the bottom," says Mark Enzer, chief technical officer at Mott McDonald, who leads the digital transformation workstream within the Institution of Civil Engineers.

The key to this is likely to be communication and a focus on how a digital transformation mindset can improve the working practices of all employees.

"For businesses that have a top-down process in initiating projects, some may find there can be a lack of buy-in from employees, and those not at senior management or board level may feel left out of the process, or a lack of communication of these transformations means employees do not see the value of the changes," and Make UK warns.

"There are also many companies using these technologies that do so because of suggestions and initiatives of those on the shop floor, who often have first-hand knowledge of what can be streamlined, improved or adapted within the manufacturing process, as well as what products could help them to improve these aspects."

The key, of course, is communication, with the most successful transformations involving regular input from employees at all levels of the organisation. According to Russell Reynolds consultant Sarah Galloway, this means paying special attention to middle management.

"As the senior management lead the change and the younger population are de facto 'digital natives', middle management needs the most help to trigger the change," she says.

90%

of companies undergoing digital transformation that focused on culture reported strong or breakthrough financial performance, compared with...

17%

of those who neglected it

Boston Consulting Group 2018

Three common failings in manufacturing transformation

1 Thinking the job's done

Many organisations approach digital transformation as a project to be completed, but it's a process, not an end-goal. Failing to acknowledge this will simply mean the organisation eventually ends up just as rigid as before. It's important to set up internal systems that allow a culture of continuous improvement, involving both management and staff, with each successful transformation acting as a stimulus for the next.

2 Skills gap

Gartner has concluded that skills shortages represent a serious threat to organisations' transformation efforts. Indeed, it says that only 20 per cent of employees have the skills needed for their current and future roles. Organisations wanting to make a success of transformation need to invest in staff training and be prepared to recruit from outside. Key areas to focus on are data analytics, machine-learning, cloud computing and security.

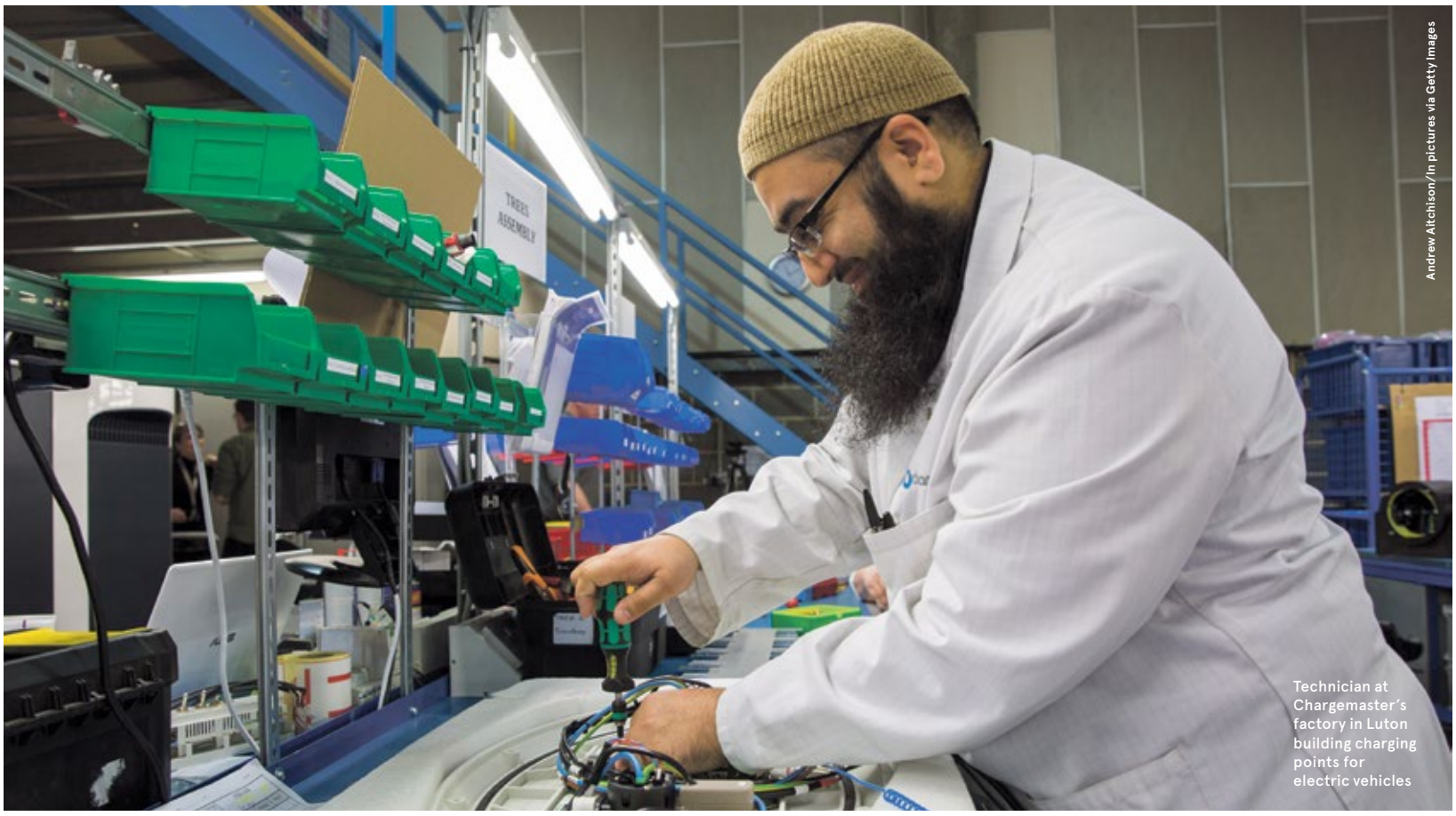
3 Poor supply chain integration

Industrial sector respondents say the availability of third-party or customer proprietary data and the skills to use and analyse it are posing challenges, according to Catarina Abrantes at Russell Reynolds Associates. More than a third of industrial organisations told Russell Reynolds they don't have sufficient third-party data. Establishing a digital ecosystem encompassing suppliers, customers and other partners can increase the effectiveness of a transformation programme exponentially.

TALENT

Anticipating the next talent shortfall

As the engineering and manufacturing sectors continually evolve, filling the gaps in talent created by technological change remains a constant battle



Andrew Aitchison/In pictures via Getty Images

Technician at Chargemaster's factory in Luton building charging points for electric vehicles

Karam Filfilan

From 3D printing to blockchain, automation to predictive analytics, the fourth industrial revolution is changing how the manufacturing industry is operating. However, with this rapid transformation comes talent challenges, exacerbated by an industry that has struggled to recruit the right people.

According to a survey by industry body Make UK, 29 per cent of manufacturing vacancies were considered hard to fill by employers in 2018, a small improvement on the 30 per cent reported in 2015 and 2013. Add in the UK's ongoing shortage of engineers and a rapidly ageing workforce, and it becomes increasingly hard for leaders in manufacturing to know where to start when it comes to talent planning.

"Engineering businesses have always required a unique combination of technical and soft leadership skills, and it remains in short supply," says Carol Burke, managing director at Unipart Manufacturing Group.

"The fourth industrial revolution is affecting all aspects of business because process is no longer about machines and people, but now about data. It is crucial that our employees have the imagination and creativity to realise the full potential of digitilisation and end-to-end integration."

To facilitate this growing demand, Unipart co-founded the Institute for Advanced Manufacturing and Engineering (AME) with Coventry University in 2014, with the aim of solving three key challenges for the business: solving skills shortages in manufacturing and engineering; increasing its capacity to fund research and development; and improving commercial benefits to its customers.

The institute houses state-of-the-art machinery and provides students with access to Unipart's operations, giving them a "live" environment in which to test their skills. Its first cohort of students graduated in 2018, with all either entering industry or going into post-graduate research.

"Our new talent pipeline is a mixture of AME graduates and apprentices. We want agile, flexible, creative and entrepreneurial employees, and this is vital in the digital world," says Ms Burke.

> **Finding the right balance between the skills new technology requires and upskilling existing talent pools is the key challenge**

For others in the industry, finding the right balance between the skills new technology requires and upskilling existing talent pools is the key challenge.

Siemens went through a period of structural reorganisation in 2014 to prepare it for the challenges facing the manufacturing industry, with industrial digitalisation being a key component of its Vision 2020 strategy. Commenting on the reasoning behind the changes in 2018, Siemens president and chief executive Joe Kaeser called digitilisation "the greatest transformation in the history of industry".

Brian Holliday, managing director of Siemens' Digital Factory, the German manufacturer's data integration wing, says: "From a talent perspective, many new roles are emerging in app development, connectivity and software engineering. Technology won't replace people in future factories, but it will augment human effort through artificial intelligence and 'co-bots' [robots that work alongside people on the shop floor], so finding the right balance will be crucial to our survival.

"We won't build factories in the future without full digital simulation and we will be increasingly reliant on data for decisions. Our engineers and managers will need to continuously develop new capabilities and embrace new tools."

Like Unipart, Siemens is hoping to create industry-ready graduates by partnering with universities on research and qualifications. It has seven partner universities in the UK, including the universities of Cambridge, Manchester and Lincoln. The latter houses its newly opened Digital Mindsphere Lab, which is a hub for developing its cloud-based operating service Mindsphere.

However, as with many industrial companies, Siemens' workforce largely consists of mature engineering talent, and apprentices and graduates, with a significant gap in the middle, says Mr Holliday.

Dealing with this talent gap is a major headache for an industry already struggling to meet demand. According to Make UK, two fifths of manufacturers say 40 per cent of their workforce is above the age of 50. The looming Brexit deadline cannot be ignored either, with European Union nationals making up 11 per cent of the average manufacturer's workforce and proper guidance on post-Brexit rules still to be decided.

For Rockwell Automation's UK director Mark Bottomley, Brexit isn't manufacturing's defining issue for coming years, but rather the industry's ability to adopt technology in the fourth industrial revolution. He believes this is what will govern future success and talent strategies are key to fostering this change.

"The single most exciting thing about the fourth industrial revolution is the breadth of talent that can find expression, the breadth of skills that can be developed and where these attributes are taking the

Unipart

Unipart

The Institute for Advanced Manufacturing and Engineering (AME), a joint venture between Unipart Manufacturing Group and Coventry University, and funded in part by the Higher Education Funding Council for England, aims to create industry-ready graduates who are experienced in shop-floor projects.

Students have access to state-of-the-art machinery, including robotics, and work on "live" Unipart projects. Its first cohort of students graduated in 2018, with five securing industry-related roles, three of them with Unipart. It is now in its fourth year of students.

AME also houses a research and development facility, which is working on projects in priority areas such as fuel systems and powertrain aerospace, automotive and renewable energy. Its team of academic staff and researchers work in partnership with experts from other sectors.

According to Unipart managing director Carol Burke, this collaborative approach to developing engineers and products makes perfect business sense. "As technology moves between sectors, there are commercial advantages to be gained in working in a consortium, such as attracting funding to support research and development, and winning contracts which are often linked to job-creation targets. With AME underpinning our business development, we have been able to secure £250 million of new business," she says.

industry. There are barriers to overcome, but the biggest risk comes in not embracing the challenge," says Mr Bottomley.

A 2017 IDC FutureScape report into global manufacturing trends supports this view, predicting that 60 per cent of the largest 2,000 manufacturers will be reliant on digital platforms for processes by 2020 and 80 per cent of human-to-machine interactions using immersive interfaces such as augmented reality by 2030.

To meet this, Mr Bottomley recommends a two-pronged approach to talent planning with inward and outward strategies.

"Investing in the people you have is hugely important. Your people already understand what you do, but do you really understand what they could do if given the right opportunities? Offering your people the chance to learn and further their own careers also makes you more appealing to other skilled talent you'll need to recruit," he says.

"The other half of the equation is about looking into the future and outside your company to understand the skills you'll need down the line. Some of these skills can be redeployed through the use of automation technologies to free up existing workforces, but industry in general still needs an influx of engineers for the future."

Perhaps this is the crux of the issue. While digitalisation is certainly the future of manufacturing, in talent terms the present is still a challenge. According to Make UK, the sector needs to find 124,000 new employees with level 3 and above engineering skills each year, but faces a deficit of 54,000 annually. More government help is required as programmes like the Apprenticeship Levy and National Retraining Scheme are yet to have the desired impact. Until manufacturers can close this numbers gap, workforce planning will remain a significant challenge.

38%

of manufacturing employers in the UK say that vacancies are hard to fill

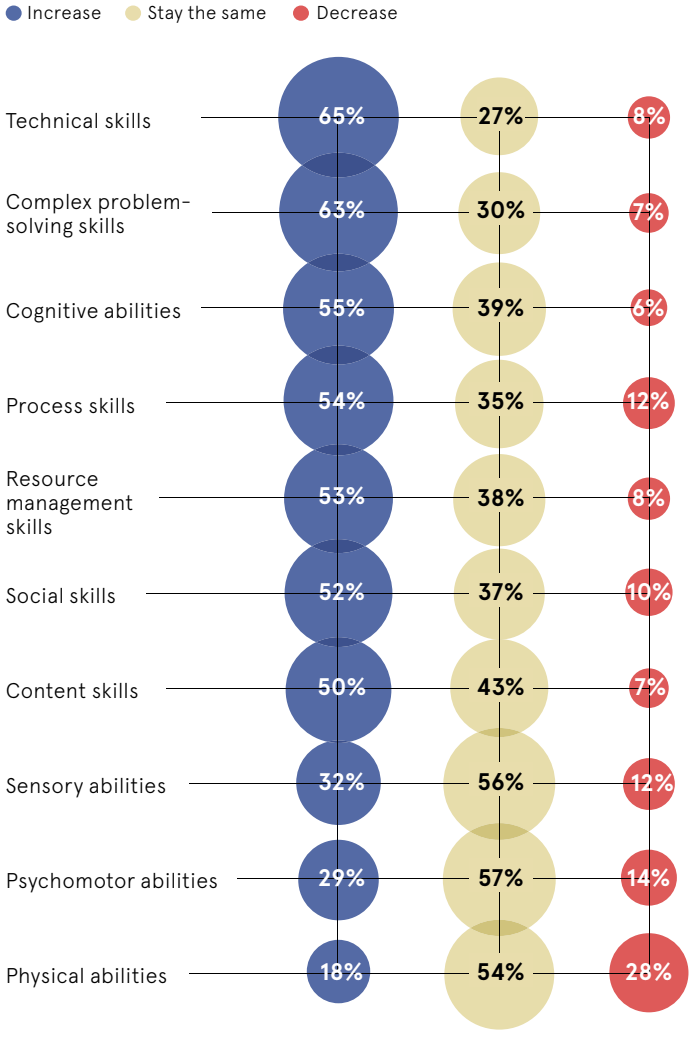
48%

are increasing their recruitment of people with transferable skills from other industries and sectors

Make UK 2018

SKILLS NEEDED IN THE FUTURE WORKPLACE

Cross-industry survey of executives were asked how the following skills would change as AI/robotics are integrated in the enterprise



Percentages may not equal 100 due to rounding

Deloitte 2018

Commercialising products and services in a digital age

Manufacturers must develop new skills to drive sales growth

New technology is transforming the way products are designed and manufactured, opening up revolutionary opportunities as well as creating new challenges for industrial businesses. The products' full potential will only be realised, however, if companies can develop more innovative ways to serve customers.

"The issue that many manufacturing and industrial businesses are going to face is how to get their products, services and ideas to market. That is an area which the sector could focus on more," argues Peter Matthews, partner at Ernst & Young LLP, who heads the UK advanced manufacturing and mobility business at EY, a professional services organisation.

The challenge is all the greater because it comes at a time of economic instability, with growth slowing, globalisation stalling and political tensions around issues such as Brexit and the US-China trade conflict. Against this backdrop, companies will be under more pressure than ever from investors to show they can grow their sales, which requires an increased focus on commercialisation.

Mr Matthews says: "Many companies' core strengths are in designing and manufacturing groundbreaking products and having great ideas. That's where they spend a lot of their budgets and a lot of their time; they are very aware of trying to improve the efficiency of manufacturing processes. The big question is, once you have new products and efficient manufacturing processes, how do you drive growth?"

Digital marketing has become essential for growth as the ways businesses engage with customers have changed. The most obvious example is digital. With so much information now available online, virtually all buyers research suppliers' products and offerings before they even talk to the sales organisation. That means digital marketing becomes much more important.

"It's an area where advanced manufacturing businesses have a bit more work to do compared with consumer-led businesses, which have been dealing with this for a while," Mr Matthews says.

To improve their customers' experience, manufacturing companies need to make fuller use of data analytics and effective customer relationship management systems to make sure they understand customers' needs, whether these are other businesses or the end-consumers. In turn, they need to raise the level of skills within their sales organisation, so people can use these tools effectively and draw the right inferences about customers' priorities.

Manufacturing companies can only compete on cost, technology and commercialisation. Commercialisation and the routes to market are key, not just using new technology to manufacture exactly what the customer wants and to reflect how they use products, but also to think about redesigning routes to market to reflect new capabilities, not simply traditional assets.

"We need a more agile process to reflect what the customer is actually asking for. Manufacturing to the customer's specification is becoming evermore important in a world where digital manufacturing enables you to be more flexible than you might have been 30 years ago," says Mr Matthews.

Customers will be looking for a seamless blend of online and offline contact. "They are going to be looking for consistency of experience across different salespeople, different products and different divisions, so they feel as if they are dealing with one business. There is an increased need for strong account management and senior client handlers within the sector," he says.

In this new world, people recruited into manufacturing, as well as customers, will be interested in using products and services that carry a sense of purpose; products which make a genuine difference to people's lives.

"The additional challenge for manufacturing will be about talent acquisition," Mr Matthews says. "Many of the science, technology, engineering and mathematics skills required are in short supply, so companies need to have a very clear purpose that will motivate and inspire a new generation who want to use those skills to help produce goods which change the world for the better."

59%

of the leading manufacturers consider enhancing ordering and delivery capabilities or multichannel strategies among the important factors for success in next three years

Almost 2/3

consider access to specialised skills for emerging technologies among the important factors for success in next few years

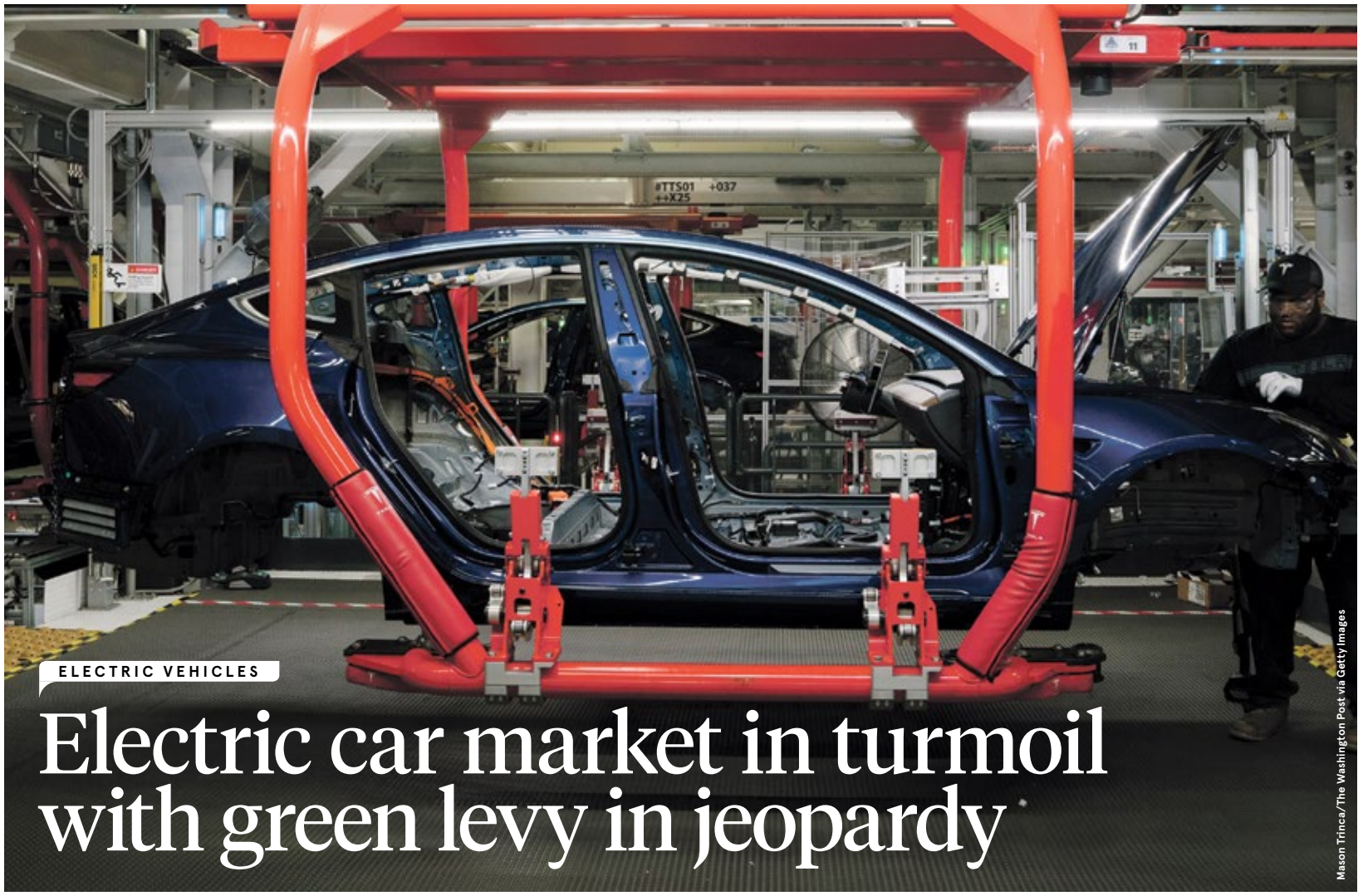
45%

have invested in developing differentiated service offering based on customer value to improve customer experience

IP continuous innovation survey, EY

For more information on NextWave Manufacturing please visit ey.com/mfg or contact Peter Matthews (pmatthews@uk.ey.com)

EY
Building a better working world



Mason Trinca/The Washington Post via Getty Images

ELECTRIC VEHICLES

Electric car market in turmoil with green levy in jeopardy

President Donald Trump is considering axing a generous tax credit designed to encourage electric vehicle sales in the United States. If it happens, green car manufacturers could face a rocky future

Olivia Gagan

As it stands, buyers of new electric and hybrid vehicles in America can claim back a federal tax credit of up to $7,500 on their purchase. The offer is an Obama-era initiative, which was designed to get more environmentally friendly vehicles on the road and stimulate the US car manufacturing economy.

But at a November 2018 press conference, National Economic Council director Larry Kudlow said President Trump planned to end the incentive "in the near future". When pressed, he was reported to have mooted a 2020 or 2021 cut-off.

Currently, a maximum of 200,000 vehicles per manufacturer qualify for the deal. Tesla was the first to hit the cap in the autumn of 2018 and General Motors followed soon after in December 2018. Other manufacturers with electric vehicle (EV) offerings, including Nissan, Ford, BMW and Toyota, are thought to have tens of thousands of cars still to sell before they hit 200,000 units.

Without the bait of a generous tax rebate to offer potential EV converts, do these manufacturers stand to lose a lot of business in the coming years? Joel Levin, executive director of California-based EV advocacy group Plug-In America, says the future is uncertain. He is sceptical whether a ban on the tax credit could be enacted in the timeframe Mr Kudlow has indicated, if at all.

General assembly of the Tesla Model 3 at a factory in Fremont, California

Mr Levin concedes that anti-subsidy sentiment is strong in some quarters on Capitol Hill. "There are a few members of Congress who would like to kill the tax credit right now. But I think that's very unlikely," he says, because axing the credit would probably require an Act of Congress to remove or amend existing law.

At the same time as the largely Republican-backed desire to end the tax credit, there is a Democrat-led movement to extend it to 2028. "That actually has a lot of interest in Congress. There's a lot of political support for it," says Mr Levin. Yet steering more EVs on to America's roads requires more than convincing lawmakers in the corridors of power. Getting the country's voters of all persuasions on side will be just as important to future sales growth.

Making the business case for EVs to consumers is key. Mr Levin says: "If the US wants to be manufacturing cars in 20 years, we need to get in front of electric technology. Otherwise, cars are going to be built in Germany and China because they're both making vast, vast investments in EV. If we don't, we'll be buying our cars from them. When we talk to people from the Midwest – Ohio, Michigan – states, where there's a lot of auto manufacturing, our argument is that this is the technology of the future for cars. No one really disputes that at this point."

> **If the US wants to be manufacturing cars in 20 years, we need to get in front of electric technology**

Even if the tax credits are cancelled, he points out that for the majority of the US EV market's clientele, $7,500 represents small change. The most popular brand, Tesla, sells cars which are largely the preserve of the wealthy. The most basic model starts at around $35,000, but most cost upwards of $100,000.

Mr Levin says for consumers able to part with this kind of cash, "a $7,500 tax credit is nice to have, but it's probably not going to be a core part of your decision". Instead, a tax credit cull would have a greater impact on sales of the cheaper vehicles, hitting drivers on lower incomes. He says: "Look at Nissan's Leaf EV model, which retails at about $30,000; if you can chop $7,500 off that price using a tax credit, that will make a big difference to your customer."

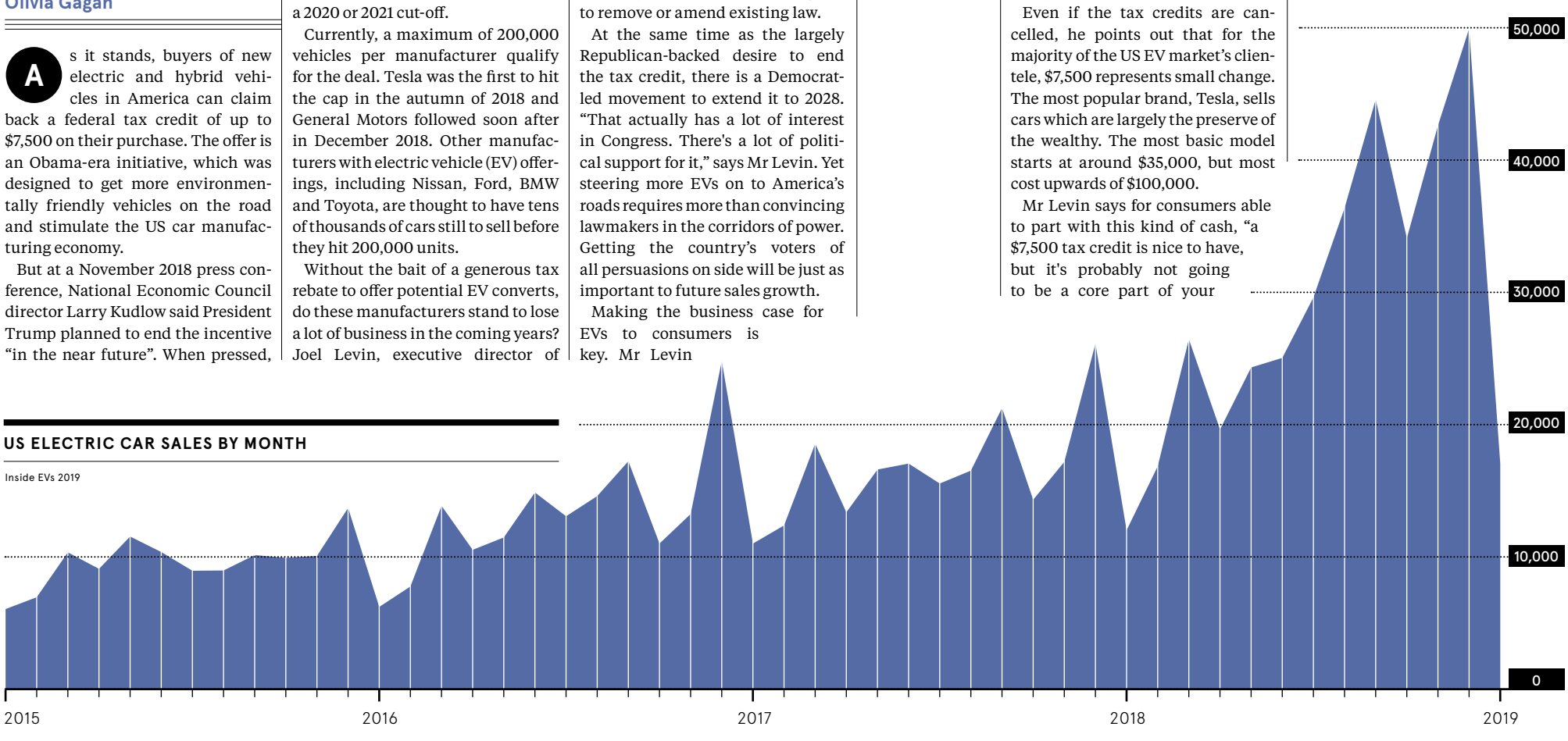
If the tax credit is axed, Mr Levin says: "It would hurt the industry, but I don't think it would kill the US EV market; it would slow it down."

Tom Wood, chief executive of used-vehicle database Cazana, says if the credit is cancelled, it could have the effect on ramping up sales of second-hand EVs. This is a trend which is already playing out in the UK. Grants for buying a hybrid or all-electric vehicle were slashed in the UK last October and since then "the secondary car market is showing a rise in the pricing of plug-in hybrid vehicles", he says.

As EV technology prices fall and uptake rises, Mr Wood believes the greater challenge lies in making sure the battery charging infrastructure is in place to support market growth. "I think tax credits are getting less important," he says. "It's a nice marketing thing to be able to use, but the economics of EVs is stacking up on its own now. The problem in the US is that it is a big country and people drive long distances. That's what the automotive industry now needs to crack: the infrastructure." ●

US ELECTRIC CAR SALES BY MONTH

Inside EVs 2019



Fourth industrial revolution can be UK Brexit lifeline

Industry 4.0 enables British manufacturers to thrive and remain competitive in an unstable world

We speak to British manufacturers every day, with a full understanding of the opportunities offered by Industry 4.0, a fourth industrial revolution. Executive awareness is growing as our leaders get the message that technology and having a connected operation gives their businesses the ability to become more profitable, thrive, stay competitive and win globally.

It has long been recognised that manufacturing provides huge value to the UK economy. It has the potential to solve many of our future challenges: economic, societal and environmental. British manufacturers have the potential to provide solutions to wide-ranging, long-term challenges and reap the commercial benefits.

And British manufacturing is still a success story. According to recent statistics from the manufacturers' organisation Make UK, the UK is the ninth largest manufacturing nation in the world, responsible for 10 per cent of total UK output. Manufacturing also makes up 45 per cent of UK exports, totalling £275 billion.

But there are various economic, political and social challenges at home and abroad. Brexit has been front of mind for many British manufacturers since people voted in favour of leaving the European Union in 2016. British manufacturers are understandably worried about a potential end to tariff-free trade, although others see opportunity to do more business in other markets including the United States and China.

However, any economic hit from Brexit must be taken into context when compared to the effect that digital disruption is having on manufacturing. Our businesses can navigate the uncertain world of tomorrow by innovating and evolving, exploring new customers and markets with unlimited potential when it comes to growth and profitability.

It's why technology and innovation through digital transformation must be our main focus, as it's the way British manufacturers can remain internationally competitive and relevant in a market that is rapidly being reshaped.

We must look at creating new value with their customers, whether that's through new products, services or revenue streams. The benefits can be huge, whether it's through increases in productivity and efficiency or providing better experiences.

A strong digital foundation enables a business to accelerate without wholesale disruption, as well as provide the ability to respond to new opportunities and threats, whatever they may be. It unlocks new opportunities for investment and even drive job creation.

We're living in a time where constant connectivity is the norm, in the midst of Industry 4.0, when major innovations in technologies are coming into maturity at the same time. Powered by the cloud, British manufacturers can integrate both the physical and virtual worlds to enable powerful new ways of working. Examples include:

Big data and advanced analytics
It has always been important to manufacturers that they remove waste and variability in processes, increasing efficiency and productivity, and in turn increasing the quality of products. Advanced analytics enables manufacturers to look at historical data, identify patterns and relationships, and optimise processes.

5
months to pay off set-up costs

$1.6m
average savings over three years

2.6k
hours of customer service saved

9%
saving on labour management

197%
average return on investment

Internet of things
Sensors and real-time analytics have revolutionised the consumer world, but it's in heavy industries such as manufacturing where networked sensors and intelligence devices have already made a deep impact in transforming traditional supply chains into dynamic connected systems.

Artificial intelligence and automation
Automation is already widely used in manufacturing as many businesses incorporate industrial robots to assemble, test and package products. However, advances in artificial intelligence may revolutionise the way manufacturers do business, enhancing and extending the capabilities of humans.

Blockchain
Manufacturers see blockchain as a technology which can create smarter and more secure supply chains, tracking the journey of products through clear and solid audit trails and real-time visibility. This can help ease compliance, traceability and safety pressures, as well as address efficiency and customer-service issues.

What should British manufacturers do?
British manufacturers must get the basics right, ensuring people, processes and solutions have a proper foundation. This could mean identifying priorities, what's driving them and how they're approaching them, with a strategic end-to-end mindset. There are four specific areas we need to focus on:

01 People
Although many news headlines focus on the effect Brexit may have on the numbers of EU workers coming to the UK for work, the bigger long-term issue is what types of job will be needed in the future with Industry 4.0, particularly with an eye on automation and artificial intelligence. Traditional manufacturing will certainly need to be augmented with programming and analytical skills, for example.

02 Software
Creation of software applications will drive Industry 4.0. This includes the use of modern enterprise resource planning systems, which can integrate all areas of a manufacturing business, such as inventory, sales and finance. With a single database, manufacturers can interpret data and provide insight in real time. This market is increasing, with cloud-based systems recognised as making manufacturers of all sizes agile, efficient and productive.

03 Hardware
Software is nothing without hardware, particularly in manufacturing where the physical and virtual worlds must integrate to create products. In digital manufacturing, there are numerous examples of hardware and software working in harmony, but 3D printing is a particularly interesting example of how materials can be joined or solidified to create objects under computer control.

04 Connectivity
Without connectivity through the cloud, Industry 4.0 is simply not possible. There would be no internet of things, no interaction of devices and no power source to drive innovation, as steam and electricity did in the past. It offers manufacturers benefits such as short lead times, on-demand production and mass customisation. Connectivity gives all businesses the potential to become global players.

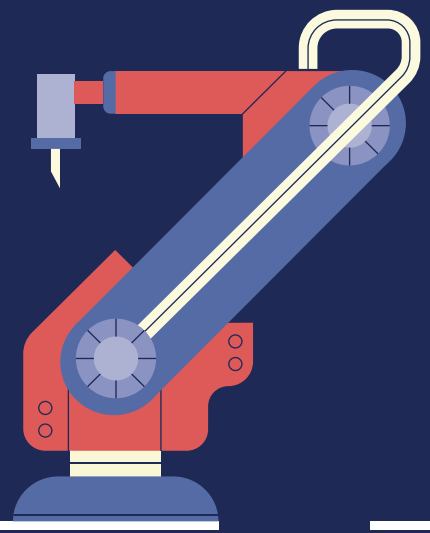
British manufacturers must not wait and see. They need to reach out and grab the opportunities that are there. Global competition will not stand still. Competitors worldwide will be forging their own path towards digital transformation and a new business landscape. We must prioritise our biggest challenges and explore how technology can keep us competitive in a changing world.

For more information please visit www.sage.com/en-gb/industry/manufacturing/

sage Business Cloud
Enterprise Management

AGE OF AUTOMATION

THE OUTLOOK FOR MANUFACTURING JOBS AND AUTOMATION IN SEVEN CHARTS



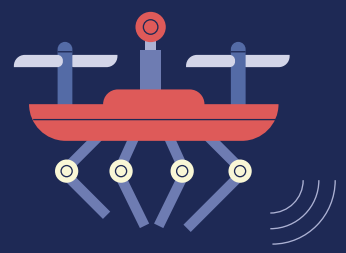
Advances in artificial intelligence and remote communication will arguably impact manufacturing more than any other sector, given that half of all roles within the industry involve manual and routine work. And yet, despite a large portion of jobs being at high risk of automation, job losses may not be as severe as feared as manufacturers upskill workers to adapt for a new technological future

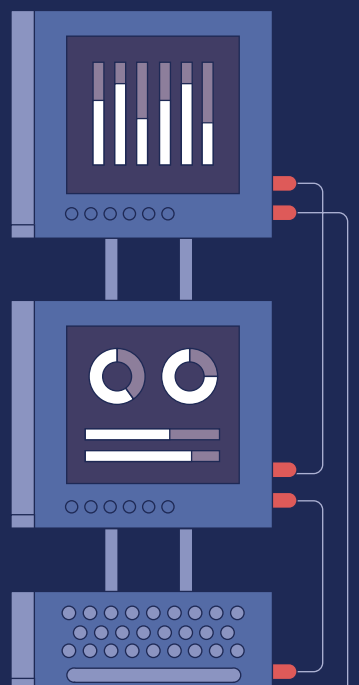
01

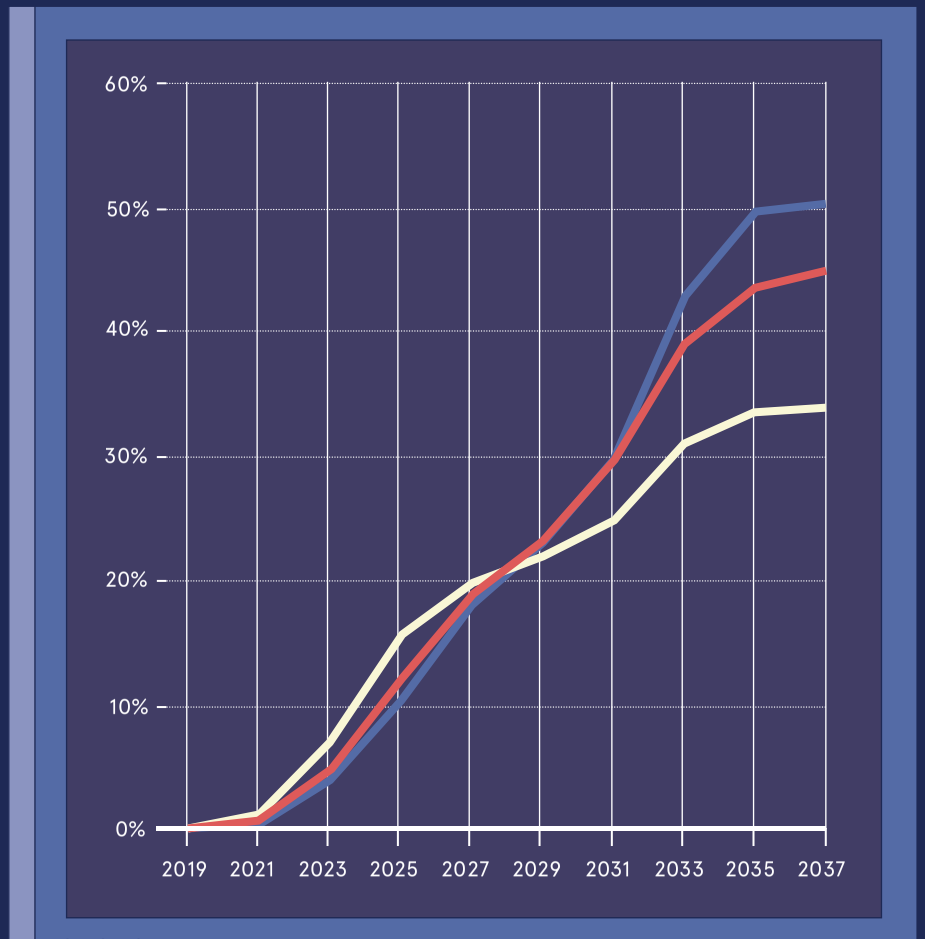
AUTOMATION'S IMPACT ON THE JOBS MARKET WILL START TO BE FELT FROM THE MID-2020S

Share of jobs with a high potential of automation

● Transportation and storage ● Manufacturing ● Wholesale and retail trade





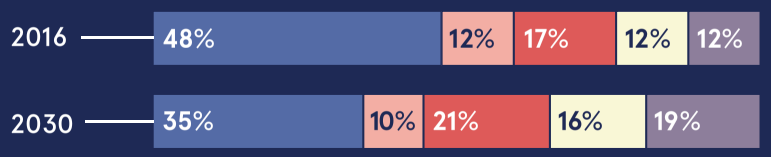


02

UPSKILLING NEEDED AS ROUTINE AND MANUAL JOBS MAKE UP HALF OF WORKFORCE

Composition of current skills needed for current and future manufacturing jobs

● Physical and manual ● Social and emotional
● Basic cognitive ● Technological
● Higher cognitive



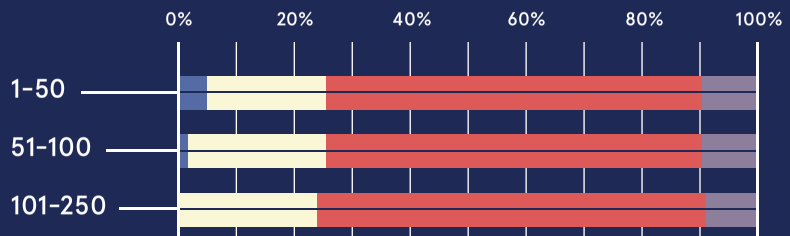
McKinsey 2018

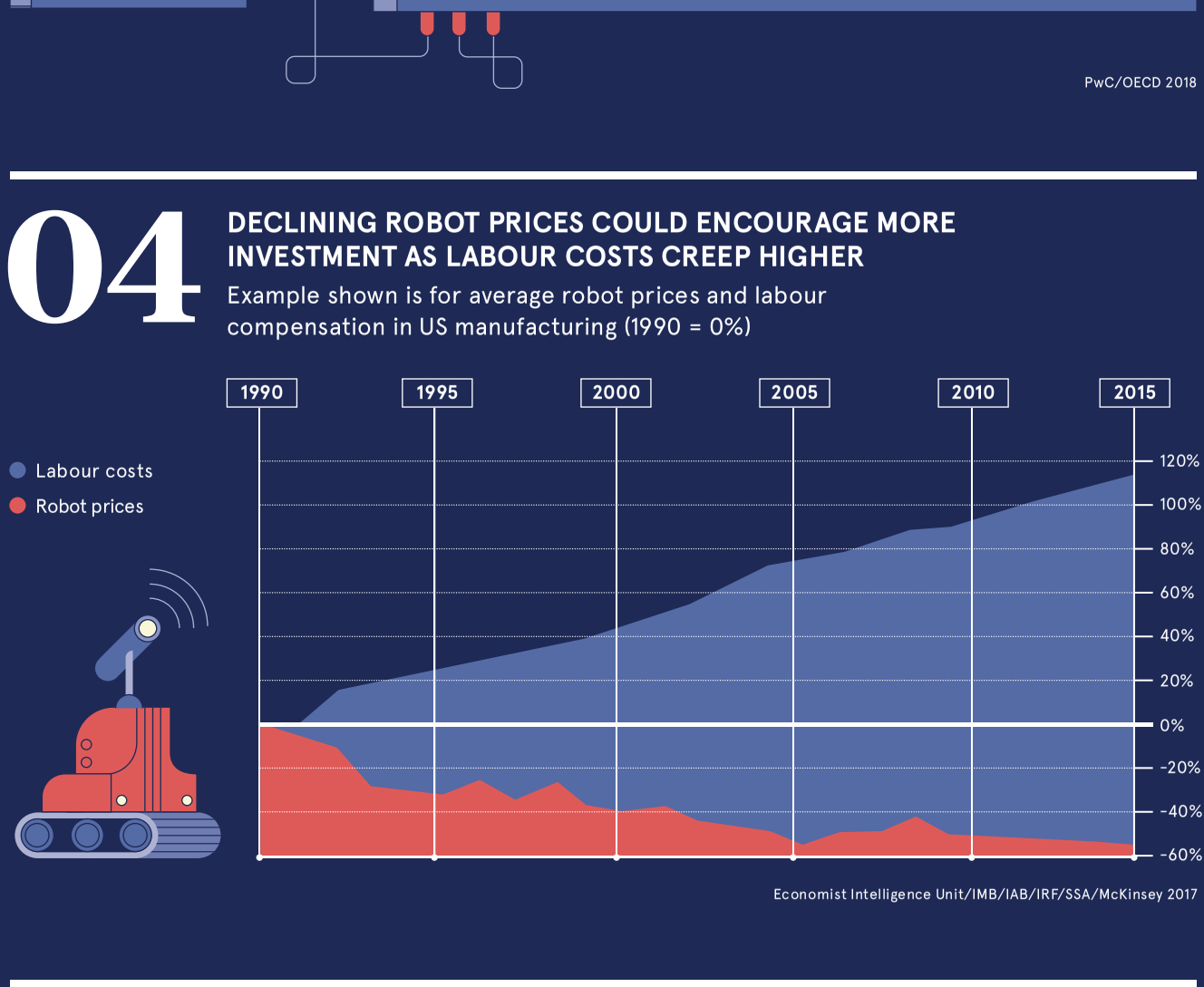
03

AUTOMATION ADOPTION VARIES WITH COMPANY SIZE

Percentage of manufacturers investing to automate processes by number of employees

● All of the processes ● Most of our processes
● Some of our processes ● None of our processes





PwC/OECD 2018

Make UK 2018

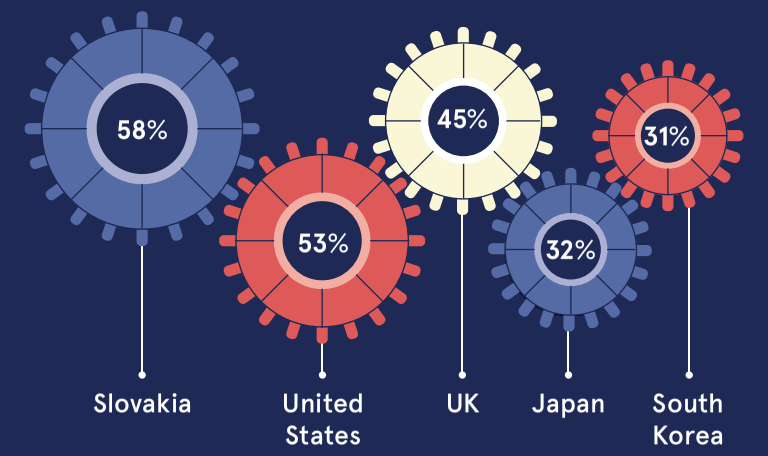
04 DECLINING ROBOT PRICES COULD ENCOURAGE MORE INVESTMENT AS LABOUR COSTS CREEP HIGHER

Example shown is for average robot prices and labour compensation in US manufacturing (1990 = 0%)

Economist Intelligence Unit/IMB/IAB/IRF/SSA/McKinsey 2017

05 OVER-RELIANCES ON MANUAL WORK MEAN AUTOMATION IMPACT IS WORSE IN SOME REGIONS

Percentage of manufacturing jobs with a high potential of automation

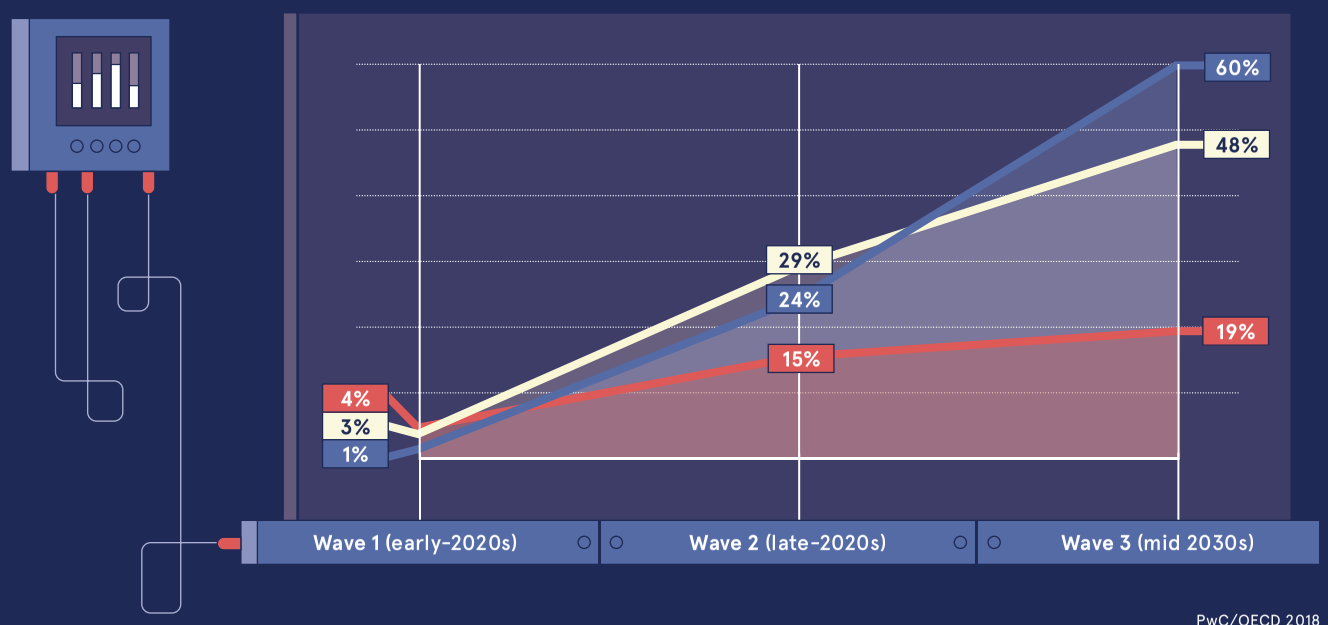


PwC 2018

06 LOWER EDUCATED HARDEST HIT AS MANUAL TASKS PHASED OUT

Share of jobs with a high potential of automation by education level

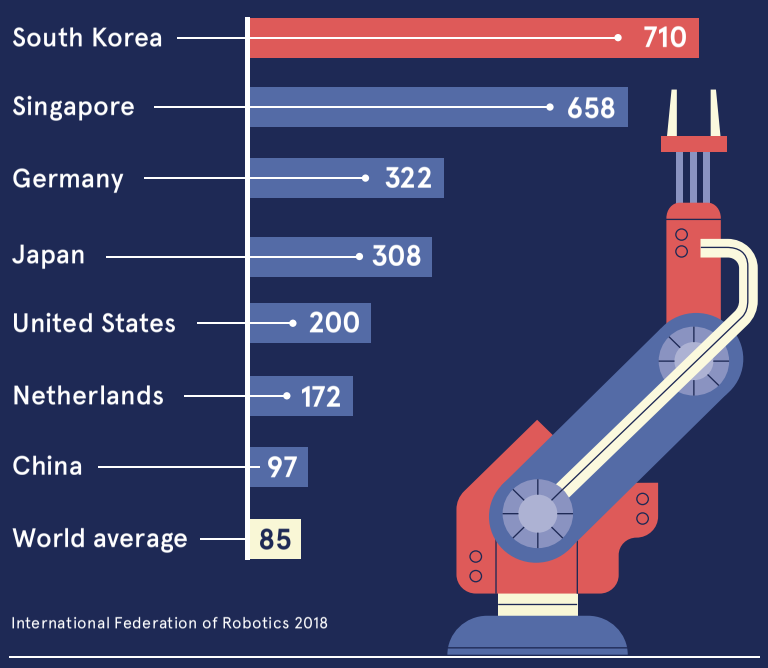
Low education (GCSE or lower) Medium education High education (graduates)



PwC/OECD 2018

07 SOUTH KOREA IS MILES AHEAD WHEN IT COMES TO ROBOT ADOPTION

Number of installed industrial robots per 10,000 manufacturing employees, selected countries



International Federation of Robotics 2018

CYBERWARFARE

New targets in worldwide cyberwarfare

The potential for international cyberwarfare could put manufacturers in the firing line as hackers go after vital services and large-scale industrial facilities

Nafeez Ahmed

It was the first known cyber-attack on an entire country. On April 27, 2007, the small northern-European state of Estonia came to a standstill. The country was hit by a series of cyber-attacks that lasted weeks, targeting the online infrastructures of key Estonian institutions such as banks, government agencies and media outlets.

Cash machines were disabled. Email systems collapsed. Newspapers and broadcasters were unable to communicate.

The likely culprit? The attacks were reportedly carried out via Russian IP addresses and were triggered around the time when the Estonian government moved a Soviet-era statue from the centre of the capital Tallinn to the outskirts. However, there is no firm evidence that Russia was behind the attack.

Estonia's crisis was merely a taste of things to come. Another major incident occurred the following year. The United States and Israel were believed to have secretly launched Stuxnet, a malicious computer worm, to sabotage centrifuges at a uranium enrichment plant in Iran. The Iranian authorities didn't even realise the nuclear plant had been under attack until two years later.

Such attacks have become more frequent and ambitious. In 2014, hackers used sophisticated malware to infiltrate the industrial control system of a German steel mill. They prevented operators from shutting down a blast furnace, resulting in massive damage to the facility.

In May 2017, the notorious WannaCry ransomware attack, blamed on North Korea, saw a Trojan virus disrupt information systems used by hospitals, businesses, banks, railways and car manufacturers across 300,000 computers in 150 countries. The virus encrypted and locked computer systems before demanding users pay a ransom to restore their data.

"Cyberspace is already an active battleground, with state and non-state actors continuously searching for adversaries' vulnerabilities, trying to obtain secret information, developing weapons and occasionally deploying them," according to a report last October by the UK's Ministry of Defence (MoD) Global Strategic Trends programme.

The cost of cyberattacks is expected to reach a monumental $2.1 trillion this year and to rise by 15 per cent every year. The major risk, says the MoD, is that "cyber-attacks can be used to disable industrial facilities or shut down public services".

A US National Intelligence Agency report published in January similarly warns: "Both China and Russia now have the capabilities to launch cyberattacks that could at least temporarily disrupt US critical infrastructure such as gas pipelines or power networks."

And manufacturers could end up first in the firing line if a major cyber-war were to erupt. But nation states are far from being the most immediate threats or perpetrators. "Low-level non-state actors can still be reasonably well resourced and cause a lot of damage," says Corey Milligan, one of the US Army's first cyber-operations technicians and now a senior threat intelligence analyst at Armor Defense, a cloud security firm in Texas.

"These days cybercrime as a service is thriving. People can be hired through third parties to conduct espionage against rival companies to track disruptive technologies and uncover proprietary manufacturing processes to attempt to reduce their competitive advantages."

As cybercrime reaches epidemic scales, manufacturers could find themselves sleepwalking into a disaster zone if they do not batten down the hatches.

Last April, a report by the UK manufacturers' association Make UK and insurer AIG found that nearly half of UK manufacturers had been subject to cyberattacks. A quarter of these attacks resulted in financial and business losses. Yet 45 per cent were not confident they had the right tools to protect themselves.

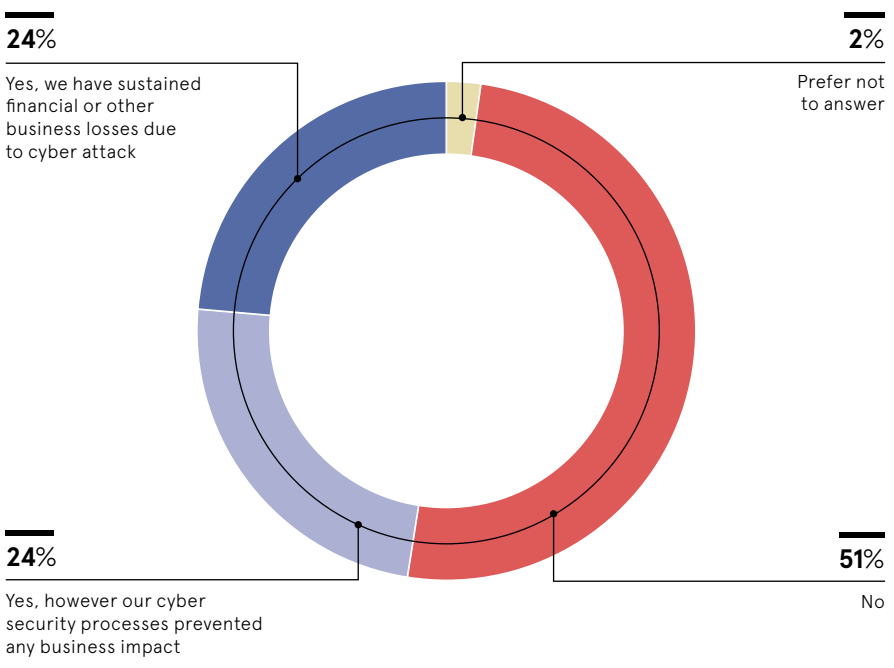
Similarly in Germany, Europe's largest economy, as many as two thirds of manufacturers were hit by cyberattacks, losing a total of $50 billion.

Ironically, manufacturers are often a desirable target due to the sheer complexity of their processes. "Look at critical infrastructure for generation of electricity, water, services and so on. The challenge is in the uniqueness of the devices involved," says Mr Milligan. "Just to evaluate the risks requires specialised training on how the individual devices work. You then need to go in and do the work of

> **Cyberspace is already an active battleground, with state and non-state actors continuously searching for adversaries' vulnerabilities, trying to obtain secret information, developing weapons and occasionally deploying them**

CYBERATTACKS EXPERIENCED BY HALF OF ALL MANUFACTURERS

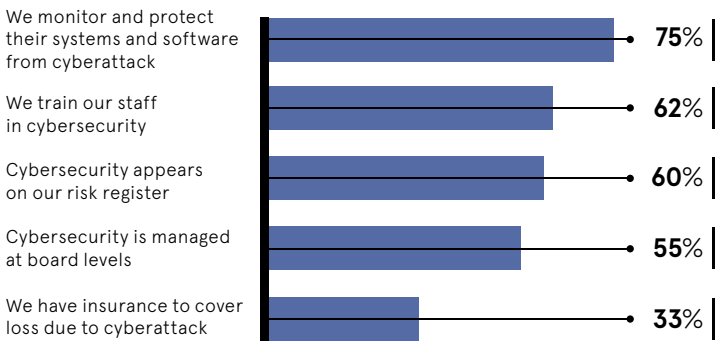
UK manufacturers were surveyed about whether or not they have been victims of cybercrime



Make UK/AIG 2018

CYBER PREPAREDNESS AMONG UK MANUFACTURERS

Percentage of manufacturers who have the following programmes in place



Make UK/AIG 2018

securing the systems. It's a difficult, expensive and painstaking process."

But he warns that unless manufacturers get on the case, they will face mounting costs from incoming government regulation; costs which some fear could put the brakes on the progress of the fourth industrial revolution.

But according to Professor Maurice Dawson, director of the Center for Cyber Security at the Illinois Institute of Technology, that could be the least of industry's problems. In his view, the "hyperconnectivity" between smart robots and the cloud could leave entire sectors vulnerable to large-scale attacks with catastrophic cascading effects. At worse, these could take a chunk out of a country's GDP.

Tampering with equipment in factories producing food, for instance, could lead to incorrect nutrient levels and unsafe items bypassing proper checks.

"Imagine a large organisation like Monsanto. A determined hacker has the ability to go in and change the makeup of the seed," says Professor Dawson. "They could make the seed life shorter. If you're planning for a harvest, the seeds fail. Now we have an issue of a food shortage. Or alternatively, the hacker can insert additives or ingredients to spark allergies or create reactions."

Similar risks potentially impacting whole populations apply across different industries. For instance, essential checks and automated quality controls in vehicle production could be bypassed. Breaks, power-steering, windows, on-board diagnostics could all be altered by recoding their operating instructions, degrading the safety and quality of cars.

> **As cybercrime reaches epidemic scales, manufacturers could find themselves sleepwalking into a disaster zone**

In both frightening scenarios, the disruption would not be detected for months before it is too late to avert disastrous consequences impacting hundreds of millions of people.

"Attackers would aim to get inside and establish a foothold without being detected," says Mr Milligan. "They would monitor what's going on for months if not years and quietly set up code designed to bring down an entire system at one time. And even then, people might still not realise that the damage is caused by a cyberattack."

Supply chain risk

Perhaps the major risk facing manufacturers' cyberdefence comes from their supply chains. "Most manufacturers outsource large areas of their supply chains to sub-contractors, who in turn sub-sub contract, and the chain goes on. An attacker would work through the chain to find a vulnerability," says Professor Maurice Dawson, director of the Center for Cyber Security at the Illinois Institute of Technology.

As wantonly alarmist as such scenarios might appear, how vulnerable really are today's manufacturers? According to Jon Boyens, cyber-programme manager at the US National Institute for Standards and Technology, around 72 per cent of manufacturers lack full visibility over their own supply chains, despite them being the locus of 80 per cent of information breaches.

The entire battlefield has shifted and manufacturers are on the frontlines. In the words of Professor Dawson: "You don't need a large army anymore, you just need smart individuals."

72%

of manufacturers lack full visibility over their own supply chains

US National Institute for Standards and Technology 2018

Best global brands call RAK home

From the world's best ceramics to the finest teas brewed around the globe, Ras Al Khaimah (RAK) in the United Arab Emirates (UAE) has attracted an impressive list of global brands to set up shop on its shores

Reliable buses manufactured in rak

Did you know that a majority of UAE's public transport buses are made in Ras Al Khaimah? Ashok Leyland, the world's fourth-largest manufacturer of buses makes and supplies buses for public transport within the UAE. Setting up its base in Ras Al Khaimah in 2006, the global brand manufactures around 3,000 buses a year and supplies them across the Gulf Co-operation Council (GCC).

Delightful tea blends from rak to the world

Did you know that one of the world's top five tea brands blends its products in Ras Al Khaimah? From its manufacturing plant in the emirate, the UK brand Ahmad Tea produces a whopping 14 million kilograms of delightful tea blends every year, which are exported to 80 countries around the world.

Ceramics from rak beautify iconic landmarks

The UAE's Burj Khalifa, Burj Al Arab and Ferrari World are iconic architectural benchmarks. But did you know that they all feature ceramic products manufactured in Ras Al Khaimah? Yes, by RAK Ceramics, one of the largest ceramics brands in the world. The UAE brand distributes 116 million square metres of tiles, five million pieces of sanitaryware, 24 million pieces of porcelain tableware and one million pieces of faucets globally every year.

Personal care products distributed from rak

Did you know that Ras Al Khaimah is a manufacturing hub for personal care products? Dabur Naturelle, part of the Dabur Group, one of India's largest manufacturers of personal care products, has been operating from Ras Al Khaimah and supplying to the Middle East and North Africa since 2007. Its wide range of products include everything from toothpaste to hair and skincare products.

Authentic italian cheese perfected in rak

That's right. Authentic creamy mozzarella is produced in RAK by Italfood, one of the most popular brands of cheese in Italy. The company has been supplying to households, restaurants and hotels in the UAE and GCC from their RAK factory since 2010. The secret to its light, creamy cheese? Italfood only uses high-quality ingredients and the very best milk from UAE farms to make its products.

ABOVE
Ashok Leyland's production facility in Ras Al Khaimah, UAE

LEFT
Ahmad Tea's production facility in Ras Al Khaimah, UAE

Common factor

These brands are among the world's best. But do you know what they all have in common? Apart from being in RAK, they all have chosen Ras Al Khaimah Economic Zone (RAKEZ) as their operational base. It is RAK's world-class industrial hub that caters for more than 50 industries, including automotive, glass and ceramics, food and beverage, pharmaceuticals, cement, packing and packaging, robotics, and many more.

RAKEZ's cost-effective industrial solutions have attracted more than 770 global manufacturers from various industries, which are all now operating from state-of-the-art warehouses and plots of land across three specialised industrial zones in proximity to major logistical hubs. That's definitely every manufacturer's dream.

More than this, RAKEZ offers simplified processes as well as a wide range of premier services in one-stop shops. From licensing, visa, leasing and other support services, investors can accomplish everything in one location. RAKEZ one-stop shops also serve as a focal point to various government entities, making it easier for companies to process government-related approvals.

Recognised by fDi Global Free Zones of the Year 2018 for its effort in reducing red tape, RAKEZ offers global investors an enhanced level of ease of doing business.

If you wish to expand your industrial operations to RAKEZ please call +971 7 204 1111 or toll free (UAE) on 800 RAKEZ (72539), or visit www.rakez.com

Commercial feature

How can manufacturers harness the fourth industrial revolution to bring them closer to customers?

New technologies are rapidly altering the global manufacturing landscape, according to **Richard Mathias, senior technology architect at LiveArea**, with connected supply chains enabling companies to boost productivity and operational efficiency

Some in the manufacturing industry have been slow to embrace the fourth industrial revolution or 4IR. A 2018 survey published by manufacturing organisation Make UK found that 64 per cent of UK manufacturers are aware of the 4IR, yet 57 per cent have yet to make a 4IR-related investment.

A possible reason for this disconnect is that there needs to be a strong business case for investing. Each industrial revolution that has come before has brought about exciting technological advances and a need to adapt to survive or be left behind.

Manufacturers will be hearing terms such as artificial intelligence and automation, and may be wondering what the fuss regarding the 4IR is about and what the reward for embracing this revolution will be.

The answer is digital transformation. The 4IR will help manufacturers to make the customer journey to purchase smooth and personal.

CONVERTING CUSTOMERS

Putting customers front and centre of a manufacturing strategy is becoming increasingly imperative. With companies across Europe and the United States facing competition from economies such as China, where high-quality goods can usually be manufactured at a fraction of the cost, businesses have to complement their manufacturing optimisation strategies with other differentiators, and leverage their closer relationship with customers.

The 4IR presents opportunities for manufacturers to better understand and get closer to their customers, by gaining unprecedented insight into buying behaviours through intelligent data analytics. If manufacturers can learn what a particular type of customer orders and how often, then they can forecast more accurately and ensure they're manufacturing enough of a certain product to meet demand.

With a suitable incentive, customers aren't averse to analytics tracking their commerce journey; 87 per cent of customers say they're willing to have their journey tracked if there are tangible benefits.

A FULFILLING CUSTOMER SERVICE

While the 4IR will help manufacturers to get to know customers intimately, the data leveraged through analytics can only be truly valuable if their commerce offering is up to similar standards. It's not much use manufacturers being able to predict what products are in demand and when, if customers can't then order goods without a glitch.

Business-to-consumer customers are already enjoying an increasingly smooth online experience, and fast and frictionless payments, and these expectations are being taken into business-to-business (B2B) transactions. B2B portals can no longer be facsimiles of online catalogues that are difficult to navigate; manufacturers need to improve product discovery and buying decisions.

This innovation doesn't stop at conversion. The 4IR can extend to customer service and order fulfilment. Greater insight into a customer can improve overall customer care. And by measuring key performance indicators, such as the ratio of inventory to sales and the ability to deliver the perfect order, by shipping the right product with no damage or delays, manufacturers can see how efficient their business processes are and where they need to improve.

RIGHT PRODUCTS, RIGHT TIME

Looking ahead to what the 4IR will mean for the future of customer experience in the manufacturing industry, manufacturers will be able to be proactive rather than reactive. While some customers will still order online as and when they require products, many more will receive goods before they need them.

Take the aviation industry. Stock management is crucial yet many airlines want lean inventories so might not invest too heavily in them. When a spare part is needed, it has to be delivered as quickly as possible, but lead times can be weeks or sometimes even months. Airlines can't afford for aircraft to be out of service for that long; every minute an aircraft is grounded, it's eating into the airline's bottom line.

Thanks to the 4IR and a wide range of sensors, the aviation industry is beginning to carry out predictive maintenance, helping to identify demand patterns. With this information, airlines will know which parts will be required before they need replacing, and manufacturers can ship the right parts at the right time, keeping aircraft in the sky and customers fulfilled.

LiveArea understands the complexity inherent in manufacturing. An exciting innovation being offered by manufacturers is the ability to manufacture bespoke and custom parts at scale with much shorter lead times and lower commitment quantities than ever before, to respond much quicker to breakdown, and to prototype new, more efficient assemblies.

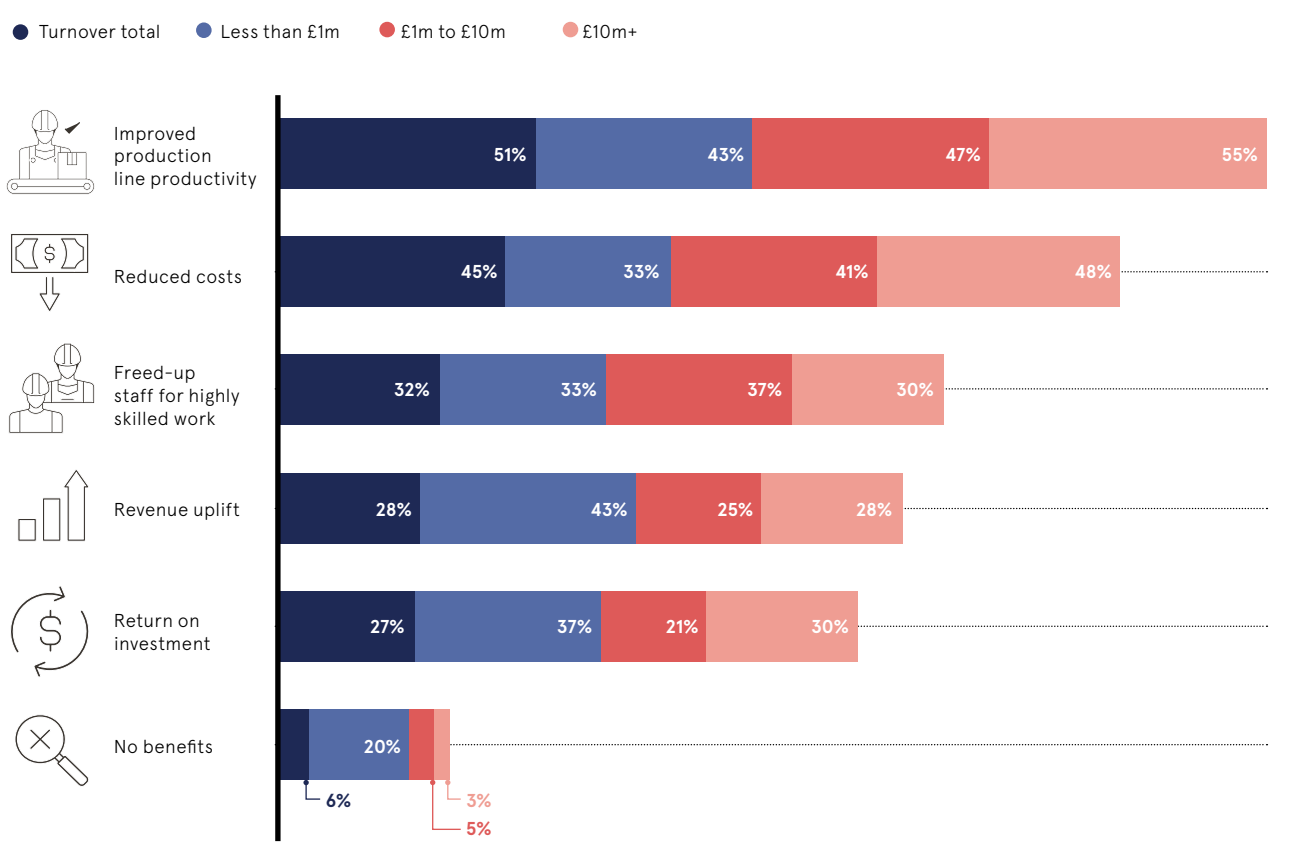
Key to manufacturing these parts is empowering customers to specify their requirements online, and to know these custom parts will be compatible with their existing specifications and processes. This requires the end-to-end vision across technology, commerce and fulfilment that LiveArea can deliver.

Ultimately, the 4IR is enabling manufacturers to make informed data-driven decisions that support customers' needs. Manufacturers that fail to embrace digital and smart technologies risk losing customers and being left behind by competitors and innovative newcomers.

For more information please visit liveareacx.com

LiveArea

BENEFITS NOTED BY MANUFACTURERS THAT HAVE INVESTED IN INDUSTRY 4.0 (BY TURNOVER)



Barclays, *Corporate Banking Manufacturing Report*, Intelligent manufacturing, September 2017

Four common misconceptions

Manufacturers wary of embracing the 4IR are likely to hold some misconceptions

01 IT HAS NO CLEAR VALUE

A 2018 Make UK survey found that 30 per cent of manufacturers surveyed said they didn't understand how 4IR technology could help their business. The most successful manufacturers are the ones that are constantly analysing their supply chains and operational models. The 4IR enables them to do this more intelligently.

02 IT'S AN EXPENSIVE INVESTMENT

This doesn't have to be the case. Manufacturers can start small, with a couple of pilot projects, to see if there's a business case for the technology. Results can then be presented to the executives responsible for making the final decision on investment.

03 IT'S HARD TO IMPLEMENT

Manufacturers need to find the right partner that can help unlock the 4IR's value and to identify the technology suited to their business. The right partner will be able to support them in integrating the technology into their existing processes and supply chain.

04 IT WILL LEAD TO JOB LOSSES

While some low-level jobs will be made obsolete, there will always be the need for a human element in manufacturers' customer service offering.

DRONES

Drones set to take flight in manufacturing

Drones used in manufacturing are still very much in their infancy, but the possibility for aerial imaging, asset monitoring and safety inspection is exciting industry experts


ZF

Car technology manufacturer ZF uses drones to fly spare parts from its central warehouse to workshops

Stephen Armstrong

Technology tipping points are hard to predict. The first time drones were used in battle was the Vietnam War when the bulky, difficult-to-control Ryan Model 147 Lightning Bug reconnaissance drones were deployed by the US military. The programme was mothballed in the 1970s, then re-emerged in the early-1990s, claiming their first kill in 2001, over Kandahar in Afghanistan. The first commercial drone permit was issued five years later, but it took another five years and smartphone technology to create a real market.

Many people working in the drone industry were originally flying hobbyist aircraft, powered by electric motors and lithium-polymer batteries, making them lighter, quieter and more reliable than military jets. Cheap smartphone microcontroller chips initially provided autopilot software for these planes. The final stage, according to Professor Dario Floreano, director of the Swiss National Robotics Centre, was the price of accelerometers, used as tilt sensors in smartphones, coming down rapidly. Suddenly a cheap quadcopter that knew its orientation and direction of movement was possible.

Also like smartphones, people soon started thinking about bringing drones into the workplace. In 2013 Amazon announced its plans for a drone-based delivery system while in 2018 management consultancy PwC set up a dedicated UK drones team and predicted the market for work carried out by drones could be worth a whopping $127 billion worldwide. And yet, given that sales of commercial drones last year were just $2.4 billion, according to Gartner, the question is: are drones really going to transform the way many companies do business or are they just another overhyped fad?

Silicon Valley is backing the tech. "Whenever you see more automation with less weight, like the trends in battery size that's driving the drone market, it's worth keeping an eye on," says Philippe Botteri, London-based partner at Accel venture capital and an early backer of Chinese drone platform startup DJI. "While flying cars are almost a sci-fi joke, battery tech has reached the stage where I can throw eight rotors on a drone and carry four people around. It's as significant as the driverless car."

At the moment, the heaviest commercial users are in entertainment and photography (42.9 per cent) and real estate (20.7 per cent), according to a survey from BI Intelligence. Industrial uses come in at roughly 25 per cent of which manufacturing accounts for just 1.5 per cent. The problem is that high-speed automotive assembly plants can be as complicated for drones as a battlefield, from robots that shoot welding arcs to machinery that can interfere with drone communication.

Nonetheless, drones are already being deployed in asset-monitoring, checking inventory by scanning radio-frequency identification chips and barcodes, and visual inspection. The most obvious area for growth, according to Jonathan Wilkins, director at EU Automation, is to expand drones capacity for doing what they're best at, recording information in ways that are too difficult, dangerous or boring for humans.

"Drones should have a positive impact on quality assurance," he argues. "By performing a variety of aerial imaging and sensing tasks, such as those using infrared and thermal technology, they could detect problems with equipment on the production line or even the environment that it's operating in."

> **By performing a variety of aerial imaging and sensing tasks, drones could detect problems with equipment on the production line or even the environment that it's operating in**

Oil and gas companies are already replacing helicopters with drones for routine pipeline inspections. Last June, Shell vice president Hilary Mercer announced the company was using drones to help build its new $6-billion US ethane cracker plant in Pittsburgh. The drones take "thousands and thousands" of pictures of the site on a weekly basis. In August, carmaker Ford began deploying drones to perform difficult inspections on overhead gantries that had previously required shutting down production to complete safely. The drones also give Ford a clear plant maintenance record.

To improve inspections, drone manufacturer 3DR has started adding infrared cameras, initially for firefighting drones, according to Jim Merrick, director of marketing for Qualcomm's internet of things business. He believes the monitoring drones could be a crucial part of factory health and safety in the near future.

Indeed, the US Occupational Safety and Health Administration (OSHA) began using drones for inspection last year. Similarly, OSHA not only used drones to inspect unsafe areas, it also used them for technical assistance in emergencies and during compliance assistance activities.

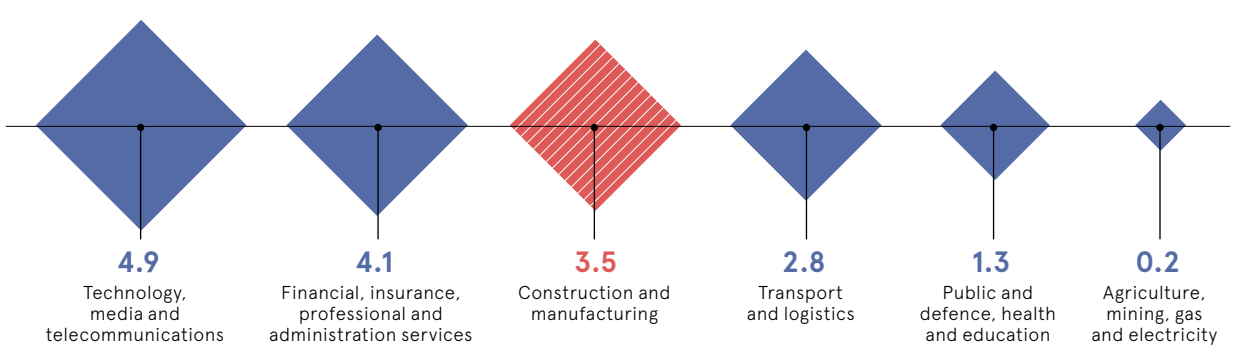
Compliance presents drones' biggest problem. Although Amazon's plan to use drones for home delivery appears to have hit a regulatory hurdle, in November car technology manufacturers ZF became the first company in Germany to use drones to fly spare parts, such as sensors or control cards, from the central warehouse to work areas. ZF's six-motor drones carry up to five kilograms and fly over the roofs of plant buildings, only crossing driveways where there is no alternative.

Audi is developing a system known as Paula, which follows a defined route set on a navigation system, but also picks up on any obstacles with laser scanners, intelligently working its way around them. Meanwhile Ocado, the UK online grocer, is building a robotic warehouse in the south of England for the French retailer Casino in which pre-programmed drone caddies move along metal rails sorting and moving goods.

Jamie Dargie, vice president at Design Group, points out that drone technology is still in its infancy. He expects to see them fulfilling more roles, from loading pallets through picking and packing to replacing sedentary robots in the manufacturing process itself. Drones in manufacturing, he concludes, are about to take flight.

EXPECTED GROSS COST SAVINGS FROM DRONE ADOPTION BY SECTOR

Forecasts for 2030 in the UK (£bn)



PwC 2018

3D PRINTING

Reshaping the dynamics of global production

As dark clouds gather over the global economy, manufacturers find themselves in the crosshairs. Long supply chains and a dependence on frictionless trade leaves them at risk to rising protectionism and slowing global growth. But a surprising form of technological defence could be available to them in 3D printing. Here are five key ways in which the tech could upend the economics of traditional manufacturing, while spurring innovation and cutting pollution

Dan Thomas

Economies of scale

Perhaps the biggest benefit of 3D printing could be its potential to cut costs, says Galina Spasova, senior research analyst at IDC. 3D printers reduce the number of steps required to assemble a finished part or product, speeding up the manufacturing process for some products, she says. Take GE's Catalyst turboprop, a fully printed aircraft engine destined for commercial use. During the production process, the engineering giant says it was able to reduce 855 separate components to just 12 by using 3D printing. It was also able to create a lighter, faster and more fuel-efficient end-product.

The firm has also spoken of being able to reduce its reliance on external suppliers, cutting unnecessary inventories and shipping costs. Gartner analyst Pete Basiliere says the technology also vastly cuts the cost of making highly customised designs because 3D printers remove the need to create injection mouldings or specific tooling for production, a process that can take weeks.

Mr Basiliere believes this will have a huge impact at the start of the manufacturing process, when firms are making prototypes. It will boost industries that need to make products which are highly tailored to individuals; think medical implant makers, jewellery designers and makers of complex machinery.

"Align Technology [a US dental company] already makes 300,000 personalised braces every day using 3D-printed moulds," says Mr Basiliere. "My hearing aid shells were made with 3D printers. The key is these products are each unique, so it wouldn't make sense to use an injection mould."

Reducing carbon footprints

It won't just help cut the cost of manufacturing, 3D printing will also make it greener. By producing products closer to where they are consumed, businesses will rely less on air and sea freight routes which are major sources of pollution.

Additive production cuts waste during the production process. "It allows users to manufacture goods on demand [rather than continuously]," says Julio Vial, research manager for IDC Europe. "Furthermore, materials used to 3D print goods like powders can be recycled and used for the next batch, reducing waste and costs."

Companies could share a printer to cut costs and waste. "A company can purchase a printer and share it with selected partners during idle time," says Mr Vial. "Or a company can present and share a specific design to a series of partners, sometimes different, who offer external 3D-printing services, evaluating which one is most convenient to collaborate with from time to time."

Spurring innovation

3D printing will enable manufacturers to make more complex designs, freeing them to be more creative. This is because 3D printing's additive technology creates objects by adding layers rather than subtracting them.

"3D technologies make it possible to create shapes and geometries that are otherwise impossible," says Lorenzo Veronesi of IDC Manufacturing Insights. "This allows designers to create objects that are inspired by natural forms and have superior physical-mechanical properties to those obtained through more traditional forms of design."

This presents immense opportunity and could totally change the way firms make quotidian machines such as cars and planes, he says. The ability to produce complex shaped components as a single piece makes it much easier to increase their strength, while reducing their weight, internal stresses and failure points.

In addition, some objects will be harder if not impossible to produce without 3D printing; think cavities and internal features in objects that are access limited or complex geometrical structures.

"We are moving from design for manufacturing to manufacturing the ideal design," says Mr Basiliere at Gartner. "With the former, you take out all the costs and you end up with a lowest-common-denominator product. But with generative design, you can make the ideal design, whatever the customer wants."

Defending against geopolitical risk

Another big benefit of 3D printing will be the ability to produce components closer to home rather than relying on imports. It will not only cut costs, but help firms at times of geopolitical tension, for instance during a trade war when the costs of sourcing components internationally rises fast.

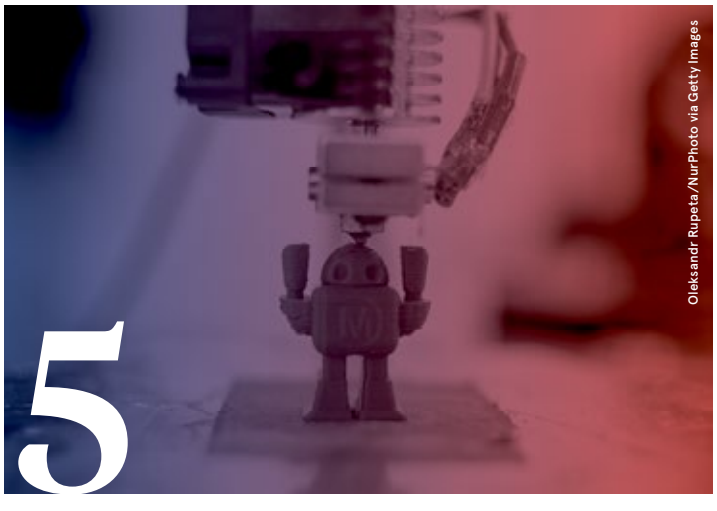
"Trade wars and manufacturing automation will drive discrete manufacturers worldwide to implement 3D printing over the next three years," says Julio Vial, research manager at IDC. "By moving the manufacturing of components upstream, logistics companies will have the production site as close to the customer as possible."

To use a current example, American firms might use 3D printing as an alternative to making products in China if the two countries' trade battle intensifies. All they would need is the product's digital design plan and they'd be able to ramp up production themselves, as long as the same quality levels were achievable.

Of course, localised manufacturing could benefit any industry that has remote operations, says Gartner's Mr Basiliere. "Think oil and gas, mining, the military on land and at sea; all of them have a very long supply chain, so they see a real benefit in being able to produce a part at short notice," he says.

In many cases such parts wouldn't have to be particularly high quality, instead providing quick fixes at times of need. "You might just need to print a part that gets your broken boat back to shore. It would be a lot quicker than going back to base to pick one up," says Mr Basiliere.

Improving competitive edge



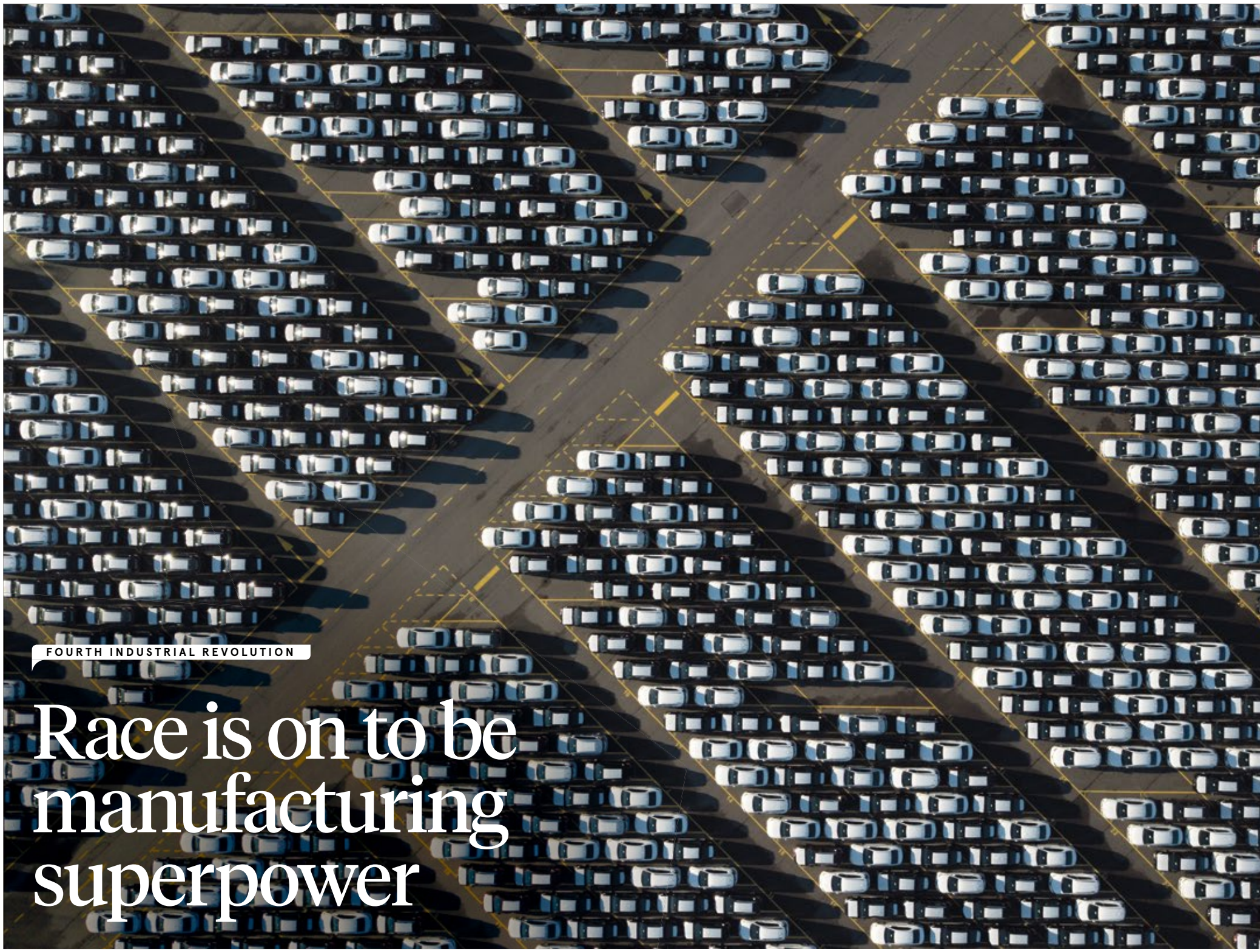
Companies have already begun to include 3D printing in their production processes, although the bulk of manufacturing continues to be done by traditional machines. However, firms may be tempted to make greater use of the technology because of its competitive advantages.

For Gartner's Mr Basiliere, firms that use 3D printing can make and test prototypes much faster than previously possible, cutting their time to market. "Add to this the design freedoms 3D printing presents and it could really give firms an edge," he says.

IDC's Mr Vial agrees that the "highly flexible" nature of 3D printing could enable manufacturers to steal a march on rivals. "The distinction between production and shipping will disappear," he says. "I can send a file and print it or have it printed anywhere in the world. And with the same machine, I can print an infinite number of different types of objects."

However, there are barriers to overcome if 3D printing is to move from a niche process into the mainstream. Questions remain about the quality of some objects produced additively, says Mr Basiliere, as well as intellectual property rights as DIY production takes off.

He concludes: "Companies like GE are going to have to spend months and years honing 3D-production processes, so they are repeatable, and there is a long way to go until we really see 3D printers shouldering a significant amount of manufacturing output."



FOURTH INDUSTRIAL REVOLUTION

Race is on to be manufacturing superpower

Each industrial revolution produced a significant reordering of manufacturing nations. As the world embarks on what many predict will be its fourth, which countries will be the main beneficiaries and how will global economic dynamics shift?

Brian Groom

Today's largest manufacturing country headed the output league table nearly two centuries ago before being ousted by Britain in the first industrial revolution.

China accounts for 20 per cent of global output, followed by the United States with 18 per cent, Japan 10 per cent, Germany 7 per cent and South Korea with 4 per cent, according to the most recent (2015) data from the United Nations Conference on Trade and Development. The UK is ninth with 2 per cent.

In the intervening centuries there have been sizeable shifts. China reclaimed its crown after 150 years by overtaking America during the past decade. Although it is early to make firm predictions about who might be winners and losers in the fourth industrial revolution, all will be trying to learn from past experience.

China was a leader in many areas of industry for hundreds of years, responsible for technological breakthroughs including paper, clocks and cannon. Then Britain began to overhaul it with an explosion of innovations such as steam power and the factory system in the first industrial revolution from about 1760 to 1840, which simultaneously saw populations and living standards eventually rise.

Britain did not overtake China's output until 1860, according to calculations by economic historian Paul Bairoch. Then Britain's reign as top manufacturing nation lasted less than 40 years. By 1900 the US had overtaken it, with Germany rising fast too, during the second industrial revolution of 1870 to 1914, which saw widespread adoption of technologies such the telegraph, railways and electricity.

The third industrial revolution, from the 1950s to the present day, has been a digital age that includes personal computers, mobile phones and the internet, with industrial applications in areas such as robotics.

A nascent fourth revolution, which some see as a continuation of the third, includes technologies such as artificial intelligence (AI), 5G telecoms, collaborative robots or co-bots, the internet of things, quantum computing, nanotechnology, biotechnology and 3D printing. What distinguishes it is a mingling of the physical, digital and biological spheres, referred to as cyber-physical systems.

"For a lot of these technologies, we are still in the hype stage and some of the consequences in the longer term will take us by surprise when they finally happen," says Diane Coyle, professor of public policy at the University of Cambridge.

Being first adopter of a technology does not necessarily guarantee competitive advantage, she adds, as sometimes a second adopter can capitalise on the first's mistakes. "It also depends on the economic context. Incentives have to be in place for technologies to be used," says Professor Coyle. Winners are likely to be those who make best use of technology, not necessarily those who invent it.

Cars lined up at the St Petersburg plant of Toyota

"The impact of a fourth industrial revolution will depend on geopolitics. A current backlash against globalisation threatens to limit the spread of benefits via trade


Anton Vaganov\TASS via Getty Images

45%

of industrial company leaders say they lack the resources or knowledge to scale up the adoption of new technologies

McKinsey 2018

In the third revolution, the US has been the technology leader, with companies such as International Business Machines (IBM), Microsoft and Apple. But its share of global manufacturing shrank as production was offshored to cheaper locations. China and emerging economies benefited from a liberal trading regime coupled with new communications technologies.

Some see China's further advance as likely, given the effort it is making to achieve leadership in technologies of the next generation of commerce and military equipment such as AI, robotics and gene-editing, a strategic concern for the US, which lies behind recent trade tensions.

On the other hand, developments such as 3D printing offer a chance for Western nations to bring some manufacturing home. There has been some reshoring already, though not enough to shift the overall balance.

Adoption of fourth industrial revolution technologies globally has been "slow and limited across all industry sectors", according to management consultants McKinsey: "More than 70 per cent of industrial companies are still either at the start of the journey or unable to go beyond the pilot stage." A PwC study found that just 5 per cent of manufacturers in Europe, the Middle East and Africa are "digital champions", compared with 11 per cent in the Americas and 19 per cent in the Asia-Pacific region.

Some companies are put off not only by the cost of investment, but by the need to reshape their organisation to benefit from it. Productivity gains in recent years have been slow. Economists such as Robert Gordon argue that innovations are less transformative than those in earlier periods, such as electrical power and powered flight.

Countries can help their case, however. Many have strategies aimed at the fourth industrial revolution, such as Germany's Industrie 4.0, the UK's Industrial Strategy, Made in China 2025 and Japan's Society 5.0. Typically, efforts include steps such as building awareness, financial incentives, improving the legal framework and education programmes.

Geoff Mulgan, chief executive of Nesta, an innovation charity, points out that technologies such as driverless cars and drones are "very systemic in nature", so they require government action on regulation and infrastructure as well as adoption by companies.

Also, the technologies question traditional concepts of manufacturing, for example people in future may buy mobility rather than cars, which requires a different type of service. "At the moment, most countries that are good at manufacturing are not so good at this," he says.

Mr Mulgan advocates "anticipatory regulation" such as test beds in which innovations are developed in discussion with regulators, who can remove barriers or pre-empt threats that might lead to a public backlash. The UK, for example, has a £10-million Regulators' Pioneer Fund. Similar approaches are being tried in Singapore, Canada, United Arab Emirates and Finland.

The impact of a fourth industrial revolution will depend on geopolitics. A current backlash against globalisation threatens to limit the spread of benefits via trade.

"It makes it hard to see macroeconomic conditions that mean markets are growing and there is going to be demand for new technologies," says Professor Coyle. She is "long-term optimistic" about technology-led growth, "but short-term pessimistic because political and social adjustments are always going to be challenging".

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