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MP ALAN MAK On seizing Britain's 4IR opportunity **P8**

Manufacturing Our Future

Out with the old

Photo taken by Joel Morgan at Griffon Hoverworks Ltd in Southampton, shortlisted in the Amateur category of the EEF Photography Competition 2017.

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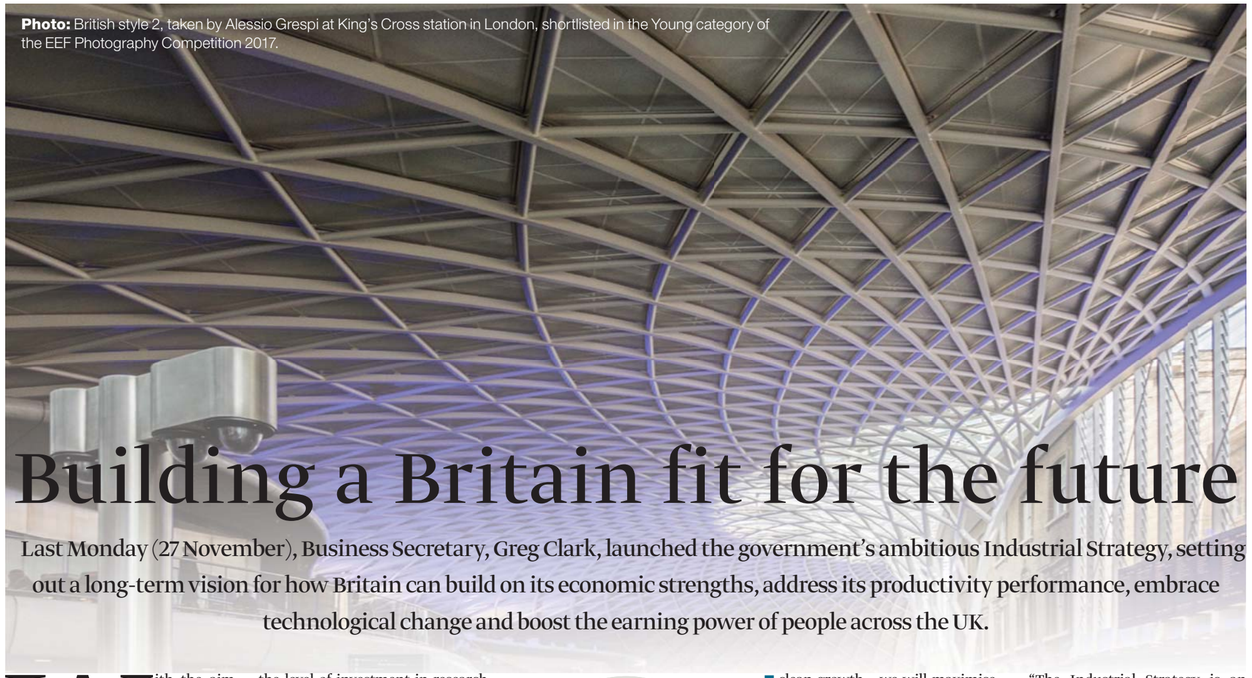

Photo: British style 2, taken by Alessio Grespi at King's Cross station in London, shortlisted in the Young category of the EEF Photography Competition 2017.

Building a Britain fit for the future

Last Monday (27 November), Business Secretary, Greg Clark, launched the government's ambitious Industrial Strategy, setting out a long-term vision for how Britain can build on its economic strengths, address its productivity performance, embrace technological change and boost the earning power of people across the UK.

With the aim of making the UK the world's most innovative nation by 2030, the government has committed to investing a further £725 million over the next three years in the Industrial Strategy Challenge Fund (ISCF) to respond to some of the greatest global challenges and the opportunities faced by the UK. This will include £170 million to transform our construction sector and help create affordable places to live and work that are safer, healthier and use less energy, and up to £210 million to improve early diagnosis of illnesses and develop precision medicine for patients across the UK.

The government has previously committed £1 billion to the first wave of Industrial Strategy Challenge Fund projects, including investing £246 million in next generation battery technology and £86 million in robotics hubs across the UK.

The Prime Minister has since announced an ambition to increase the level of investment in research and development (R&D), rising from 1.7 per cent to 2.4 per cent of GDP by 2027. This could mean around £80 billion of additional investment in advanced technology in the next decade, helping to transform whole sectors, create new industries, and support innovation across the country.

The White Paper also confirms government will be pressing ahead with a series of Sector Deals with construction, life sciences, automotive and AI the first to benefit from these new strategic and long-term partnerships with government, backed by private sector co-investment. Work will continue with other sectors on transformative sector deals.

In the strategy, the government has identified four Grand Challenges; global trends that will shape our rapidly changing future and which the UK must embrace to ensure we harness all the opportunities they bring. The four are:

- artificial intelligence – we will put the UK at the forefront of the artificial intelligence and data revolution
- clean growth – we will maximise the advantages for UK industry from the global shift to clean growth
- ageing society – we will harness the power of innovation to help meet the needs of an ageing society
- future of mobility – we will become a world leader in the way people, goods and services move

Rt Hon Greg Clark MP
Secretary of State for Business, Energy and Industrial Strategy

"The government's Industrial Strategy is an unashamedly ambitious vision for the future of our country"

Each Grand Challenge represents an open invitation to business, academia and civil society to work and engage with the government to innovate, develop new technologies and ensure the UK seizes these global opportunities.

Business Secretary, Greg Clark, said: "The way we earn and live our lives as workers, citizens and consumers is being transformed by new technologies. The UK is well-placed to benefit from this new industrial revolution and we start from a position of significant strength. We have a thriving research and science base and are home to a wide range of innovative sectors, from advanced manufacturing and life sciences, to fintech and creative industries.

"The Industrial Strategy is an unashamedly ambitious vision for the future of our country, laying out how we tackle our productivity challenge, earn our way in the future, and improve living standards across the country."

The strategy unveiled reflects this engagement, with a new and unique partnership between government, academia and industry, supported by policies that are committed to making the UK economy more productive and giving it a competitive edge in the future and abroad.

The White Paper focusses on the five foundations of productivity – ideas, people, infrastructure, business environment and places – with a clear and complementary vision for each. ■

Department for Business, Energy & Industrial Strategy

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Photo: Deep Sea Electronics, taken by Steve Morgan at DSE in Hunmanby, Bridlington, shortlisted in the Professional category of the EEF Photography Competition 2017.

It's time to seize the manufacturing opportunity

By Mark Gregory

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Manufacturing is valuable ...

Despite much commentary about its demise, manufacturing remains very important to the UK. The recently published Made Smarter review estimated that manufacturing supports around 5.1 million jobs in the UK directly and indirectly. EY's view is that, with induced employment included, we might be heading towards 7 million in total, or over a fifth of the UK workforce. The sector is even more important in relative terms in many areas of the UK, accounting for 22 per cent of economic output in Sunderland and 25 per cent in Hull.

Its importance goes beyond its contribution to manufacturing sector jobs and output. According to the work for Made Smarter, the sector accounts for 70 per cent of UK business research and development (R&D) spend and 14 per cent of all business investment. At a time when the UK is struggling to improve productivity, manufacturing is the sector offering a way forward.

... and increasingly available ...

I could have made the same observations as those above about manufacturing at any time in the past 20 years but I would have been cautious about the prospects for the sector in the UK. Since the 1980s, UK manufacturing has been under pressure from increased competition and the shift of production to low-wage economies. As EY's work on reshoring demonstrated, the UK offshored a greater share of its manufacturing output than any developed economy.

We now find ourselves at a defining point in the evolution of manufacturing globally. Businesses in developed markets had begun questioning their moves to offshore production to low-wage economies as the impacts on innovation, quality and time to market started to detract from performance. Technological change is now increasing this move, offering the potential to reduce the importance of labour costs as a share of total production and tilting the balance back towards location in developed markets, especially for high-value goods that appeal to Western consumers.

... and the UK needs to act ...

With technological change creating opportunities at the same time as Brexit is challenging UK manufacturers to improve their competitiveness, now is the time for action. The UK requires an integrated approach to manufacturing that includes trade and domestic policies and that is designed to operate at both national and local levels. Institutional and political reform will be key pieces in the jigsaw: it is not only manufacturers themselves that will need to do things differently to ensure success.

At the heart of any programme has to be a higher level of co-operation between business and government at all levels. This will ensure policy is designed to have the right impacts, build the confidence necessary to encourage investment and allow integrated policymaking. The key components will be infrastructure, skills, innovation and institutions.

Mark Gregory
UK Chief Economist, EY
@MarkGregoryEY

"There has to be a higher level of co-operation between business and government at all levels"

... with a clear strategy ...

Just like any business would do, the starting point should be the articulation of a clear vision and strategy. This will require that choices are made, especially around the sectors to be given priority and the role the UK believes our businesses can play in these sectors. This is not "picking winners," in the sense of identifying national champion companies, but it does require taking a view on where to focus resources. At a macro level there are already obvious candidates. Health, construction and energy are sectors in which changes in the economy and society are already creating opportunity and the ones from which additional benefits will flow to the domestic economy in terms of better and more efficient provision. Automotive is a sector in the midst of major disruption, and food and drink will need to transform after Brexit. There are more candidates but the potential is clearly there.

Alongside the sector focus, geography will also be important. The value chains for manufacturing are global and the UK needs to identify where it can play. Working with business, government has to assess existing capabilities and outline its vision of the future options available for manufacturing. It will then be possible for the Department for Business, Energy and Industrial Strategy to shape government interaction alongside the existing business support networks, Local Enterprise Partnerships (LEPs), interest groups and chambers of commerce to help domestic and foreign businesses understand the opportunities in the UK.

... and a plan ...

With a clear strategy and framework, the individual components of policy become easier to design. Potential investment and spend on infrastructure, skills and R&D can be evaluated against the priorities. If the UK decides renewables are a target sector, then infrastructure investment should reflect this and skills development should take into account the level and type of skills required. Equally, support for R&D in universities and businesses should be weighted towards potential deployment in the target sectors.

This will also require more devolution of powers to the local level. While some of the activity, such as major infrastructure provision and incentives for investment, will remain national in nature, the provision of the right infrastructure and skills development locally will be vital to ensure a match to sector demand. The largest cluster of automotive manufacturing is likely to remain in the Midlands, while the strength of the food sector in the North East will continue and so skills need to match the demand locally.

... starting now

There is no time to lose. The market is changing and so is the UK. We have managed to retain and develop our manufacturing base despite relatively little policy support. With a new focus there is a chance to build a modern, manufacturing sector and move up the global league tables. ■

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COLUMN

Lee Hopley
Chief Economist, EEF

Is the UK manufacturing sector geared up for 4IR?

Understanding what the fourth Industrial Revolution (4IR) can offer is a far cry from being able to take advantage of it. A major determining factor will be the UK business environment and the ability of policymakers to take the necessary steps to underpin this transformation of industry.

It is important that UK manufacturers are geared up for this change. While manufacturers can invest in the right technologies or approaches in isolation, the benefits will only be realised where change is driven right across supply-chains. In most sectors of manufacturing, supply-chains are dense, global networks that have developed over time; 4IR could therefore be both a risk and opportunity for UK manufacturers, depending on their position in that global supply-chain.

There are advantages to moving first and downsides of not taking advantage of the opportunity presented. First movers may spend more upfront, but will realise the benefits faster, particularly in the evolution phase, freeing up resources for faster and further reinvestment. First movers may also be able to capitalise on their advantage by displacing supply-chain competitors at the global level. An additional benefit of moving first is the ability to determine the platforms that will underpin the processing and exchange of data, locking this in across your supply-chain and reaping the benefits before your suppliers' other customers dictate these platforms. Late movers may see lower upfront costs, as some solutions may be closer to being 'ready-made', but keeping pace with the change will be difficult. This is especially true if the business culture is overly conservative in its approach to change or if this is applied 'off the shelf' without a meaningful business strategy to underpin it.

11% of manufacturers think the UK sector is geared up to take advantage of 4IR

57% don't know or are neutral

33% say the sector isn't geared up for it

Early indicators are UK manufacturers are positive about their ability to take advantage of the changes associated with 4IR. Our survey showed that 61 per cent of manufacturers feel they will be able to keep pace with the change brought about by 4IR and 68 per cent are not worried about the competition that will be brought about by this change.

Despite this only 11 per cent of manufacturers think the UK manufacturing sector is geared up to take advantage of 4IR, 57 per cent either don't know or are neutral and 33 per cent say the sector isn't geared up for this change.

This highlights an early warning – not enough of the UK manufacturing sector is confident enough to start discussions about this with their peers in industry. Without industry and supply-chain leadership, the risk is that the UK will be left behind. There is also a risk of complacency of understanding. Change will be happening quickly and while the outcomes from technology may be clear now, new insights may change the manufacturing process in unforeseen ways within some sectors. Keeping abreast of change will be a significant requirement for industry leaders. ■

Connectivity boosts productivity and quality for visionary manufacturers

The fourth Industrial Revolution (4IR) is here right here, right now and manufacturers must decide quickly when to join the party and re-invent their own businesses.

By Steve Hemsley

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ORACLE

The time for talking is over and manufacturers must make some bold decisions sooner rather than later about how they digitalise their workplace.

Cyber systems and technology connecting humans and machines are already impacting on the customer journey, design thinking and on manufacturers' people processes. Those delaying investment risk being left behind.

"The manufacturing sector knows something big is happening but too many firms are still unsure about exactly what technology they need to adopt for their specific companies. There are real opportunities to reinvent their business model so they need to stop theorising," says Vikram Singla, Strategy and Marketing Director of Technology at enterprise software business, Oracle.

"A producer may decide to keep everything as it is, but this needs to be a conscious choice rather than due to a denial strategy."

Increased connectivity can boost productivity

Singla believes many UK firms still take the view that any decision linked to technology is a project for the IT department and they are failing to put the R&D team at the centre of any decision making. He says cross-functional teams should be created and C-Suite executives encouraged to take ownership of any investment in technology so that initial changes can be scaled up quickly.

Oracle has partnered with The manufacturers' organisation, EEF, to produce: "The Fourth Industrial Revolution: A Primer for Manufacturers' white paper. It outlines how increased connectivity will enable manufacturers to deliver a higher-quality customer experience at a mass production price point. The report explores a number of benefits that 4IR technology adoption will bring to firms, including:

- How the use of smart manufacturing techniques will increase production, improve quality, lower resource consumption and enhance workplace safety
- How connecting products will improve production performance and the collection of valuable data can enable projects – for instance, maintenance – to be carried out remotely
- How connecting the supply chain means assets such as trucks and inventory can be accurately tracked

Meanwhile, the factory of the future could look very different, thanks to technology such as 3D printing, which is already being used by companies to print manufacturing-grade components.

There is a clear direction of travel within manufacturing and firms need to use technology to respond to emerging trends. This includes the demand for more customisation where tech can be used to reinvent the customer experience and increase customer lifetime value.

Singla urges firms that are not yet geared up for change to look at what early 4IR adopters have already achieved.

For example, in the US, additive manufacturing company, Carbon, is using the cloud to improve its processes and grow demand internationally for its Digital Light Synthesis technology. Using an integrated suite of applications it has become more agile, has futureproofed its operation and reduced its close cycle from 28 days to seven days.

Also in the US, self-service kiosk and point-of-sale terminal maker, NCR Corporation, is moving its operation to the cloud to improve its agility and reduce costs as it evolves from being a product-centric to a solutions-based business.

Technology is also allowing disruptors to flourish in traditional markets.

In Germany, integrated energy installer, Thermondo, has digitalised its processes to become an access point for consumers. Householders enter 15 data points about the heating system they need and an algorithm matches solutions from different gas, oil heating systems and solar based equipment companies.

Digital technology is also making it possible to integrate manufacturing with engineering and design.

Global medical device company, Hologic, has launched its 3D Digital Breast Tomosynthesis System for use in breast cancer screening. Its design, manufacturing and engineering teams worked closely together using Oracle's Agile Product Lifecycle Management platform to get the product to market faster.

America adopts 4IR early

Oracle vice president, manufacturing industries business unit, John Barcus, is based in the US where, he believes, there is often more of an entrepreneurial spirit among manufacturers that is driving adoption of digital technologies.

"There are more start-ups and they are pushing established manufacturers to be more competitive," he says. "The infrastructure that firms will need in future, wherever they are based, must be flexible, robust and support the new requirements of connectivity and machine learning. Different IT systems must also work together and be secure."

Barcus adds that enterprises will get the buy-in they need from their C-suite if it is clear how smaller, technology-led manufacturing projects can pay for themselves by delivering business benefits without the need for capital investment.

"In most cases it will not be necessary to make wholesale replacements to infrastructure because a manufacturer can test, validate and monetise a manufacturing project on a smaller scale."

Barcus says these are exciting times for manufacturing but the future is not just about investing in technology. Firms must also ensure that their culture and leadership embraces innovation, is visionary and is not afraid to make data-driven business decisions. ■

oracle.com/uk/industries/index

PHOTO: THINKSTOCK

Cross-functional teams should be created and C-Suite executives encouraged to take ownership of any investment in technology so that initial changes can be scaled up quickly.

Vikram Singla
Strategy and Marketing Director – Technology, Enterprise Software Business, Oracle

"Too many firms are still unsure about what technology they need to adopt for their specific companies"

John Barcus
Vice President, Manufacturing Industries Business Unit, Oracle

"The US has more start-ups and they are pushing established manufacturers to be more competitive"

EXPERT PANEL SUPPORTED BY THE ALL-PARTY PARLIAMENTARY GROUP

What challenges does the fourth Industrial Revolution present to SMEs?

George Dibb
Head of Industry, Technology and Innovation, Policy Connect

Taking full advantage of the fourth Industrial Revolution presents challenges for all manufacturers – large and small. But, here in Britain, we already have a head-start against global competitors.

The UK has a unique combination of manufacturing heritage, a solid skills base, some of the world's finest research establishments, high-growth innovative companies and a government with ambitions to grow as a global industrial leader.

Juergen Maier, in the Made Smarter review, highlighted that SMEs see significant risk around adapting to new tech. The UK's record of innovation in start-up companies shows that SMEs have great skills in exploiting advanced technology in new ways. The challenge is for established companies and those scaling up to find the time and space to continue to develop creative thinking, alongside dealing with day-to-day commercial and regulatory demands.

That space and capacity for creative thinking is key to progression. Bringing politicians, industry professionals, academia and policymakers together provides the right environment to shape technological, political and regulatory developments. I recommend any company that wants to participate in creative thinking around the fourth industrial revolution or in our parliamentary groups on manufacturing or big data to adopt this approach. ■

Patrick Heskins
Chief Executive, BAMA

For industrial manufacturers, an interconnected supply chain will almost certainly improve efficiency and reduce lead times and inventory. But what might be the impact on product innovation?

FMCG (fast-moving consumer goods) companies rely on new products to drive sales and improve profitability. This could be new fragrances for a brand of air fresheners or improved nourishing properties in a skincare range. If, through the internet of things, your smart device monitors your daily usage and then simply adds the same item to your shopping basket, how will manufacturers get consumers to buy their new offerings?

Many consumers know what they want and will buy the same brand every week, whether this is through an online shop or in store. However, sometimes, consumers have changing needs or want something different. They may want to trade up or trade down depending on their disposable income. They might simply want to try something new.

The challenge for FMCG manufacturers, large and small, will be how to get their new or improved products into the consumer's shopping basket if all a smart device does is give them like-for-like when it automatically replaces a product that has run out. ■

Tom Botwell
Chief Executive, BCF

Coatings are critical to UK manufacturing, and advanced coatings help improve functionality and performance.

They help to make surfaces corrosion-resistant, wear-resistant or enable them to withstand high temperatures, provide antifouling or antimicrobial properties or even turn a benign surface into a smart material or a product that senses and reacts to external stimuli.

The British Coatings Federation (BCF) is the trade association for the manufacturer of coatings, printing inks and wallcoverings, with 80 per cent of members being SMEs. BCF members' products impact a broad range of sectors, from manufacturing to construction, with an estimated 300,000 people using paints, coatings as printing inks as part of their job every day. As an enabling industry, our members' products impact over £200 billion of UK GDP.

Three out of four cans of paint sold in the UK are made in the UK, and 30 per cent of all UK production is exported. The UK is a net exporter of paint and inks, and many multi-national companies manufacturer in the UK for their European markets. UK SME coating, printing ink and wallcovering companies are also strong exporters, with three out of five BCF members regularly exporting. . ■

Philip Law
Director General, British Plastics Federation

The UK plastics industry employs 170,000 people across more than 6,000 companies, most of them SMEs.

Over the past few years, the industry has continued to evolve and innovate in order to keep pace with customers' demands and developments in technology. The focus is shifting from mass production to mass customisation defined as "producing goods and services to meet individual customers' needs with near mass production efficiency".

Plastics manufacturing is at the forefront of this movement. However, we haven't reached our full potential and even though we have achieved high levels of productivity with only a relatively modest adoption of Industry 4.0, we still lag behind other advanced nations.

To boost adoption we need to upskill thousands of industrial workers to enable digital technologies to be adequately exploited. This will allow the industry to create new, higher-paid, higher-skilled jobs while strengthening UK supply chains. Similarly, mass customisation will improve resource efficiency through efficient manufacturing and will allow the reshoring of parts of the supply chain currently based in countries with cheaper labour.

The opportunities for SMEs are huge and the time to make progress is now. Failing to do this could cost the industry its international competitiveness. ■

Charles Jarrold
Chief Executive, BPIF

Print is a major part of the UK economy, worth over £13bn, comprising over 8,000 companies.

Print is increasingly targeted, personalised and customized – with more variety, shorter production runs, greater use of data and higher levels of automation. Robotics and sophisticated use of data, systems and process automation have been a part of UK print for several years.

To continue to take advantage of these developments, print SMEs need to have a good understanding of developments in AI, analytics and process automation and the role these play in meeting customer needs and improving efficiency. It is also important to consider the impact on workforce skills. SMEs need to identify what new and different skills needs are needed to support customer and market requirements in the future.

For SMEs, the challenge is to find the time to understand the fast-changing capabilities of highly specialised print equipment, the role of data and analytics in more targeted content, the need to carefully understand the market's needs, and to find ways to creatively address those needs.

This isn't easy for SMEs, given the day-to-day requirements of running their businesses, but it's more important than ever, considering the increasing scale and pace of change. ■

EXPERT PANEL SUPPORTED BY THE ALL-PARTY PARLIAMENTARY GROUP

10 manufacturing experts share their insights

Christopher Greenough
Commercial Director, Salop Design and Engineering Limited

There is a challenge faced by SMEs to have access to the latest information, both in terms of technology and indeed information, when we are busy making sure our businesses are performing.

What there has not been from government is a real engagement with SMEs when it comes to the 4th Industrial Revolution.

If you add to this the number of terms being used in the marketplace, 4IR, the IoT, connectivity, Industry 4.0, how can SMEs get to know the real story, and real benefits that can come? A roll-out through central government to original equipment manufacturers (OEMs) and stakeholders with money to invest, will get the benefits. But, how can we get the SME market involved, as this is where the most benefit can come from? A 10 per cent improvement in all SMEs is better than a 10 per cent improvement in an OEM.

SME engagement is key. We have a network who can get involved and share the message.

We need to make sure that, for SMEs, this is the next industrial revolution, and not a revelation. Let's drive the information down the supply chain to drive results back up the chain.

Incentives similar to the research and development tax credits would help significantly in terms of risk management and a major co-ordinated and understandable flow of information. ■

Andrew Large
Director General, Confederation of Paper Industries

Although technological advances go hand in hand with Industry 4.0, people remain at the heart of both the challenges and opportunities that its introduction brings.

Even more important is the need for the workforce to be engaged early in the process, so that they can understand what Industry 4.0 will look like in their organisation, to avoid speculation about employment impacts, and to learn about any opportunities for retraining/upskilling. Suitably skilled and motivated employees can help SMEs identify and commission cost-effective, robust and upgradeable proprietary systems and help with training. Working with like-minded colleagues, peers and partners on supply-chain optimisation, they can also help to drive waste and cost out of the system as collaborative digital supply-chain platforms become de rigueur.

Although a challenging concept on many levels, the fourth Industrial Revolution will be embraced by paper-based businesses in the UK to ensure that they remain at the forefront of innovation in global markets. ■

Dr Diana Montgomery
Chief Executive, CPA

For the construction industry, the 4th Industrial Revolution will mean better understanding and control over the entire supply-chain, with technology that creates a more efficient connection of people, things and systems.

Construction product manufacturers will benefit with improved design, fabrication and ability to produce higher-value products, while our distributors will be able to provide greater certainty on getting the products to the construction site. This means there would be further opportunities to develop value-adding capability in the supply chain, including after-sales service, assembly or installation, maintenance and remanufacturing. Our supply chain could change so much that the manufacturers and suppliers dominate in the industry, with the role of the contractor on site changing significantly.

Sixty-one per cent of employment in construction product manufacturing is in SMEs and the opportunities for these companies to remain competitive could help ease the impact of a chronic skills shortage facing construction. However, with most sector-wide developments, SMEs are under pressure to keep up with limited resources and may not have the margins to invest. Beyond the technology there are steps SMEs can start to take; managing this change is not necessarily a costly process but it does require businesses to dare to innovate. ■

Angela Coleshill
Competitiveness Director, Food and Drink Federation

SME access to digitalisation opportunities is key to delivering improved productivity and efficiency in food and drink manufacturing.

This is against a backdrop of a frequently risk-averse business culture, due in part to low margins and long timeframes for return on investment. This creates short-term views on innovation and derisking the adoption of innovative processes would significantly quicken progress in our sector.

Knowledge from business leaders of digitalisation matters, the time to think about individual business needs and an understanding of the new skills is key. This will require management leadership to support upskilling. It will also necessitate the training of them and their staff to be able to deliver the transition and then subsequently maintain the new technologies. To achieve this, companies need cost-effective access to expertise, increased awareness and confidence in new technology to leverage opportunities.

It is inevitable that there will be concerns. Concerns about the speed of change, for example, how will they keep up with changes from a technical perspective and also in terms of ongoing costs? And there will also be concerns around knowing how to understand when is the right time to invest. To overcome concerns over data security, companies need better understanding of how data will be kept safe to help them to have the confidence to invest. ■

James Selka
Chief Executive Officer, Manufacturing Technologies Association (MTA)

Some of the biggest challenges the fourth Industrial Revolution presents to SMEs are the shifts it necessitates within workforces.

They are not only around harnessing the technology, like acquiring the skills needed to automate a production process, but about understanding the potential for businesses to change, indeed to transform. There is a need for leadership skills, as well as technical ones. SMEs face challenges specific to them, given their size, expertise and their understandable caution. However, they can also operate more flexibly than larger enterprises.

Although this shift in manufacturing processes presents its challenges, it is, above all, a remarkable opportunity for businesses to evolve and increase their productivity. To this end, technology is just an enabler; it's the skills and the people we have that will make the difference. We have a once-in-a-generation chance to reindustrialise the UK, and I'm feeling a lot more optimistic.

Industry 4.0 will make a huge mark on investment in UK industry. From this perspective, manufacturing exhibitions, such as MACH 2018, have the responsibility to promote this shift in industry and provide exhibiting companies with the tools to succeed within the new technological landscape. ■

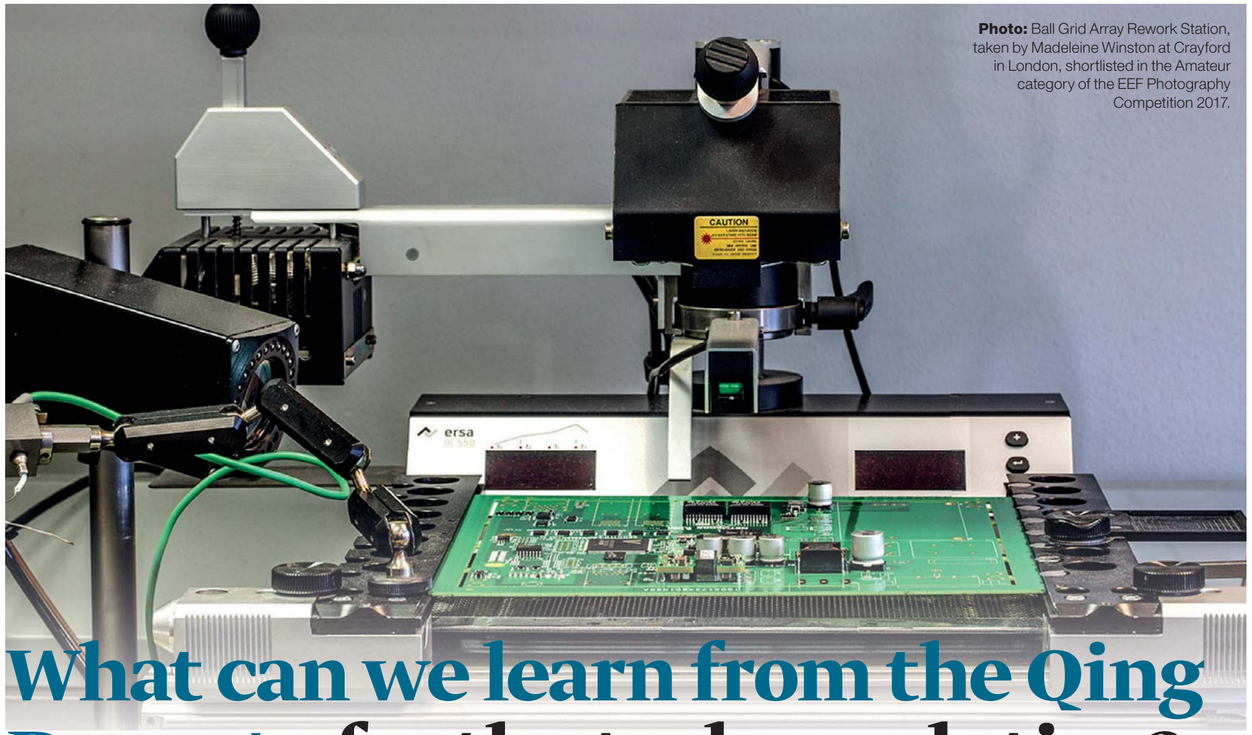

Photo: Ball Grid Array Rework Station, taken by Madeleine Winston at Crayford in London, shortlisted in the Amateur category of the EEF Photography Competition 2017.

What can we learn from the Qing Dynasty for the tech revolution?

With a technological revolution taking place, Alan Mak MP argues that government should seize the opportunity to reassert its status as a global trading nation.

By Alan Mak MP

Under the Qing Dynasty in the late 18th-century, China was the world's greatest economy, and had been for most of recorded history. With the world's largest population, and a proud history of scientific success – from inventing paper and porcelain to fireworks and the compass – China had not yet been forced into the competitive race for innovation that is so important to the prosperity of modern economies.

However, new technologies and innovative business models were emerging in Western Europe that would soon break the link between the productive capacity of an economy and the size of its population. As an expansionist, Britain was initiating what became the first Industrial Revolution by looking for new trading partners to fuel her rapid economic growth, China had turned in on itself, becoming isolationist and stagnant.

Now, as we enter the fourth Industrial Revolution (4IR), China is determined not to be left behind. The "Made in China 2025" initiative is designed to comprehensively upgrade Chinese industry, while the ambitious "One Belt, One Road" initiative creates the infrastructure for expanding global trade. In Britain, we too must respond with our own national strategy for mastering the 4IR.

The government's newly-released Industrial Strategy goes a long way towards this, setting out a bold vision for how the UK can lead the world in the 4IR.

This includes investment into technical skills, a new National Retraining Scheme, better digital infrastructure, a £31bn National Productivity Investment Fund and a new £1.7bn Transforming Cities fund.

I have long argued for stronger national leadership on this issue, and called for government and industry to work together to create a national strategy for Britain's future in the 4IR.

Britain must act quickly to take full advantage of this technological revolution, and we can't allow the 4IR to take a back seat amidst Brexit and other policy priorities – urgent action is required as other countries compete with us.

Alan Mak MP
Founding Chairman of the All-Party Parliamentary Group and MP for Havant

"We can't allow the 4IR to take a back seat amidst Brexit – urgent action is required as other countries compete with us"

From creating a new and more integrated network of innovation centres and national research institutes, to reforming our education and skills system, to targeted investments and other measures to boost R&D, we have much to do to keep Britain ahead of the pack.

If we can rise to meet these challenges – and the government has rightly signalled its intention to do so – then we can expect resurgent economic growth, rising productivity, and a range of benefits for both consumers and businesses across Britain. From more efficient supply chains and lower production costs, to personalised products and new services, digitisation of our industrial base is an economic imperative for Britain.

The government's Industrial Strategy has already set out strong foundations for a post-Brexit economy fuelled by regional growth, improved productivity, and rising skill levels. However, to secure our prosperity after Brexit, Britain needs to lead the 4IR, not just be shaped by it.

It is impossible to resist the rise of the machines and advanced technologies such as artificial intelligence, so we must let them lift us towards a Global Britain that uses the fourth Industrial Revolution as a springboard to a more productive, outward-looking economy. This will mean new trading opportunities, more jobs, rising living standards, and more money for our public services.

As Emperor Qianlong discovered, the lessons from history are stark. No matter the size of the economy, or the early advantages a country might enjoy, the consequences of inaction or an anti-innovation policy platform are disastrous.

Only by seizing this opportunity can we reassert Britain's industrial strength, delivering a growing economy, and a new era of cleaner, smarter economic growth. ■

Read more on **businessandindustry.co.uk**


PHOTO: THINKSTOCK

The UK led the first Industrial Revolution; what part will it play in the fourth... and beyond?

By Cara Haffey

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UK manufacturing is operating in a more complex environment than ever before. Whether it's further advances in automation and the impact of AI, the move towards connected factories and digitalisation of the supply-chain, or the disruption caused by the rapidly developing way of doing business, manufacturers face an increasing number of decisions on investment and innovation.

Uncertainty over the outcome of the Brexit negotiations is already impacting talent, supply-chain, raw material costs and exports. Meanwhile, customers are also facing changes in their sectors, including further industry convergence.

All this is against a backdrop where labour productivity in services grew by 0.2 per cent in the last quarter while manufacturing fell by 1.3 per cent – something the UK government is hoping to redress through its Industrial Strategy. This long-term blueprint for action aims to see the UK become a front-runner in the fourth Industrial Revolution (4IR)

The government has already highlighted the leading role the UK can play in connected, autonomous vehicles and clean energy technology, where city and off-road test-beds across the country are already helping to accelerate these into practical application. This will be further boosted by a new £2.3bn investment fund for research and development.

We predict that, from 2025, electric vehicles could become cheaper to run than diesel or petrol cars. Our latest Connected Car research into those with mobility challenges revealed that six in 10 (57 per cent) believe connected and autonomous vehicles will improve their quality of life as well as educational and employment prospects. The question is: who will adopt and apply these en mass first? Fleets, last mile journeys, freight transport, or specific smart cities? Whatever the answer, the UK wants to be in the driving seat.

Driving the digital revolution

But what about the wider implications for manufacturers? Industry 4.0 is characterised by the increasing digitisation and interconnection of products, value chains and business models – supported and enabled by technologies including the Industrial internet of things (IIoT), artificial intelligence (AI), advanced robotics, machine learning and billions of connected devices and sensors

As the factory and supply-chain becomes digitalised, this will help to support more efficient, more agile and more responsive supply chains. With increasing numbers of sensors, connected objects (and therefore data), manufacturers must look at their data analytics, IT infrastructure, and cyber security.

The conversation on cyber security must move from not only protecting employee data, customer data, financial data and intellectual property to the threat of hacking physical processes in manufacturing and connected products such as the car. Manufacturers must look at every part of their supply chain when addressing this – you are only as strong as your weakest link.

Cara Haffey
Industrial Manufacturing Leader, PwC

"In the longer term, manufacturers will see an evolution in their value chains and relationship with their customer."

In the longer term, manufacturers will see an evolution in their value chains and relationship with their customer.

While Industry 4.0 is predominantly about leaner processes, efficiencies and cost cutting, in the future, it will be about generating new forms of revenue. Efficiencies from predictive maintenance will be a benefit for their customers as much as for themselves. Disruption and competition could come from outside their sectors from more agile companies as the barriers to entry lower as technologies become cheaper. Manufacturers will need to fundamentally review their business models - and they may even need to look at new partnerships in order to capitalise on innovation.

Meanwhile, investment in physical and digital infrastructure as well as collaboration between business, government and universities is needed to convert innovation into new products and services, unlock the skills challenge and drive prosperity and productivity. Regions must identify how they will play in the 4th Industrial Revolution. What will they be famous for and how will they achieve this?

Powering your pipeline

Beyond attracting talent, manufacturers also have a significant role to play in transforming skills and their organisational culture. Fears that robotics and AI will destroy roles, and change others so radically that the existing workforce won't be able or willing to do them, may well be misplaced. But the implications are certainly profound, reaching much further and wider across the workforce as new value chains and business models develop, tackling a more digital environment and advances in cobotics – even creating new roles.

Employers are already looking for new and emerging skills, which is why we have launched our own new technology degree apprenticeships with the Universities of Birmingham, Leeds and most recently, Queen's University Belfast. The UK's catapult centres are also great examples in bringing industry and talent together and there are several individual examples of manufacturers driving training of STEM skills.

While STEM skills remain critical, today's CEOs also need to recruit people with softer skills such as empathy and an understanding of what their customers and ultimately the consumer is trying to achieve. Interestingly, four in five CEOs in our CEO survey expressed challenges in attracting people talented in creativity and innovation or leadership, with emotional intelligence (70 per cent), problem-solving (69 per cent), and adaptability (68 per cent) also an issue.

Only with this variety of skilled talent on board will they be able to build the customer relationships needed to sell complex, multifaceted solutions, and then collaborate with those customers to run the solutions and embed them in their businesses. Those with relevant industry and sector experience will be as important as engineers and technologists. Competition for talent will be fierce, coming from outside the sector. Companies will need to build a culture of innovation that both attracts new and develops existing talent and digital skills.

I believe the UK can take advantage of its apparent lack of remaining heavy industrial legacy to build a brand around the technology of tomorrow. In fact, it is the manufacturing industry that has driven much of the technologies of today.

To succeed. we must work together, whether on smarter cleaner transport, the future of our cities or educating the future talent pipeline. Most of all, we must enable and empower the workforce and future talent pipeline to harness the opportunities of 4IR. ■

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Industry 4.0: Tips for building your digital enterprise

Industrial revolutions are huge, significant events, and many observers believe we've gone through four of them. The first was initiated by the introduction of the commercial steam engine and the birth of the textile industry. The second was sparked by electricity and mass production. And the third was triggered by the computer after World War 2.

Professor Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, believes we're well under way with the fourth industrial revolution, or Industry 4.0. It refers to major innovations in technology that are coming to maturity at the same time, embedded by companies around the world, integrating the virtual and physical worlds to bring forth powerful new ways of working. Examples of this technology include:

Internet of things

The fusion of physical objects such as software, sensors and electronic items with internet and machine-enabled data collection and transfer. IoT allows real-time communication, initiating physical systems and giving rise to smart cities. This means that traditional supply chains can become more digitised and connected – becoming completely integrated ecosystems that are fully transparent to the contributing marketing, product development, manufacturing and distribution departments.

Big data and advanced analytics

With the internet of things comes a huge amount of data, and the way businesses read and analyse it is important, especially if it involves critical events such as power outages or an attempted data breach. In manufacturing, the availability of data from product development, production and testing for example, can add new dimensions to manufacturing, allowing targeted innovation, marketing and decision making.

Robotics and automation

Robots are already used extensively in the manufacturing world – mechanical arms on assembly arms, for example. Industry 4.0 could see the contribution of robots massively increasing, and with the smart factories we could see these robots taking ownership of manufacturing and bringing them to customers by themselves, thanks to computing and communication systems being linked to physical systems.

Simulations, 3D printing and augmented reality.

These are already common place today, so goods can be virtually modelled and tested, saving time and reducing the materials, efforts and money spent. Through 3D printing we can see the creation of customised, complex and lightweight designs at remarkable speeds, while augmented reality sees a future where employees can be trained on the job far more effectively than with paper or monitors.

Manufacturers can and should do better with Industry 4.0

Photo: Working Down T'Mill, taken by Mark Tomlinson at Liberty Steel in Stocksbridge, South Yorkshire, shortlisted in the Amateur category of the EEF Photography Competition 2017.

The value that companies get from new technologies could (or should) be able to exceed low-single-digit cost savings. In the US, a report from Boston Consulting Group suggested that although American manufacturers recognised Industry 4.0 value, they are approaching the opportunity in piecemeal fashion and could miss significant business benefits. BCG said that, to succeed, companies must set ambitious goals and capture value rapidly over a transformation spanning many years.

Justin Rose, a BCG Group partner and co-author of the report said, "Industry 4.0 stands out as a means of generating significant productivity gains. The real value is achieved when manufacturers maximise the impact of these advances by combining them in a comprehensive programme.

BCG partner Vlad Lukic and co-author of the report said: "Our findings point to the need for US manufacturers to gain a deeper understanding of how they can apply Industry 4.0 and accelerate the pace of adoption. The winners will approach the race to Industry 4.0 as a series of sprints, yet manage their programme as a marathon."

Industry 4.0 will also have an important role to play across the Pond, according to the independent UK industry-led Made Smarter Review, led by Siemens UK CEO Professor Juergen Maier. It said that over 10 years, industrial digitisation could boost UK manufacturing by $455bn, increasing sector growth by 3 per cent and creating a net gain of 175,000 jobs. And recently, the Confederation of Business Industry put out a call to action to business leaders to unite behind a leapfrog industrial strategy to win with Industry 4.0. Again, the message was that organisations needed to wake up quickly and make decisions on how they plan to adapt.

Dean McGlone, Sales Director at Finance Automation company V1, said: "We've seen organisations embrace our technology to automate financial processes in their finance department and in fact, across their organisation. Is it changing the face of the finance team? Absolutely.

"But the reality is that it is removing mundane tasks that can be effectively streamlined by cutting-edge technology and driving productivity gains.

These time savings can free up staff to focus on more high-value, strategic roles – such as ensuring the finance team provides the data-driven insight to the rest of the business about new opportunities and trends, so that businesses can make informed decisions based on the numbers." ■

Tips on making the most of Industry 4.0

In a blog post, PwC Chief Technologist Chris Curran said that you can't leave emerging technology to chance or luck, but that this was a trap many companies fell into due to resource constraints, competing priorities and different views on how technology can lift a business. He offered five practices a business leader could start with in preparing for Industry 4.0.

Rethink the way you experiment. Make sure that you evaluate technology through a business lens. This will allow you to experiment with technology that can differentiate your company, with the aim of expanding capability so that you can do things your competitors won't be able to do.

Engage with your emerging technology ecosystem. Identify the organisations and start-ups working with and researching the tech relevant to your industry, products, customers and markets. Establish working relationships where suitable, and keep an eye on all of them. For example, you could think about partnering up with a university or other suitable educational institution.

Build your own learning lab. If your enterprise is getting to a certain size, you should certainly start thinking about having an innovation team to get business value from ideas – perhaps through the creation of demos and prototypes. You can share whatever you create internally, or with selected partners and customers.

Develop a maker's mindset. Curran said that enterprises should develop thinking which allows them to draw connections across technology and solve real-world problems. He says that makers are willing to try, test and fail, get their hands dirty, and share and build on other people's discoveries.

Established a process to scale emerging technology. Curran believes that regular enterprise working processes, such as building a business case and planning projects with the financial benefits in mind, won't work for tech-driven innovation. He suggests processes with shorter stages that includes advancing ideas, developing prototypes, market testing, and scaling.

It's important to remember that the change being brought about by Industry 4.0 won't be considered as new and cutting-edge for very long. Because ideas can spread at such a rapid speed, we'll soon see many companies come up with their own versions of the same business products and solutions. Simply playing at innovation won't be enough to separate your business from the competition – your organisation needs serious planning and strategy to avoid falling behind.

INSPIRATION

Photo: Ocado Smart Platform Robots, taken by Lucy Carr-Archer at Ocado CFC3 Andover in Andover, shortlisted in the Amateur category of the EEF Photography Competition 2017.

Solving the green dilemma in a digital world

By Steve Hemsley

Manufacturers will always embrace new technology to boost efficiency and productivity, but without investment to improve sustainability their profitability is at risk.

The fourth Industrial Revolution will make manufacturers smarter and more efficient, but there is also pressure on them to become more sustainable.

As firms make ambitious investment decisions and adopt new technology to transform their processes they must find new ways to reduce their use of energy, water, raw materials and to cut the amount of waste they produce.

Professor Steve Evans, Head of University of Cambridge's Institute for Manufacturing's (IfM) Centre for Industrial Sustainability, says a sector-wide sustainability strategy is essential to ensure goods are produced that consumers and businesses really value and that take into account their individual needs.

"For example, if a car manufacturer can use data to discover how someone drives their current vehicle, then less energy could be used when building their next one," he says. "If you know how a car has been driven and looked after, and whether someone has had any crashes, you can decide which parts could be recycled."

Evans says sustainable organisations can be very profitable but he warns that firms will not make money in future without being sustainable. Manufacturers have worked out how to cut costs and improve their products, he says, but their challenge today is how to take less from the earth but still deliver value. He wants to see the wider adoption of ecoefficiency and ecotechnology in factories.

Working together

Evans has more than 20 years of academic experience plus 12 years working in industry, and he wants manufacturers to work more collaboratively.

"In a car factory, a manufacturer can disassemble a competitor's product and calculate how much labour was needed to produce it, but it is much harder to work out how much energy was used," he says.

"New analytics technology will help everyone, if all manufacturers are prepared to provide anonymous data around their processes to improve overall energy consumption."

Evans also expects more investment in virtual and augmented reality to assist with factory floor planning to map the flow of energy and make it easier to manage supply and demand so that less energy is wasted.

Risk and reward

With demand for finished goods rising globally, but the supply of some raw materials becoming scarcer, resource productivity and scheduling will become priority areas for manufacturers.

The IfM supported the sustainability report "Lean and Clean: Building Manufacturing Excellence in the UK," published in October by the independent think tank, Green Alliance, which calls for a more resource-efficient manufacturing strategy.

Professor Steve Evans
Head of the IfM's Centre for Industrial Sustainability

"The challenge today is how to take less from the earth but still deliver value."

The study claims that, while some firms have cut energy use by about 50 per cent in the past decade, the reduction for most producers has been between 10 and 15 per cent. It seems many companies struggle to identify and quantify inefficiencies and vulnerabilities in their operations.

"Many firms are not aware of the resource risks they face or the opportunities for savings that would make them a business priority," says Evans. "The government's industrial strategy provides foresight and benchmarking for UK manufacturers to realise the untapped potential of resource efficiency and help build long term manufacturing competitiveness."

The Green Alliance estimates that, by improving resource efficiency, performance in manufacturing could add £10bn to firms' profits.

Recycle boost

Evans would also like to see every product manufactured given its own digital passport that details exactly which materials it is made from and which chemicals have been used to produce it. "This information will reveal whether you can return something to its original state or recycle it in other ways."

New technology could also be one solution to the UK's current productivity problem. According to the Office for National Statistics, the country's output per hour fell 0.1 per cent between March and June 2017.

"You might see someone standing around in a factory or looking busy, but do you know if they are actually adding value?" says Evans. "You can use digital technology to assess, for instance, if tools or equipment are in the wrong place and that, if they were relocated to different parts of the factory, productivity would improve."

Communicating the benefits

However, there are barriers to the sustainability ideas being suggested by the IfM, the Centre for Industrial Sustainability and the Green Alliance. Many consumers and businesses remain reluctant to share data while real concerns exist about future cyber security threats around the internet of things.

"Industry must work as one to ensure robust data security, while there is a societal challenge for manufacturing to convince consumers there are real benefits to them if production and supply chain processes do become more sustainable." ■

Read more on **businessandindustry.co.uk**

OPINION

Photo: Loading one of the Strip Cast furnaces at Less Common Metals, taken by Adrian Waine at Less Common Metals Limited in Cheshire, shortlisted in the Professional category of the EEF Photography Competition 2017.

Brexit – industry must be proactive

We may be suffering from Brexit overload but, as Victoria Montag, argues, we need to be thinking about some of the issues that may not make the headlines, but could affect the way that UK industry functions in the future.

Is anyone else suffering from Brexit fatigue? I have to admit that I am. We've had almost 18 months of daily coverage of the UK's impending break from the EU, often with contradictory reports coming out on the same day – and it's a little draining.

So, if it's so exhausting, why the heck am I writing about it? Because it is important.

I wouldn't blame anyone for sitting back, waiting to see what happens and just getting on with it when they know what's what, especially with the continued lack of clarity over developments in the negotiation process.

But, as a trade association, Gambica would be remiss if it took this approach. We need to be proactive. Indeed, I would be surprised if any industry body in the UK was not paying close attention to developments and working out how to minimise any adverse effects to the industry they represent, and how to exploit any opportunities.

To be living and working in this country, you would be mad to want post-Brexit Britain to fail. You may not like that it is happening and hope that the process is stopped, but to hope that Britain is plunged into economic disarray so that you can say "I told you so" is about as useful as screeching hysterically "we won, you lost – get over it" every time a potential challenge is raised. Not only are these stances not useful, but they wilfully invite damage to our country's economy and quality of life. Rather, we should be having conversations that start from the premise of "if this is to be a success, we need to address...."

Gambica, along with seven other trade associations (Beama, Eama, REA, Cesa, Feta, MTA and TechWorks) has created an advisory body on the potential impacts of the changing relationship between the UK and EU for the UK government, manufacturers and media. The EURIS (European Union Relationship and Industrial Strategy) taskforce exists to have precisely these constructive conversations.

And there is a lot to think about. The focus of mainstream media reporting on Brexit has been on the future trading relationship with the EU, the implications of the rights of EU citizens living in the UK and vice versa, and the controversies surrounding the terms of legislating for the UK's withdrawal from the European Union bill.

Victoria Montag
Head of Industrial Automation, Gambica

"Will we still use CE marking? Will we adopt EU laws that come into force during any transition period?"

But there are intricacies. For example, a Gambica member recently pointed out to me that, if the Reach directive were transposed directly into UK law, it would not be fit-for-purpose because manufacturers and importers are required to gather information on the chemical substances and to register the information with the European Chemicals Agency – which, presumably, we will no longer be part of.

This problem is not something I am losing sleep over. The proposal for a two-year transition period gives some leeway for the UK to amend the directive and to organise the necessary infrastructure in the UK. But it's not long and the UK could decide to deregulate – though as Steve Brambley, Gambica's newly appointed CE argues, significant regulatory divergence creates its own problems including making the UK a dumping ground for unsafe products. So there is a potential problem there – although not unsolvable.

I do worry whether the people in charge are thinking about these things. Will we still use CE marking? Will we adopt EU laws that come into force during any transition period? You may argue that these issues are not as important as getting the trading relationships with the EU and other countries sorted. You may be right. But if companies are unable to trade because their products fall into scope of a regulation that is impossible to comply with, it would be better to raise these matters now rather than later.

EURIS works with its combined membership of more than 3,500 companies to raise what is important and tell government what they think needs to be done for Brexit to be a success. Happily, the government has – thus far – engaged positively with the taskforce.

The success of EURIS depends on the continued input from industry – from you. ■

If you would like to find out more about EURIS, visit **euristaskforce.org.uk** or email **info@euristaskforce.org**

PHOTO: THINKSTOCK

According to the study, employment levels within the manufacturing sector will increase by 0.8 per cent between now and 2021 as a result of the increased utilisation of Industry 4.0 technology.

Skilling up the manufacturing workforce for 4IR

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The increased use of 'Industry 4.0' technologies within UK factories will not have a significant impact on overall employment levels in the manufacturing sector, but will cause a significant swing towards higher skilled positions which will most likely be distributed in London, accoding to a study, recently published.

The Go Fourth report by national law firm, Irwin Mitchell and the Centre for Economic and Business Research (Cebr), examines the latest trends and impact on the manufacturing sector of new technologies such as fully autonomous robots, 3D printing and augmented reality.

These technologies, often referred to as the fourth wave of the Industrial Revolution, create Smart Factories, which offer many benefits including higher productivity, increased speed of production and improved product quality.

A common fear associated with Industry 4.0 is the loss of jobs it could cause, but according to the study, employment levels within the manufacturing sector will increase by 0.8 per cent between now and 2021 as a result of the increased utilisation of Industry 4.0 technology.

However, it says that certain occupations will be hit harder and the impact of this will be felt to a greater extent in some areas of the UK.

The report forecasts that in the next four years, lower-skill professions and administrative jobs will fall, while there will be a 12 per cent increase in managers, directors and senior officials and a 7 per cent rise for professional occupations.

The report reveals that manufacturers in the East Midlands, Northern Ireland and Yorkshire employ the highest percentage of at-risk occupation groups, while London and the South East employ the least. In the South East, for example, only five per cent of jobs are elementary occupations, for which employment is expected to decline by 10 per cent by 2021, while the figure for Yorkshire and Humberside is 11 per cent. In the East Midlands, 23 per cent of jobs are process, plant and machine operatives, but in London only nine per cent of manufacturing workers are employed in this area.

Dorrien Peters
Partner and Head of Manufacturing, Irwin Mitchell

These regional results suggest Industry 4.0 will generate a change in the distribution of manufacturing jobs within the country. Aggregate employment is not forecast to change significantly, and the job creation will occur in areas with more employment of managers and professional occupations, of which there are a higher proportion in London and the South East.

The report incorporated a YouGov study of senior decision makers in 300 UK manufacturing companies. Key findings from the report are:

- The majority of manufacturers are not familiar with the term Industry 4.0. Only one-in-three manufacturing companies classified themselves as being familiar with the term. The figure is even lower when analysing small businesses only.
- The survey results find that '3D printing' and 'data' are among those terms, manufacturers are most familiar with.
- Investment in Industry 4.0 technologies remains limited. Only 14 per cent of manufacturers have invested in big data and/or cloud solutions while 12 per cent invested in 3D printing technologies.
- There is a long list of reasons why companies are not investing in Industry 4.0 technologies. Around one in three firms believe that their business is too small to capitalise upon the benefits of Industry 4.0 with more than a quarter of firms indicating that their facilities are not suitable.
- Industry 4.0 is believed to result in productivity gains. Over one third of companies believe that Industry 4.0 technologies will have a positive impact on overall productivity. Only two per cent of manufacturers expect a negative impact on productivity.

Dorrien Peters, partner at Irwin Mitchell and head of the firm's manufacturing sector group, said: "This report shows that, in the UK, usage of and familiarity with Industry 4.0 technology is at a low level in the manufacturing sector. However, it is growing, especially within the adoption of cloud solutions and big data analytics.

"This growth will provide productivity benefits but it appears that many manufacturing businesses in the UK are still concerned by the cost of investing in Industry 4.0 technology. Also, a number of businesses believe that their cyber security would be threatened by Industry 4.0.

"While one in three businesses surveyed believe that Industry 4.0 will reduce employment in the next decade, the report forecasts that on aggregate, employment will be stable until 2021. The distribution in terms of type of job and the location is set to change considerably and could have major repercussions for a large number of businesses." ■

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