What does the coming year have in store for UK manufacturing? Some leading voices from the sector make their predictions.

THE MANUFACTURING LANDSCAPE

INSIGHT

PROFESSOR STEVE EVANS, CHAIR, IET MANUFACTURING POLICY PANEL

WE LISTENED to the Chancellor's Autumn Statement on 23 November with great expectations. Following the creation of the Department for Business, Energy and Industrial Strategy we clearly expect industry to play a major role within this government's strategy for growth, but in what form is still unclear.

The purpose of an industrial strategy is to help government, industry and society work together to deliver a resilient, productive, sustainable and competitive industrial economic sector. In order to have a successful strategy, government needs to clarify: what is encompassed by 'industry', why it remains important to our economy, what success would look like in five, 10 and 30 years and finally, how we will measure it. Generating economic growth is an objective, an outcome from a strategy; it cannot be the strategy in itself.

In the Autumn Statement there are welcome indicators of support for industry, specifically on the National Productivity Infrastructure Fund (NPIF). The details of the NPIF have not been fully confirmed but we do welcome a review of the research and development tax environment, which to date has been very helpful in supporting product innovation. Announcements on infrastructure spending, on increased R&D, and on 5G were also welcome, but the ability of our skills sector to meet the increased demand for agile, practical and competent people is still key and was not addressed enough.

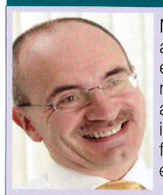
One concern is that industry will choose to 'wait and see' what happens about access to markets, and therefore delay productivity investment, or even make that investment in foreign plants. Any solution that nudges this decision – for example including technology that improves innovation in processes in the Enhanced Capital Allowance scheme – would have been welcome.

The NPIF is a good start but it does not tackle productivity across industry with any fundamental lever. The investment in funds needs to be braver to tackle specific causes of poor productivity directly, such as poor resource efficiency. UK national productivity is measured as being below other nations, such as the USA, Germany and France, but these statistics do an immense disservice to our manufacturing industry, where direct labour productivity has remained high – improving by 3.2 per cent a year for 2004–2011.

Indicators of what the government has planned for its industrial strategy are still few and far between. While we recognise that the final industrial strategy document is likely to be a separate announcement, we would have welcomed any comment on the progress toward this and any excitement felt by government prior to full announcement.

INSIGHT

DICK ELSY, CHIEF EXECUTIVE, HIGH VALUE MANUFACTURING CATAPULT



MUCH HAS changed in the UK in 2016. The aftermath of the EU referendum and the US election has created a fluid landscape where we need to determine our position in the world. This is a time of political and economic uncertainty, but it is also a time to rethink, agree and commit to the factors that shape the composition of the UK economy.

Early signs – including Nissan UK securing its next generation of vehicles – have given cautious ground for optimism about the attractiveness of the UK's industrial economy following the EU referendum. Business and investors, however, yearn for certainty. It is therefore paramount that industry leaders have sight of long-term stability and constancy of purpose.

The manufacturing industry needs to maintain and grow its world-class innovation translation model to support UK companies and attract international investment. The expanding facilities at the High Value Manufacturing Catapult enable UK manufacturers of any size to take risk out of scaling up and commercialising their innovations.

It is also important to make the most of this country's world-class research capability and bring new products and services to market, develop a rich seam of value-added advanced manufacturing in our economy, and continue to drive productivity improvements.

Further, we must maintain a constant stream of talented young people embarking on careers in engineering and manufacturing. We need to continue to attract local young people through apprenticeships and educational programmes, but we also require ongoing access to the most talented people from across the world.

Finally, it is imperative that as an industry UK manufacturing maintains influence over the international standards and regulations that shape the way we create our products. All nations want this as well so we face fierce competition and there is a lot at stake.

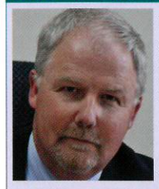
The UK is one of the top10 manufacturing nations in the world; 10 per cent of our GVA (gross value added) comes from manufacturing and the Government's recent 'Manufacturing Metrics' found that the number of manufacturing jobs may be as high as 5.1 million. The sector has evolved into a world of high productivity, as well as high-quality and high-value products and services.

It's tremendously encouraging to see our collaborative bodies bringing together key players to define what industry needs and what technologies need to be developed.

Through the Catapult programme we have the opportunity to give UK manufacturing a lead in its demanding markets and to close the productivity gap. I'm determined not to squander this once-in-a-lifetime chance.

INSIGHT

DR GRAEME PHILP, CHIEF EXECUTIVE, THE GAMBICA ASSOCIATION



HAVING DONE a reasonably good job of adopting and adapting lean principles, the UK manufacturing industry now faces the dual challenges of improving productivity whilst planning to adopt the new technical, investment and business model challenges of the digital revolution.

As a natural optimist, I believe that the technical advances represented by what the Germans call 'Industry 4.0' and what we in the UK are learning to call the 'Fourth Industrial Revolution' may well be an answer to our challenges in productivity and, in the longer term, could result in manufacturing being sited close to local markets rather than in large global centres whose location is determined largely by low labour costs as it often is today.

I realise that glib names like Industry 4.0 and the Internet of Things have invited criticism from some as being more hype than reality, but my perspective is different. I believe that you only have to look around to other parts of industry to spot where the principles involved in the digital revolution have been deployed for a decade or more, with proven results that it would be credible to extrapolate into broader manufacturing applications.

I have spent more than 30 years of my career in process control instrumentation, serving the chemical, petrochemical, oil and gas and pharmaceutical industries, first as an instrument designer, then in various management roles and finally as CEO of a £100m UK instrument vendor, so I have seen how technology has advanced.

In the late 1980s sensors and actuator instruments in this industry began to 'go digital', first with a hybrid analogue plus digital signalling system using the same cabling infrastructure as for the existing analogue system and then in the mid-1990s with a fully digital system. For those who know this area of industry, the first technology was known as HART and the later, fully digital, system was generically known as fieldbus.

Both systems allowed secondary information to be transmitted alongside the primary measurement signal, enabling, amongst other things, health and safety and maintenance information to be transmitted back to the control room. In today's parlance, this would be called 'metadata'.

Whilst the measurement signal was acted on immediately by the control system, the metadata was stored in a separate database, called an Asset Management System, to be looked at in non-real-time. This is analogous to the 'big data' in 'the cloud' that we hear so much about today.

The main purpose of this data was to assist in predicting likely failures or other servicing needs so that the plant was only shut down for maintenance when it had to be. Shutting down a process plant can be a very expensive process and this predictive maintenance proved to be a real cost saver and productivity improver which many plant operators would not be without today.

The metadata also gave useful intelligence on the operating efficiency of the plant, which could be used to modify operating processes and parameters to make it more efficient. This product design optimisation is another facet of Industry 4.0 and the Internet of Things that is often trumpeted.

The process industries can testify, with 20 years of experience, that this really does work.

All very encouraging so far – so is there a fly in the ointment? Well yes, as a matter of fact. Particularly in the case of fieldbus, competitive pressures between instrument vendors meant that two opposing and incompatible systems emerged. For many years there was no international standard for interoperability of devices. Sadly this resulted in a confused market and a much lower take-up of the technology than expected.

We need to learn this lesson as we roll out Industry 4.0 and work together to everyone's advantage if the benefits, which are very real, are really to be reaped.

INSIGHT

DAVE WRIGHT, DIRECTOR OF STRATEGIC INITIATIVES, COVENTRY UNIVERSITY

HAVING BEEN asked to write this piece about the UK manufacturing landscape, it didn't take long before I started thinking about the current government's industrial strategy, and pondering what shape future intervention in the manufacturing sector might take. Like many of us, I was delighted when the Department for Business, Energy and Industrial Strategy was announced, and following on from the government's announcement of its future industrial strategy, I am eager to see what work will be done over the next few months to put this in place.

My biggest hope is that the government recognises that there is a need for it to intervene; rather than hiding behind the arguments in favour of market forces. We need government to accept the importance of manufacturing to the UK economy: it creates wealth by adding value, by converting raw materials into products that people buy. Businesses pay tax; they employ people who pay tax and support supply chains which employ people who pay tax, etc. The industry is responsible for stimulating research and innovation through the development of new products. This helps to anchor talent in our world-class universities and research and innovation organisations.

The government's role, or duty I believe, is to ensure that the ecosystem that supports manufacturing businesses is properly aligned and, most of all, joined-up. My pet hates are the three d's: displacement, duplication and dilution. Displacement occurs when an initiative is pushed aside in favour of newer ideas despite having been working well within the industry. Duplication occurs when someone sees something working and decides to do something similar or even the same, but consumes valuable resources in doing so; this is particularly painful when public funding is used to fuel the egos of organisations that should be collaborating, not competing. Dilution is the result of both of these things, and means that the investment of public money becomes sub-optimal; we don't get the 'bang-for-the-buck' that we should.

We need national programmes deployed locally. I am a firm believer in the effectiveness of local delivery, provided that it does not add an unnecessary and unaffordable overhead burden in the process. The public money for supporting industry needs to be spent in the businesses receiving support, rather than organisations providing it.

The Midlands Engine and Northern Powerhouse can be great forces for good, but need to think and act locally, not insularly or parochially. We have tremendous research and innovation assets nationally, in our universities, the Catapult centres and research and technology organisations, but we have to ensure that they are used nationally and operate as part of our joined-up ecosystem.

We need to be patient, and we need to commit to a constancy of purpose. A better educated, better trained, more highly skilled workforce is essential for growth and competitiveness.

My last wish is also a difficult challenge: government needs to be brave; it needs to make choices and not try to implement watered-down, vanilla-flavoured 'ubiquitous' programmes. This might be deemed to be 'backing winners', but why waste valuable resources? There is a huge appetite in industry to work with government in a structured and effective manner; sector-based strategies with collaborative groups like the Automotive Council, the Aerospace Growth Partnership and their equivalents in other sectors have been seen to be effective, so long as they have access to senior ministers. I would be delighted to see that happening again.

The Fourth Industrial Revolution – buzzword, concept or already happening? Depending on who you talk to, it could be any or all of those things and more.
By **Steve Brambley**

TAKING INDUSTRY TO THE NEXT LEVEL

IT'S A SHORT phrase that covers an enormous scope and like the consumption of the proverbial pachyderm, we often break it up into bite-size pieces to better digest it. However, looking at the slice of meat on your plate doesn't tell you what the whole animal looks like, and analysing components of Industry 4.0 in isolation can sometimes distract from the bigger picture and the wider potential.

Automation is a key aspect of the concept, as is integration to manufacturing execution systems and enterprise resource planning. Big data, cloud storage and cyber-security all feature heavily, with predictive maintenance, employee scheduling and logistics management also linked in. While all of these and many others contribute to the whole, the end result is not just about incremental improvement – quicker, cheaper, better – but it is the opportunity for new business models and an entrepreneurial approach to bringing products to market. That is where the revolution happens, enabled by a technological evolution.

Buzzword

You probably noticed that in the above paragraph I didn't call an elephant an elephant, I mixed fourth industrial revolution with Industry 4.0 and then quoted a bunch of industry jargon that needs further definition. This illustrates one of the fundamental issues of any movement – what to call it and how to describe it in plain English.

The UK government prefers the fourth industrial revolution, building on the fact that Britain was the birthplace of the first one. Industry 4.0 has gained popular status but others such as Industrial Internet of Things (IIoT), smart factory, connected enterprise, digital manufacturing and many more are all used interchangeably.

We shouldn't get too bogged down in semantics, but these phrases themselves can sometimes suggest a limit in their scope compared to the total picture – you could argue that the benefits are not restricted to within the factory walls or you might question whether manufacturing includes water processing or electricity generation. Perhaps the broadest reach is in Industry 4.0, where simply removing the '4.0' leaves you with a single word that encapsulates many sectors including manufacturing, processing, logistics, construction, agriculture and commerce.

Regardless of this multitude of terms, the great thing is that these phrases are entering the conversation and helping to form a wider awareness and appreciation of the concepts and opportunities. Diverse stakeholder groups from industry, government, academia, institutions and the media are all collaborating and converging on the same goal – the future strategy for UK industry.

MASS CUSTOMISATION

PERSONALISING LOW-VALUE GOODS

The automotive industry has long been able to offer personalisation in cars, from choosing the colour, trim and wheels to the many optional extras available. This has allowed manufacturers to propose enough combinations of choice to their customers that almost every car is made to order. However, while this mass-customisation business model is feasible for high-value goods such as vehicles, it has not yet been widely adopted for example in the food and drink industry where the value of the product is usually just a few pounds or below.

A good example of Industry 4.0 technology enabling a disruptive start-up business is mymuesli, which uses advanced automation techniques to offer bespoke muesli to its customers. The production facility can mix more than 566 quadrillion possible muesli combinations. Customers create their own unique cereal recipe using the mymuesli website and then this specific mix is scheduled in the production process, where intelligent carriers communicate with the filling machines before shipping to the customer directly.

This runs entirely contrary to the mass manufacture of identical products to enable an economy of scale, bringing an improved customer choice and transforming the way a food product is brought to market. An important aspect of this example is that it wasn't an established food manufacturing company that began the business, but three young entrepreneurs who had an idea and then found the tools to make it happen.

While this model is not widespread yet, it can also be found in the clothing industry, another area of typically low-cost goods where bespoke tailoring and unique design is not accessible to most customers. Shirt manufacturers like Youtailor allow a similar online design process where the customer can choose from many different options of material, collar, cuff, buttons and more to create the exact specification they would like rather than the limited choice of the traditional retailer.

Concept

So, we can decode a range of titles that describe parts or the whole of the initiative, but what lies beneath them? What is the definition of the Smart Connected Digital Industrial Manufacturing Factory Revolution 4.0?

The International Standards Organisation had a strategic advisory group look at specifying which characteristics could define this range of phenomena. The result was that any definition should include: the integration of customers and partners in business and value-added processes; the collaboration of human beings, embedded systems, autonomous machines, and systems of systems; and the convergence of advanced manufacturing capabilities, digital technologies and the Internet of Things. These factors, when combined, lead to: new forms of value creation, business models and services; an improvement of human productivity and innovation cycles; evolution of safety, security, work structures and work roles; and the individualisation of products (batch size one), services and processes.

The former is not a bad summary and, most importantly, succeeds in focusing on broader goals of business models, innovation, employment and supply chain in addition to manufacturing technology. This broad reference model can be further divided along three separate dimensions: vertical, horizontal and time.

The vertical dimension is the connection and integration of all business systems, from manufacturing and processing to logistics, planning and engineering. You can picture the production planning system connected to maintenance planning, spares management and resource scheduling to autonomously organise the most efficient throughput and use of resources.

The horizontal dimension runs right through the supply network. Facilities are connected in real time to the supply base and customers to dynamically order, handle, process and deliver in the most effective way.

The time dimension covers the full product lifecycle, from design and development, through production, use and end-of-life recycling, re-use or repair. Rapid digital development is enabled by modelling and simulation of both products and manufacturing processes. Tracking and monitoring of products gives benefits not only in production but in service and at end of use. Feedback into the design process, condition monitoring and incremental updates are all enhanced by greater connectivity and data capture.

Business models

There are some benefits that have always been associated with automating – increased throughput, efficiency and quality leading to a better product and service being just a few. Product miniaturisation and mass production are other advantages – smartphones and tablets couldn't be made otherwise. There are three main business models within industry 4.0 which provide further benefits in terms of cost-reduction and improved customer experience.

Firstly, complete automation can take the customer experience to another level – the goal of mass customisation and 'batch size one' could bring an unprecedented level of personalisation to products without the hefty price tag usually associated with them. A supplier could take advantage of the ability to manufacture made-to-order products from a menu of choices, locally and efficiently. The customer is offered the opportunity to buy the exact configuration they desire without paying bespoke service costs.

Further to this, localised manufacturing reverses the trend to mass-manufacture in low-labour-cost countries by allowing efficient production in high-wage economies. This enables manufacturing to be located where the market is, reducing both shipping costs and lead time, both key competitive elements in a business. The digitisation of the design and development mean that local contract manufacturing businesses could manufacture goods designed by specialists, entrepreneurs, customers or end-users.

Another business model that is enabled by the increased connectivity between products and producer is servitisation. The classic model is to sell goods that then become the customer's responsibility to operate and to achieve desired performance. Servitisation means that a customer buys a performance level on an ongoing basis, maintained by the supplier of the product. An example would be in paying a monthly service charge, rather than paying for a machine outright. In this instance, a supplier would deliver a machine but would then also be responsible for the performance of the machine and actions to maintain it. In order to achieve this, the supplier would need to be connected to the machine to gather data, monitor and act upon the real-time analysis.

Is this already happening? One of the phrases I hear from time to time when discussing Industry 4.0 is that "it is nothing new, we've been able to do that for 20 years or more". I would agree in part, but it is a little like a pioneer of Arpanet claiming that a live-streamed, interactive webinar is nothing new as they were sharing plain text messages between a handful of computers in the 1970s. It is the resulting application that is radically improved, enabled by the gains in data speed, storage and connectivity.

After all, we have been making telephone calls for over 100 years, but a voice-activated call with a Bluetooth headset is hardly the same as placing a call through a manually patched telephone exchange.

The revolution has begun, but will truly be happening when the norm is to find manufacturing that is local to the customer, has fully integrated business systems and is linked in real time to customers and suppliers to produce mass-customised goods on a rapid lead-time. Then we won't be calling it 'Industry 4.0' anymore, it will just be 'Industry'. •

Steve Brambley is director of public affairs of the Gambica Association.

TECHNOLOGY DEVELOPMENT

DRIVING EFFICIENCY IN MANUFACTURING

It is often the case that automation is behind the scenes and "just works" so that it is not always even that obvious that it is there. The resulting improvements in quality, throughput or efficiency can be startling, but the small boxes with flashing LEDs that make it all happen are often hidden away in enclosures.

An example of a technological leap bringing new capabilities is the Smart Factory approach of Ubisense, a real-time location system that tracks the position of people, tools, machines and products to create a connected and flexible manufacturing system. The system is mostly invisible to the human eye and yet radically improves the capability to manage a complex operation.

BMW Regensburg manufactures over 1,000 cars per day, with multiple models produced on the same assembly line, each to an individual customer specification. With 150 workstations and thousands of complex processes there is a high risk of errors, delays and waste, all of which impact cost and productivity.

The Ubisense system connects all of the elements to ensure correct parts, tool settings and interactions take place for each operation on each unique car being built.

DREAMSTIME