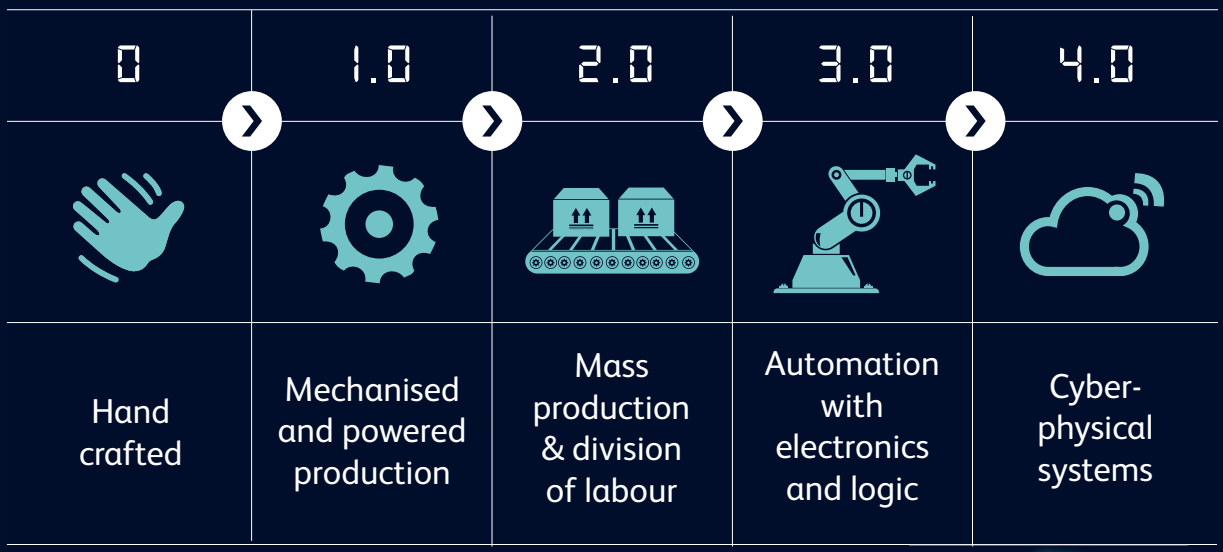

NewStatesman
Manufacturing on the march
3D printing
Clean technology
Intelligent processes
EPSRC
Engineering and Physical Sciences Research Council
ADDED SCIENTIFIC

WHAT IS INDUSTRY 4.0?

MANUFACTURING IS UNDERGOING A TRANSFORMATION TO INDUSTRY 4.0



This latest transformation would deliver a step change with estimates of over a **£350bn** boost by 2030 to the UK economy

80% of manufacturers say industry 4.0 will be a business reality by 2025

THIS TRANSFORMATION WILL SEE GREATER INTEGRATION OF PHYSICAL PRODUCTION WITH DIGITAL TECHNOLOGIES

MULTI-PURPOSE PRODUCTION LINES
UNIVERSAL DATA INTEGRATION **NETWORKS**
AUGMENTED REALITY WITH REAL TIME INFORMATION
RAPID ADDITIVE MANUFACTURING/3D PRINTING
CAPITAL EQUIPMENT WITH **NETWORKED CONTROL SYSTEMS**
CAPITAL EQUIPMENT WITH EMBEDDED DATA ANALYSIS
CAPITAL EQUIPMENT WITH EMBEDDED SENSORS, CLOUD SOLUTIONS
FULLY AUTONOMOUS ROBOTS
3D SIMULATION OF MANUFACTURING PROCESSES

COULD THE UK PIONEER THE NEXT INDUSTRIAL REVOLUTION?

MANUFACTURERS ARE LOOKING TO THE FUTURE

60% of firms agree their business could be using digital technologies more to boost their productivity

62% of firms plan to invest more in internet connected capital equipment in the next five years

BUT THERE ARE SOME WORRIES

Quality of infrastructure is the 4th most important factor when determining where manufacturers plan to make their next investment – is the UK competitive enough?

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New Statesman
2nd Floor
71-73 Carter Lane
London EC4V 5EQ
Tel 020 7936 6400
Subscription inquiries:
Stephen Brasher
sbrasher@
newstatesman.co.uk
0800 731 8496

Supplement Editor
Guy Clapperton
Design and Production
Leon Parks
Sub-Editors
Tracey Beresford
Prue Hone

Commercial Director
Peter Coombs
+44 (0)20 3096 2268
Account Director
Laura Alderson
+44 (0)20 3096 5778


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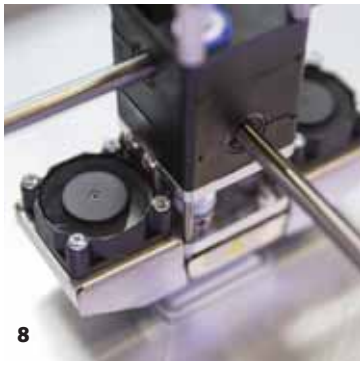
Steel is in crisis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The UK leads from the front


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The digital supply chain evolves

Manufacturing moves on

Any discussion of manufacturing in the UK at the moment is a conversation about extremes. On the one hand, the steel industry is in crisis following Tata Steel's decision to sell or abandon its operations in this country. The shadow business secretary, Angela Eagle, makes the point eloquently in this publication: stuff has to happen and it has to happen quickly.

The other side of the debate is that we're doing rather well in the field of innovation. It's now a few months since the *New Statesman* published its last supplement on manufacturing, and the subject has moved on apace. This time we are publishing articles on manufacturing and the internet, the so-called Internet of Things and, significantly, 3D printing (also known as "additive manufacturing"). The sheer speed at which these technologies are making an impact is breathtaking; even earlier this decade, the suggestion that someone could print out a car would have been greeted with scepticism. It's now happening.

Such drastic change brings with it midterm as well as short-term issues. People have been talking about skills gaps and about younger people not having what it takes to enter the workplace probably since the introduction of the sewing machine, but there is now a 20 per cent shortfall in recruitment into the IT industry, according to the worldwide training and accreditation body CompTIA. This would not have been an issue for manufacturing in the past but IT is now a major component. The infographic opposite, extracted from a larger one supplied by the manufacturers' association EEF, has some telling figures: 60 per cent of manufacturers believe digital technology will improve their business; 62 per cent plan to spend more on internet-connected equipment (this is the Internet of Things at work again) because they want their processes to work by themselves.

The suggestion, echoed by EEF in its article on page 20, is that we are on the cusp of a new industrial revolution and the UK is positioned to be at its head.

The state of the British steel industry in the present and the skills gap moving into the future are unhelpful if this potential is to be realised. The hope is that both government and the private sector will work to resolve them over time.

Unfortunately, there isn't much time left. The rewards, if these obstacles can be overcome, are considerable. ●

Guy Clapperton

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The paper in this magazine originates from timber that is sourced from sustainable forests, responsibly managed to strict environmental, social and economic standards. The manufacturing mills have both FSC and PEFC certification and also ISO9001 and ISO14001 accreditation.

COVER: SHUTTERSTOCK/DESIGN BY LEON PARKS

Steelmakers need our support

Manufacturing depends on steel, but the industry is in crisis. **Angela Eagle**, shadow business secretary, calls for a new strategy

On 29 March this year, the board of Tata met in Mumbai and announced the company's intention to sell its entire UK steel business. At the same time the UK's Business Secretary, Sajid Javid, was telling an audience in Sydney that it was a "pleasure to be in Australia". Javid's trip, while the UK steel industry was on the verge of collapse, showed not just a staggering lack of political judgement; it was an insult to British steelmakers and their families. His absence was all too illustrative of this government's ideologically driven, hands-off approach to the steel industry and the manufacturing sector as a whole.

Javid is a self-confessed devotee of that goddess of selfishness, the *über*-libertarian Ayn Rand. She claimed: "Government 'help' to business is just as disastrous as government persecution . . . the only way a government can be of service to national prosperity is by keeping its hands off." The secretary of state has certainly followed this dictum in his handling of the steel crisis.

Yet recent events in the steel industry have shown just how short-sighted such an approach can be. Steel is a vital foundation industry and it's also very cyclical. Of course there are global forces at play, but there are many actions a government with an active industrial strategy could have taken to secure the future of the industry. It was slow to assist with the high energy costs that faced energy-intensive industries in the UK after it unilaterally introduced the revenue-raising carbon price floor, and it has done nothing for the industry on business rates. Forward-thinking businesses in the UK that invest in new plant and machinery get landed with higher business-rates bills, something EEF (the manufacturers' organisation) has described as a "tax on investment".

Labour has consistently called on the government to develop a full industrial strategy that includes a procurement policy, committing to using British steel wherever possible for publicly funded infrastructure projects, and supporting industrial supply chains across the UK.

Crucially, we have been calling on the government to support tougher EU action to ensure a level playing field and prevent the dumping of Chinese steel. It should be supporting the scrapping of the lesser duty rule, which prevents higher tariffs being imposed. So far the UK has blocked this, showing much more interest in cosying up to the Chinese government.

> Industries do not exist in a vacuum. They are deeply embedded in the economy

The fact is that Javid is so deeply wedded to laissez-faire, free-market dogma that he is blinded to the enabling role the state should play in supporting a modern manufacturing sector. In contrast, Labour believes that we need an intelligent, modern industrial strategy, which recognises the role of government in cultivating an environment where manufacturing can thrive. It may not hold the central place it once did in the UK economy – throughout the 1970s it accounted for around 30 per cent of economic output, and in 1982 still employed 5.6 million people. Now it accounts for 11 per cent of output, employing around 2.6 million people.

But in spite of this, manufacturing remains vital to the economic health of the UK, with goods produced in the sector accounting for 44 per cent of all UK exports. Furthermore, communities – such as those in Port Talbot, Scunthorpe and Redcar – are still bound together by the manufacturing jobs that have existed for generations.

In the face of technological change and low-wage competition from other countries, some hold the view that the continued deindustrialisation of the UK economy is inevitable, and that we are wasting our time trying to save manufacturing industries such as steel.

No one is denying that the sector faces severe challenges. However, UK manufacturing *must* have a future in the 21st century, and it is the responsibility of the UK government to develop a robust industrial strategy to secure this future. The economic and social cost of inaction would be too great to bear.

Industries do not exist in a vacuum. They are deeply embedded in the economy through networks of supply chains, and through their contribution to wider demand and skills growth.

The steel industry is a case in point: it has been calculated that up to 40,000 jobs would be at risk if a buyer cannot be found for Tata's British strip products division, including workers currently employed by Tata and those dependent on the supply chain. The loss of these jobs could cost the government £4.6bn in tax revenue and benefits, and could reduce UK household spending across the economy by £3bn over ten years. In 2016-17 alone, the lost revenue

The economies of Port Talbot and many other towns in Britain depend on steel and manufacturing

and benefit costs are estimated to be £800m, or £2.2m every single day.

Furthermore, steel is a key foundation industry, whose reach is far and wide. The British aerospace, automotive, defence, construction, rail and nuclear industries are all reliant on a strong and sustainable steel industry. The loss or severe degradation of British steel capacity will clearly have implications far beyond the industry and the immediate communities it supports. This is one example of the interdependence of the manufacturing sector, which places additional responsibility on the government to formulate a comprehensive industrial strategy.

This isn't about some sort of Chinese Communist Party five-year plan. A sensible industrial strategy was put in place by Peter Mandelson when he was business secretary, and was continued in part under Vince Cable. It's about an active and supportive government, working alongside employers, unions, skills providers and regions to ensure businesses have access to the supply chains, the funding and the skilled workforces they need to grow. The CBI and EEF, which represent manufacturing employers, are calling for an industrial strategy, as is the TUC. Unfortunately we now have a business secretary who is so straitjacketed by his restrictive ideology that he is unable even to utter the words, let alone take decisive action.

While most secretaries of state seek to resist savings to their departments, Javid has so far seemed willing to accept deeper cuts at the Department for Business, Innovation and Skills. He may even be the first secretary of state in history who doesn't believe that his own department should exist.

Until the government recognises the recklessness of this approach, our manufacturing sector will continue to decline. In his 2011 Budget speech, George Osborne set out his vision for "a Britain carried aloft by the march of the makers". Unfortunately it hasn't really got off the ground. Manufacturing output has declined since Osborne's speech; in January this year it was lower than the previous year, and it is still 6.4 per cent down on the same period before the global crash in 2008 (in contrast, the service sector is up 12 per cent).

This trend has been reflected across all rich economies in recent decades, as growth in the service sector has outstripped manufacturing. But the UK situation is particularly poor – in Germany, manufacturing still makes up 21 per cent of output, compared to the UK's 11 per cent.

The crisis in the steel industry has exposed this government's abject failure to devise a coherent strategy for manufacturing. It has been left behind the curve, caught out by predictable events. We have a secretary of state who is seemingly allergic to any form of government intervention, and oblivious to the role the state can play in stimulating our industrial base. The UK desperately needs a comprehensive strategy for the manufacturing sector, and unless the government realises this, the "march of the makers" is destined to become yet another unfulfilled Tory promise. ●

SHUTTERSTOCK

k3 syspro

Where are we on the global stage?

Manufacturing is changing, says **Cathie Hall**, managing director of K3 Syspro, and the UK needs to find its place on the world stage

Manufacturing is undergoing a revolution. The days of mass production and high volumes are evolving; now the marriage of technology and industry is thought to be the future of the UK's industrial success by industrial analysts and business leaders. This digitisation of industry, or Industry 4.0, as it is known, is an approach pioneered by Germany, a nation that, according to PwC, is investing €40bn (£31bn) a year into Industry 4.0 research and development with the aim of increasing manufacturing revenue streams by around 12.5 per cent annually. For Germany, the smart factory of the future is just around the corner. For the UK, there is still work to be done.

Should the UK invest similar sums in Industry 4.0 research, the trade association Gambica predicts this would bring an additional £20bn into the economy. Yet the EEF has revealed that one in ten UK manufacturing businesses still fear being left behind. Can we create an interim strategy?

Industry 4.0 is all about the digitisation of production, enabled by technological advances such as the Internet of Things, giving machines and people the ability to cohabit and collaborate wirelessly. The road to this brave new world starts not with technology, but with the manufacturing business model.

Enter the growing trend of servitisation, a shift from selling product to selling product-service systems. Rolls-Royce spearheaded this by providing "power by the hour": instead of purchasing aero engines, businesses buy the power with additional maintenance packages. Such a strategy requires a change in how manufacturers make things, as well as how they sell them – and this is where technology plays a significant role.

In order to deliver more personalised products and long-term services and create demand, rather than simply predict it, manufacturers need to rethink how they generate revenue, what their cost base is, how they interact with customers and who their allies are in this industrial transformation. Complete visibility of the wider value chain is essential, and businesses need to review how they are using traditional technologies such as enterprise resource planning (ERP).

ERP systems play a major role in collecting transactional information and should be the first reference point for any business-model transition. To compete in Industry 4.0, businesses need to control costs, reduce working capital and yield efficiencies. Data held within ERP can highlight where these savings can be made across the wider value chain.

Looking at batch quantities of imported materials, and comparing these against the cost of locally sourced products before analysing warehousing costs and the overall difference in lead times, can enable finance departments to make informed decisions and reduce costs while adding greater value to end customers. This can then be taken a step further for inventory optimisation. Historical inventory data can be accessed and compared with sales forecasts. Using a range of mathematical algorithms, you can analyse the two to understand the right inventory levels required to hit customer service targets. Once these simple workflows are set up, they can be applied to almost any data analysis activity.

To state that the UK is out of touching distance with Germany in the race to Industry 4.0 is inaccurate. ERP technologies such as Syspro have long been embracing trends in SMAC (social, mobile, analytics and cloud) to channel data analysis through a central ERP databank. For many manufacturers, the acceleration into Industry 4.0 does not require heavy investment, or complex automation. A simple change in thinking, business model and digital strategy can bring UK manufacturing one step closer to the future factory.

For further information, visit www.k3syspro.com

3D or not 3D

Experience tells us that hype underdelivers, so what should we make of additive manufacturing? **Mike Adams**, chief executive of HiETA Technologies, looks at its prospects

From its origins in the early 1980s, additive manufacturing (AM) or 3D printing has grown into the next overnight sensation. There are a variety of processes, but they all have the same principle. A product is "grown" layer by layer using a 3D digital model, hence the more common description, 3D printing. It allows greater degrees of design freedom than those available from more conventional manufacturing techniques. From the early days of working only in polymers, it has moved on with the built material now including ceramics, metals and composites.

As the column inches mount up in the technical and national press, there is a sense that AM can deliver utopian manufacturing; many people are watching with interest to see how that manufacturing utopia manifests itself.

There is much to back up that view, although it is important to be circumspect. Industrialisation is a work in progress. The trend is upwards, with the expectation of 10,000 parts per annum before 2020, but it is unlikely to be a commodity process in the short term. Repeatability, reproducibility and productivity will be essential milestones on the journey. What will drive industrialisation is AM's ability to deliver solutions that other manufacturing processes simply cannot. Experience suggests that lightweighting, part-count reduction or component integration, and enhanced heat transfer, are all areas in which additive manufacturing can create considerable added value. There are manufacturing challenges that only AM can offer realistic solutions for, making it an exciting and dynamic business to be working in.

However, AM is not simply a replacement for existing processes: more often than not it offers the designer the potential for adding value to a component or product design, over and above any benefits to be gained from the manufacturing process alone. So the job of AM practitioners often includes educating prospective customers to look at the underlying design problem first and foremost, and then challenging them to understand how additive manufacturing can help them to solve it. That is when AM can genuinely break moulds and offer real competitive advantage for its customers.

> Customers have to be confident that they are not taking a risk.

There has been significant investment in AM by Innovate UK (previously the Technology Strategy Board), who recognise it as a process that could offer UK manufacturing a genuine competitive edge on the international stage. Much of that investment has been directed towards encouraging innovation with the Manufacturing Technology Centre and the Catapult programme. It also supports entrepreneurial SMEs and therein lies the real strength of AM production. It is creating a real opportunity for a new generation of young engineers to think differently about how we make things – and that is not just your AM Engineer. As AM develops it brings innovation across all engineering disciplines, including design, testing, validation, materials, software and scanning.

Customers have to be confident that they are not taking a risk by implementing an AM solution. So robust validation and test processes are as key to AM as they are to all manufacturing processes. Ensuring these are in place is instrumental in proving that using AM as a process is not a risky business.

When we talk about AM offering blue-sky solutions, it really is time to think again. The reality is more mundane but, by definition, more accessible. AM is not about engineering freedom at the expense of risk management. It is about marrying design creativity with practical implementation. It brings together the most innovative new generation of design engineers and empowers them to design the products/components that customers really want – solving problems that may have seemed insurmountable – not the products/components that they already have.

HiETA Technologies Ltd
www.hieta.biz
enquiries@hieta.biz

Next-generation manufacturing: a joined-up view

The UK is well placed to be a global trendsetter, says **Professor Sir Mike Gregory**, a former head of the manufacturing and management division of the University of Cambridge engineering department, and of the Institute for Manufacturing

Manufacturing involves turning ideas and opportunities into products and services. What could be more important for an economy than engaging with the whole manufacturing cycle, from research and design through production and distribution to service and sustainability? There has been a growing realisation that this broader view of manufacturing leads to completely different conclusions about its importance and future. If it is just about "bending metal" to make conventional products, then others may do it faster or more cheaply. But if it is about ideas and innovation in complex ecosystems, then the opportunities are vast.

So how are we to take advantage of these opportunities? We need to understand not only the requirements of customers and the capabilities of competitors but also the rapidly changing world of manufacturing processes and systems: from 3D printing of complex parts to the rapid rise of composite materials for aeroplanes and cars, to the sophistication of global logistics and the digitisation of the whole chain from design to delivery.

The UK engineering group Renishaw can 3D-print parts for dentistry, providing a rapid personalised service, and complex 3D-printed parts are already flying in jet engines. Lightweight composite materials are to be found in aeroplanes, cars and wind turbines. Advances in logistics and digitisation mean that we can have products from around the world delivered to our door at the touch of a button.

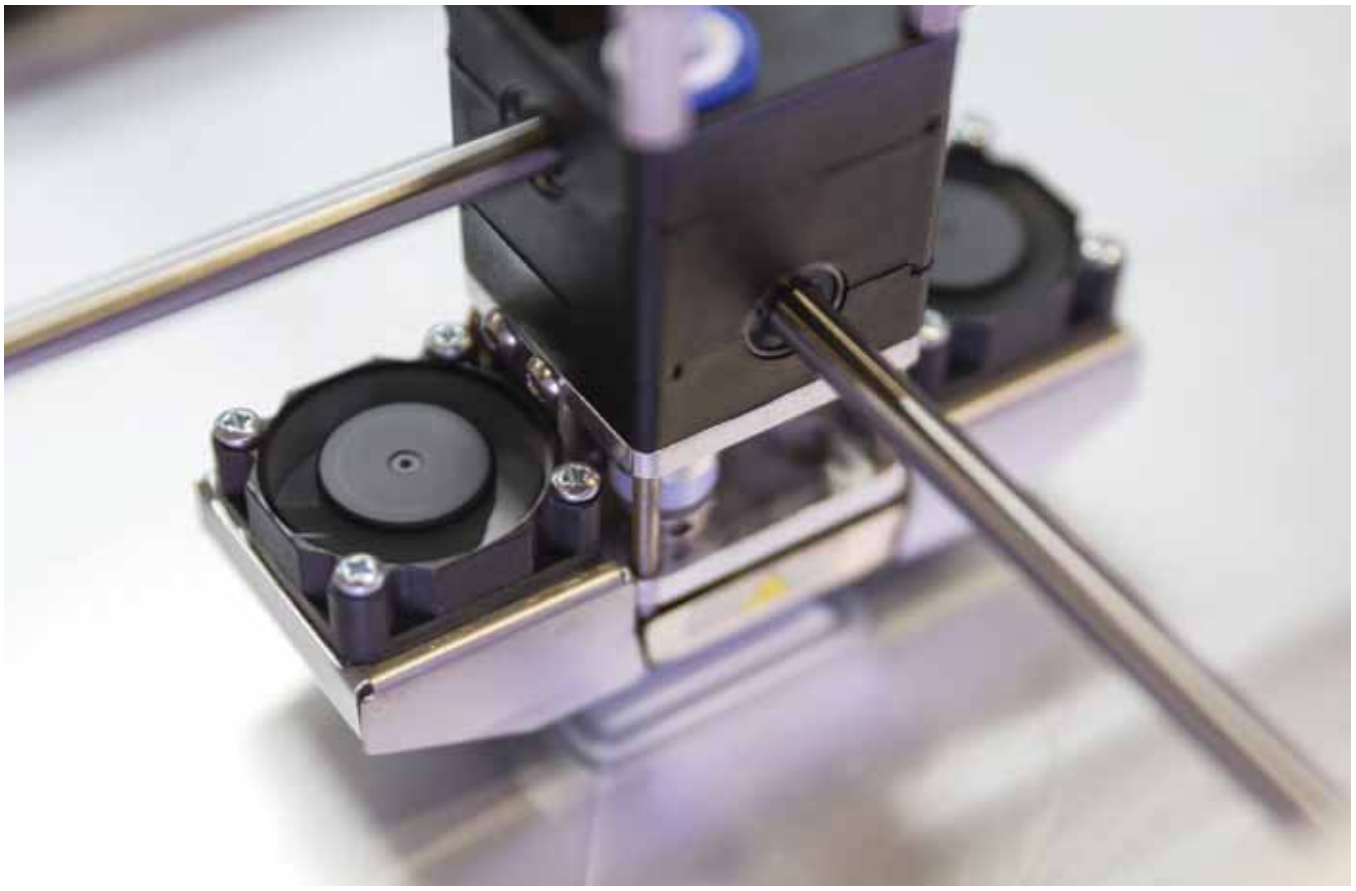
Over recent years manufacturers have learned to generate and capture more and more value from their core production activities. This has been achieved by offering products with more desirable functions, offering services linked to the products and then cutting the costs of production through well-managed supply chains and novel production processes: phones that play music, computers used for shopping, and a bewildering array of goods provided in local supermarkets at previously unimaginably low prices.

> Many see the UK as a pioneer in dealing with "dirty" industries

Over the past decade the UK has quietly been building the infrastructure and capabilities to prepare for this new world of manufacturing and the opportunities it presents. The Engineering and Physical Sciences Research Council's Centres for Innovative Manufacturing to generate new technologies, High Value Manufacturing Catapult centres to bridge between research ideas and industrial application, and a strategic approach to key manufacturing sectors have all helped to strengthen UK capabilities. These developments have also raised the profile of the UK internationally as a country with world-leading manufacturing capabilities.

The context and opportunities for manufacturing are better than they have been for decades. What more needs to be done to take advantage of these positive conditions? I would highlight three themes to which we should pay particular attention: production scale-up, sustainability and industrial systems.

Production scale-up is one of those underappreciated capabilities in manufacturing. New and successful products can command premium prices, but any manufacturer wanting to make the most of this opportunity has to increase production rapidly. Traditionally, scale-up has been the domain of tough project managers, and we certainly continue to need them. But we need to be smarter at R&D and design so that we develop products that are suitable for rapid scale-up to match demand growth. Then we need to be able to assemble the supply and distribution



3D printing is only one of the steps forward

networks rapidly. With "smart scale-up", manufacturers in the UK could capture significantly more value from their ideas.

The term sustainability can be applied to the environment, the economy, or individual businesses. While there is some disagreement, almost all informed scientific opinion is unambiguously of the view that human activity is having a measurable and damaging effect on the planet's temperature, with potentially severe consequences but also opportunities.

There are, of course, some obvious targets – the rate of domestic consumption, the environmental treatment of existing buildings, and the use of fossil-fuelled transport. Often neglected, however, is the role of industry. A reorientation of existing engineering capabilities can lead to the design of processes that are less resource and energy-hungry, factories that are more efficient and "waste" outputs of one process become the feedstock for the next.

Building on the current momentum, the UK is well placed to re-establish itself as a trendsetter in industrial sustainability. Indeed, many see the UK as a pioneer in dealing with "dirty" industries and providing a regulatory environment that is practical and effective. New sustainable production systems require new equipment and systems, which the UK has the ability to provide.

The term "industrial systems" might be a better way of representing what we mean by modern manufacturing. The emergence of new production processes, digital representation and communication, and internet-based transactions has highlighted the need to understand the implication of these rapidly changing and highly interdependent developments.

Some speak about the "industrial internet", others the Internet of Things, and still others Industry 4.0. All struggle to capture precisely the nature and implications of rapidly evolving manufacturing systems. These movements represent a great opportunity for the UK to move beyond traditional industries and build on our global reach, research excellence and innovative capabilities. The challenge now is to co-ordinate and focus the UK's excellent manufacturing innovation ecosystem to best effect.

Some modest orchestration is required if we are to capture the benefits. Of course the conductor doesn't write the music, choose the audience or tell the players how to do their jobs. The stick is very small, but the conductor can turn what would otherwise be a cacophony into harmony, simply by providing rhythm and focus. Like all analogies this one quickly breaks down. But it remains the case that at a national level, the country's capabilities and actors do not always have the means to self-organise to national advantage. The experience of recent years, however, suggests that they are willing to work in partnership with government for the national good.

SHUTTERSTOCK

ZERO CARBON FUTURES

Driving into the future

Dr Colin Herron, managing director of Zero Carbon Futures, considers the progress of the car industry

When I began my career in the automotive industry, the manufacturing plant was a very different place. When, in the 1990s, Nissan Sunderland secured the development of an engine plant, it was seen as a sign that the future of the factory was secured. Fast-forward twenty years and we celebrated again – this time with the opening of the battery plant – completely changing the face of manufacturing for the future at the plant.

Today, the question of "who will be the carmaker of the future?" is really up for grabs. With technology companies such as Google and Apple entering the market, Ford opening up a new outpost in Silicon Valley, and new entrants Tesla seeing people queuing through the night for a car that they had never seen, the automotive industry is – in the words of Tim Cook, Apple's chief executive – "at the precipice of massive change". What is clear is that current ICE technology will not meet future emission levels, and major change is needed now to meet the drive for carbon-free zones in cities.

Could it be the case that as cars become more digitally intelligent, then established, traditional car brands could actually disappear? What is for sure is that car companies who fail to adapt fast could disappear in the same way as the UK motorbike and shipbuilding industries did. So what do companies need to do if they are to keep up? In my view, I see that the changes fall into three categories: parts, people and players.

Today's drivetrains actually make vehicles easier to assemble, but the parts required are a lot more complex. The real difference is the interface with the software required within the vehicle. This opens up a wealth of new opportunities for technology companies to enter the industry. New equipment and parts suppliers have had to be found and integrated into an existing socio-technology environment.

> The question of "who will be the car-maker of the future" is up for grabs

This also requires a completely radical rethink of the skill sets required. Factories that have been on a new model treadmill, with minor technology changes from vehicle to vehicle, have suddenly had to produce electric vehicles and batteries. Not surprisingly they have found that their existing skills set did not work and they had to catch up very quickly with technologies and professions which were completely new.

For the first time, we're also seeing different players being required to help us to get from A to B. Never before have manufacturers had to consider refuelling infrastructure; however, right now many are investing in EV and FCV infrastructure, which not only come at an additional cost but also require dedicated resources to ensure compatibility from vehicle to charging infrastructure. For the first time the electricity and transport sectors need to work together – major car plants and their close suppliers are now more than power consumers, they are part of the whole modern power-supply map. Nissan and Tesla, for example, are already marketing the integration of the vehicle with the home – allowing home charging and reverse power flow (V2H) – so we're seeing cars capable of acting as an energy source, completely transforming the power picture.

Companies, countries and regions which forecast correctly will make profits, as mobility as a concept will remain as a human prerequisite. The challenge is to bring the very different worlds of IT, energy and propulsion together to create the plant of the future.

For more information visit: www.zerocarbonfutures.co.uk

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Building the skills

Professor Lord Bhattacharyya, chairman and founder of the Warwick Manufacturing Group, says a cultural shift is required to help employees realise their potential

If you measure business success by newspaper headlines, you'd get the sense that British manufacturing is uncompetitive and underperforming. The reality is very different. Our manufacturing industry employs two and a half million people. It's a forward-thinking sector too – paying for almost 75 per cent of business innovation.

Manufacturing is the most export-intensive part of our economy, so success demands high productivity and outstanding products. You need a skilled, motivated workforce to do well, which is why manufacturing jobs pay the average employee £4,000 a year more than the service sector.

What's more, attracting talented people to manufacturing is not just crucial to the success of one part of Britain, it's vital to the growth of the whole country.

For example, Dan Dicker left his job as a highly skilled product designer at Dyson to start Cornwall-based ashortwalk.com in 2003. Today, the firm employs seven people, and uses waste plastic plant pots as the source material for elegant home and garden products.

To help firms like Dicker's, we must address the critical shortage in UK skills. As the engineers and technicians trained in the 1960s and 1970s retire, we need to attract talented young people to manufacturing and give them the skills to succeed.

We must make manufacturing careers attractive to people of all genders and backgrounds. That requires a transformation of science, technology and maths education, and big cultural changes in manufacturing itself.

An industry-education partnership is crucial, whether at school, through university technical colleges, in vocational skills – where the apprenticeship levy will help firms develop their new employees – or inspiring future leaders at university.

Employers have to see that every potential employee deserves the chance to develop skills. Too often, firms have wasted talent by defining people by their status, not their potential.

> Attracting talented people to manufacturing is vital to growth

This is changing. Nearly half of respondents to a recent CIPD survey are developing their staff. Sponsoring professional qualifications or "up-skilling" employees through NVQs and part-time degrees is increasingly common.

Giving employees a chance to earn high-value qualifications means employers can guarantee new recruits will get the transferable skills needed across their whole industry. For an apprentice that means they can earn while learning, avoid student debt and get a head start in their career.

I've seen this first hand in the Jaguar Land Rover Academy for Lifelong Learning. The academy integrates every level of training, from first-year apprentice to doctoral dissertation, into one structure, open to all staff. For example, higher apprentices can earn an engineering degree from the University of Warwick through Warwick Manufacturing Group's Applied Engineering Programme.

The JLR academy also gives those apprentices the chance to do a doctorate during their career. They'll know such qualifications are really valued, not least because their chief executive, Ralf Speth, earned his doctorate that way.

A major skills programme works well for larger employers, but what about the backbone of the economy, the small and medium-sized firm?

At WMG, we work with many SMEs who want to develop their staff, but can only offer high-value qualifications when they know that the abilities their staff will develop in future are worth the cost of losing them for part of the week now.

Politicians of all parties talk about the importance of apprenticeships, but ultimately if manufacturers are to back their people, they need government to help with the cost, and for the skills learned to be truly worthwhile.

Business and government must work together to give every employee a chance to develop new skills and build better careers through quality education. That way, manufacturers in Britain can improve productivity, advance innovation and, ultimately, increase their profits.

For more information on WMG's education programmes visit: www.wmg.warwick.ac.uk

Driverless cars shift up a gear

The technology behind the latest models is not new but, says academy director **Professor Nick Reed** of the Transport Research Laboratory, it's accelerating

The automotive industry is well used to adapting to automation in manufacturing. Many of us will remember the Fiat adverts from the late 1970s with the tagline "Handbuilt by robots". The implementation of robotic car manufacture led to significant cost savings and improvements in the reliability and flexibility of vehicle mass production.

A new challenge to vehicle production is on the horizon and, again, it comes from automation. However, this time it is not to do with the manufacturing process, but with the vehicles themselves.

Research projects on vehicle automation are not new. The Transport Research Laboratory has had vehicles with limited self-driving capabilities for more than fifty years, resulting in significant contributions towards driver assistance systems. But since Google announced in 2010 that it had been trialling self-driving cars on the streets of California, progress in this field has rapidly gathered pace.

Improved safety

There are many reasons why technology is advancing so fast. One frequently cited motive is safety; indeed, TRL research has demonstrated that more than 90 per cent of road collisions involved human error as a contributory factor, and it is the primary cause in the vast majority. Automation may help to reduce the incidence of human error.

Another aim is to free the time people spend driving for other purposes. If the vehicle can do some or all of the driving, it may be possible to be productive, to socialise or simply to relax while automation systems have responsibility for safe control of the vehicle. If the vehicle can do the driving, those who are challenged by existing travel models – such as older or disabled travellers – may be able to enjoy significantly greater independent mobility.

Fewer cars on the road

Beyond these direct benefits, we can consider the wider implications for transport and society, and how manufacturing processes might need to respond as a result. At present, the average car spends more than 90 per cent of its life parked. Automation means that car-sharing schemes become much more viable, particularly in urban areas with significant travel demand. If a significant proportion of the population choose to use shared automated vehicles, mobility demand can be met by many fewer vehicles.

The Massachusetts Institute of Technology investigated automated mobility in Singapore, finding that fewer than 30 per cent of the vehicles currently used would be required if fully automated car sharing could be implemented. If this is the case, it might mean that we need to manufacture many fewer vehicles to meet demand. However, the number of trips being taken would probably increase, partly because automated vehicles would allow a greater number of older and disabled travellers to become mobile, but also because empty vehicles would have to be moved from one customer to the next.

Modelling work by the University of Michigan Transportation Research Institute suggests automated vehicles might reduce vehicle ownership by 43 per cent, but that average vehicle mileage would double as a result. As a result, each vehicle would be used more intensively and might need replacing sooner. This faster rate of turnover may mean that vehicle production will not necessarily decrease.

Decline in car ownership

Car sharing may prompt other changes in vehicle manufacture. Car buyers will purchase one car rather than another for a range of reasons but many will choose a vehicle that is an adequate compromise to meet their needs, not just for mobility but also for efficiency, performance, as a status symbol, etc. If we move to a model where consumers are tending not to own a single vehicle but to purchase access to a range of vehicles through a mobility provider, drivers will have the freedom to select one that best suits their needs for a particular journey, rather than a compromise across all their requirements.

Since, for most of the time, most of the seats in most cars are unoccupied, this may boost production of a smaller, more efficient range of vehicles that suit the needs of individuals. Specialised vehicles may then be available for exceptional journeys, such as going on a family camping trip or helping a son or daughter move to university.

The growth of the US carmaker Tesla, rising sales of cars with hybrid powertrains and the ongoing arguments

Driverless vehicles have been developed on the Greenwich peninsula by a consortium led by the Transport Research Laboratory

around vehicle emissions are all signposts towards significant changes in the way in which vehicles are powered. This is compounded by an increased focus on air quality in urban areas, exemplified by London's challenges in meeting targets for reducing levels of nitrogen dioxide.

It is also the case that vehicle automation is simplified by the use of electric drivetrains, which have simpler power transmission systems and are more amenable to computer control. However, vehicle manufacture will need to adapt to the highly complex electronic systems used for perception, localisation and guidance. These systems must be installed to work at a sufficient reliability level to ensure they can deliver safe control of the vehicle.

A further potential development in the automotive industry is the possibility of using additive manufacture (3D printing) for creating not just components but complete bodies of cars, including structural elements to withstand a crash. The US-based company Local Motors has already demonstrated the use of 3D printing to create cars, with its Strati concept. The company has built on this technique to develop the LM3D model, for which it is aiming to gain European "type approval" for large-volume car production, and is also exploring its use to create vehicles for urban transport systems, with its concept Berlino smart minibus.

In a future where automated vehicles are common, manufacturers could have the flexibility to make changes within software to designs and components, and then upload those changes directly to the 3D printing production line.

Trust and acceptance

There are a number of hurdles to overcome in delivering automated vehicles to our roads. These include the technical difficulties in ensuring that the vehicle works reliably in the infinite range of traffic, weather and road situations it might encounter; the regulatory challenges in understanding how liability and enforcement might change when drivers are no longer essential for vehicle operation; and the societal changes that may be required for communities to trust and accept automated vehicles as being a valuable part of the mobility landscape.

It's clear that there are many challenges that need to be addressed but, through robust and targeted research – like that being undertaking in our UK Smart Mobility Living Lab at Greenwich in south London – I believe we can conquer these within the next ten years. Mobility will change in such potentially significant ways and in association with so many other technological developments, such as telepresence and virtual reality, that it is hard to make concrete predictions about the future. However, one thing is certain: change is coming, and the need to be flexible in response to this will be vital for those involved in manufacturing the vehicles that will deliver future mobility. ●

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Datawright

3D printing and the Internet of Things

3D printing has finally come of age, according to **Andy Gough**, general manager at Datawright

In December 2015, the crew of the International Space Station needed a ratcheting socket spanner. The problem? There wasn't one on board. But the ISS did have a 3D printer. Using CAD instructions emailed to the space station by Nasa, space station commander Barry Wilmore switched on the 3D printer and duly fabricated the required spanner.

The future of manufacturing is here

Industry 4.0 is set to revolutionise manufacturing. Central to this are machines capable of producing components faster and more precise than ever before; 3D printing is now rapidly finding its way out of the R&D laboratory, and into mainstream manufacturing.

For proof, look at the Paris Air Show, where Airbus proudly showed the A350 XWB passenger jet, which contains more 3D printed components than any other aircraft currently flying – about 1,000. Aerospace, it turns out, is an ideal application for 3D-printed parts, offering a way to cut lengthy supply chains dramatically, while simultaneously producing parts that are both cheaper and lighter.

Once an industry as demanding as aerospace makes the jump to a new technology, others will follow. What is less clear is how prepared businesses are for the coming revolution. Consider the mass-production model, unchanged since the industrial revolution. At its simplest, it reduces the manufacture of every assembled product – however complex – to a series of steps: build a batch of component A, to start with; then build a batch of component B; then build a batch of component C, and so on. And then, when all the batches of components have been completed, begin the assembly into a finished product.

New ways of thinking

It had to be like that, because it's inefficient and unproductive to make components one at a time – until now, with 3D printing.

Few industries will escape this revolution, even ours at Datawright. Enterprise applications such as MRP and ERP have their roots in managing and co-ordinating the manufacture of those batches of components, choreographing their production, and bringing them all together at the right time for assembly.

The next manufacturing revolution

As if all this weren't enough, combining 3D printing with the Internet of Things presents new possibilities.

At first, no obvious connection seems plausible – the Internet of Things is the connected world made possible by connecting internet-enabled sensors to devices and objects. But there's a very real connection between the two: the possibility of manufacturing objects that can declare what they are, and if necessary, broadcast that information.

Now, with a component cut from a once-molten piece of metal, there is no opportunity to embed an RFID chip – the temperatures and pressures involved are far too high. But with 3D printing, where objects are built up under room temperature conditions, adding an RFID chip is easily accomplished. And once embedded, that chip, unlike a detachable "tag", is firmly and irrevocably part of the component. From a quality and product conformance point of view, it's difficult to imagine a more secure way to maintain the "as built" integrity of a product.

Experts have also revealed a development with even greater potential, embedding unique three-dimensional codes inside the material of a 3D-printed object, capable of being read by a terahertz scanner. Science fiction? Technologists at Carnegie Mellon University and Microsoft Research have already demonstrated such an approach in action.

The future is here

The import of all this? A revolution is under way, transforming the art of the possible, and manufacturers need to keep up. In short, an emailed spanner is just the start.

To read more insights from Andy Gough, visit: blog.datawright.com

EPSRC
Engineering and Physical Sciences Research Council

Driving productivity through research

Philip Nelson, EPSRC's chief executive, explains the part research and training plays in the manufacturing story

Manufacturing research is where the UK's competitiveness really begins, and investment in both skills and research is driving innovative partnerships that business can harness for the good of the economy and society.

The Engineering and Physical Sciences Research Council (EPSRC) is the driving force behind engineering and physical sciences research and training in the UK, investing £800m and raising more than £230m each year through partnerships. Its vision is for the UK to be the best place in the world to research, discover and innovate, with 6,000 research projects under way at any one time, and more than 9,000 doctoral students training in 40 higher education institutions. EPSRC's investments are essential to industrial success, today and in the future.

Investing in underpinning research in emerging areas is essential for delivering real impact for the country. Robotics and autonomous systems (RAS) is a field that has the potential to grow productivity, enable leaner and safer practices, enhance quality of life and empower a more resilient society. In 2015 EPSRC announced the formation of the RAS Network. It provides leadership, a co-ordinating function for academic activities in the UK, and seeks to expand collaboration with RAS-dedicated facilities and centres for doctoral training across the country. The network is already inspiring young people through UK Robotics Week (25 June to 1 July), which involves schools, parents, academia and industry.

RAS technologies promise to transform the whole of society, part of the "embodied internet" that will be at the heart of our future smart cities, smart homes and smart industries. A report by consultants at McKinsey estimates a potential economic impact of $1.9trn to $6.4trn per year by 2025 through the application of advanced robotics.

Manufacturing research is another area where EPSRC can demonstrate the value of its investments, with 13 Centres for Innovative Manufacturing already part of its portfolio. In 2015 EPSRC added to these centres with two £10m Future Manufacturing Hubs, where leading academics work alongside industry experts on solving today's manufacturing challenges. The hubs have attracted more than £72m of additional funding and will develop the next generation of hi-tech products, as well as tackling industry challenges such as rising materials costs.

The future liquid metal engineering hub

Metallic materials are the backbone of manufacturing and the fuel for economic growth. The UK metal-casting industry adds £2.6bn a year to the UK economy, employs 30,000 people, produces 1.14 million tons of metal castings per year and underpins the competitive position of every sector of UK manufacturing. The hub based at Brunel University and supported by academics at Oxford, Leeds, Manchester and Imperial College London, will address the industry's challenges of increasing energy and materials costs, tightening environmental regulations and skills shortages.

The UK excels in photonics research, which is applied in aerospace, defence, telecoms, satellites, welding and cutting technology, to name a few. Worth £10bn to the UK economy, the industry supports 1,500 SMEs employing more than 70,000 people and growing at 8 to 10 per cent annually.

More than 75 per cent of UK-manufactured photonics products are exported. These kinds of numbers make the high-value photonic manufacturing research hub, hosted by the University of Southampton and supported by complementary academic expertise at Sheffield, a compelling proposition.

EPSRC is committed to discovery-led research and collaborations between the UK's greatest minds, companies and entrepreneurs that deliver against global challenges. By developing areas of expertise, we can ensure we lead the way in research and commercialisation that pays long-term dividends.

For more information go to www.epsrc.ac.uk

Sharing is key to survival in the Information Age

Companies are being battered by a perfect storm of disruptive new technologies in a globalised world. Going it alone is no longer an option, say **Mathieu Dougados**, senior vice-president at Capgemini Consulting, and **Laila Beswick** of GT Nexus

Like many new terms, "digital transformation" has a broad definition; however, across these various interpretations there is a broad consensus that it "refers to the changes associated with the application of digital technology in all aspects of human society". That's a very broad statement, and understandably so. In practice, digital transformation is often used these days to describe significant strategic initiatives that are taken on to enable a business to survive and thrive in the information age.

Businesses currently face a convergence of powerful technology trends. Headlines are awash with references to cloud computing, big data analytics, 3D printing and the likes of robotics, autonomous vehicles and drones. In just a few years the presence and impact of these technologies has grown and their performance has more than doubled.

Each of these technologies by themselves can disrupt an industry, but if you put them together in their now mature state, they represent the perfect storm for existing business models. It is this digital disruption that lies behind the growing trend in digital transformation. Organisations are having to change their existing business models for new infrastructure, platforms, processes, tools and talent to make sure that they continue to compete in the digital world.

In today's globalised and outsourced industries it's not enough to think of digitally transforming just one business entity. Digital transformation isn't something that only happens within the four walls of a single business. The success of a global organisation depends largely on how effectively it can orchestrate a vast network of trading partners and suppliers to manufacture and deliver its goods and services.

If digital transformation is applied only to one single organisation within that network, it will fall short. The conclusion that an organisation's success is no longer dependent solely on its own efforts terrifies many chief executives. Carrying out an internal review of a business's own processes and then applying digital technologies is no longer sufficient. Nor is it enough to focus efforts solely on transforming how a business engages with its customers.

A lot of the discussion, debate and research on the topic of digital transformation has been more or less confined to these two categories. But there is another aspect of the process that is playing an increasingly important role in the global economy, and that, so far, has had little attention. A whole other chain of people and businesses need to be considered – the value chain.

This gives us three separate areas to consider if we are to develop a complete strategy:

1 Digital transformation inside a single organisation: for example, how digital technologies transform internal enterprise resource planning systems.

2 Digital transformation between organisations and their customers: for example, how digital technologies transform customer relationship management.

3 Digital transformation between organisations and all of their partners across the value chain.

Identify the weakest link

Success for a global organisation depends on how effectively it can orchestrate its supply chain network. A successful digital transformation addresses

Collaboration is the new black

its partner value chain, including all the processes and information flows between those different partners. Digital transformation of an extended value chain is only as robust as the transformation of its weakest link.

Organisations need to take a holistic view of the ecosystem of partners, from raw material providers, manufacturing partners and suppliers, logistics and transportation providers, to retail and distribution channels. What happens between the individual parts of the network is just as, if not more important than, what happens inside each one. What happens between the parties is data access, data sharing, collaboration and network-wide analytics.

Eighty per cent of the data that a company needs to orchestrate its supply chain successfully comes from across its partner networks – outside the four walls of its business. Like any successful partnership, a key ingredient for success and continuity is trust in the information that is shared and exchanged. Relationships with external partners need complete, accurate and timely data. Without data, companies can't have true insight and visibility, which can lead to missed opportunities. Organisations will be successful if they are able to collaborate in this way, with their network of partners working from the same supply chain information, which must be accessible and true.

A recent global study by Capgemini Consulting and GT Nexus explores the current and future state of digital supply chain transformation and reveals some interesting findings and expectations with respect to data accessibility. The study surveyed 337 executives from some of the largest global manufacturing and retail organisations in more than twenty countries around the world – largely from Europe and North America.

The key findings include:

- Today only 15 per cent of respondents say the majority of data from the extended supply chain is accessible to their organisation. In five years, expectations rise to 54 per cent.
- Today only 23 per cent of respondents say the majority of data from the extended supply chain is analysed and used for decision-making. In five years, expectations rise to 68 per cent.
- Five years from now, 95 per cent of respondents expect more processes with suppliers to be automated.
- Five years from now, 94 per cent expect to receive more real-time status updates from across the supply chain.

The study reveals a large gap between where organisations see themselves today on their joint digital supply chain transformation journey with their extended value chain partners and where they want to be in five years. In fact, 75 per cent of respondents say digital transformation of the supply chain is important, but a big gap exists between where companies are today and where they expect to be in just five years from now. Transformation initiatives within the enterprise pose significant challenges in themselves.

An organisation's value chain can include hundreds of partners. For this reason, connectivity between partners, cross-company access to data, and the use of network-wide analytics become the key focus areas.

Technology is going to play a big part in how successful organisations can digitally transform. Respondents from the research project identified supply chain visibility platforms/tools, big data analytics, simulation tools and cloud as the biggest technology enablers of digital supply chain transformation. What is common to all these technologies is the use of information to provide insight into business decisions. Supply chain visibility provides real-time awareness of business processes. Big data analytics turns raw information into actionable insights, and the cloud is a technology paradigm that tears down barriers by creating universal accessibility to data.

Successful digital transformation for organisations that have started their journey can perhaps be envisioned in five years or more. That is a future where data flows freely between all parts of the supply chain and where data will be used to make stronger business decisions. The information exchange and connection between manufacturers, retailers and their suppliers will be far more collaborative and strategic than ever before. For those that are yet to start their journey, it's going to be a real sprint.

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Dextra GROUP PLC
dextragroup.co.uk

Manufacturing privateers – a future?

Fifty years ago the rallying cry was "buy British" – and it still should be, says **Rupert Martin**, group chairman of Dextra Group

My qualifications for writing this article do not come from a conventional route, but are based on running my own business in the manufacturing of lighting fixtures (luminaires) since the late 1970s. The industry has been astonished by the change from conventional fluorescent products to those utilising LEDs (light-emitting diodes) mounted on circuit boards called "light engines". This is the most fundamental change in light sources since the late Twenties, starting gradually a little over five years ago with the introduction of LEDs. Products using LEDs now comprise more than 95 per cent of my company's production.

The opportunities for flexible, fast-moving and aggressive businesses have been enormous, but this is not the whole story. Regrettably, it has allowed a flood of unregulated commodity products to arrive from the Far East, at prices that would not cover the cost of raw materials for UK manufactured products.

Constant improvement in efficiency requires regular redesign to take advantage of massive (up to 80 per cent) power saving. To keep ahead of the competition, good service, credible warranties, innovative design with technical back-up and recycling (WEEE directive requirement) complete the ideal package to beat competition from around the globe.

How can a UK manufacturer achieve these goals, in a country that has lost its engineering expertise, and still produce an acceptable profit?

My experience tells me that it's not one factor that is the answer; the same rules were applicable before the LED revolution. Constant re-equipping of the correct and latest manufacturing equipment is paramount to produce high volumes efficiently. It is equally important to motivate and keep the best operatives who are proud to work with state-of-the-art machines located in a stimulating environment.

These criteria can be ingrained into the DNA of a company, but it takes many years and much tenacity and indeed heartbreak along the way. Once it is achieved, however, and everyone is "singing from the same song sheet", the effect can be incredibly stimulating.

I often speak to acquaintances in the lighting industry – generally employed by multinationals who are competitors – and they are amazed at the speed we introduce new products; but for us this is normal, although accelerated with the introduction of LEDs with the possibility of differing wattages, colours and controllability.

Dextra Group, based in Gillingham, Dorset, considers itself at the cutting edge of luminaire development. Our latest in a long line of investments are dedicated LED PCB production facilities and production of our own packaging equipment.

This allows the design of ground-breaking luminaires, bringing a new level of flexibility to production and design, supported by our "just in time" manufacturing ethic. Our belief in high service levels, with more than 37 years' experience, is an ethic that continues to go forward throughout the group's companies and is an ethos that employees embrace.

With seven subsidiary companies, we cover all facets of the lighting industry. Our industry-leading service levels enable us to offer bespoke and standard energy-efficient lighting products in record-breaking times. With our wholly owned distribution facility and liveried transport fleet we operate a working-week delivery policy and can deliver to a very wide and diverse range of outlets across the UK, Ireland and Europe, including site deliveries. Uniquely, end-of-life products are processed under WEEE regulations.

Our goal is not to be the largest lighting manufacturer in the UK (Dextra Group is currently number two) but to enhance our position as the most client-friendly, profitable and respected privately owned lighting manufacturer in the UK.

For more information go to: www.dextragroup.co.uk/

Institution of MECHANICAL ENGINEERS

Securing the UK's manufacturing future

The economy is recovering – but how are manufacturers coping? **Stephen Tetlow** MBE, chief executive of the Institution of Mechanical Engineers, considers the outlook

In the past few years since the banking crisis, manufacturing has returned to the spotlight. Today, ministers and MPs from across the political spectrum can regularly be seen visiting factories, innovation centres and local companies, busy promoting the advanced technologies being developed by UK engineers and scientists.

Politicians and the public at large are grasping the importance of our manufacturing industries, bolstered by success stories such as those of Nissan, Hitachi and Brompton Bicycle.

Modern manufacturing is finally getting the attention and acclaim it deserves; with industries such as car manufacturing at a ten-year high and exporting more than ever before, there are lots of reasons to be optimistic.

However, the uncertainty over Tata's UK steel operations, and growing evidence of the shortage of skilled technicians and engineers, means there are also reasons for concern.

Tata Steel's future is not just important for local communities, such as that of Port Talbot – it is vital for the entire country. In the latest Budget the government committed to the development of UK transport infrastructure, supporting the National Infrastructure Commission's recommendations for Crossrail 2 and extensions of HS2 up to our northern powerhouse cities.

At the heart of all these projects is the requirement for steel, which is also integral to the UK's thriving car manufacturing sector. And it goes further than that, as specialist steels are at the heart of a modern manufacturing economy as a whole. We cannot allow short-term market forces to jeopardise the UK's ability to balance its economy.

> We need the building blocks of a diverse and skilled workforce

Allowing UK steel to fail would mean losing irreplaceable key technical and engineering skills, which we cannot afford to do. Despite the localised but significant setback, the UK still has an engineering skills shortfall at a time when technology looks set to increase its dominance over much of our lives. It is not just that we need to retain our existing skills, but we urgently need to encourage and inspire more people to take up engineering.

Key to this is increasing the number and breadth of young people choosing engineering careers. The Institution of Mechanical Engineers' latest report, "Big Ideas: The Future of Engineering in Schools", proposes a radical rethink of engineering education, including maintaining a broad curriculum for all until the age of 18, and broadening routes into engineering by promoting flexible entry requirements for engineering degree courses.

The future of UK advanced manufacturing could and should be bright. UK engineering is among the brightest, most innovative and exciting in the world. We need the building blocks of a diverse and skilled workforce, abundant raw materials and an effective supply chain to enable UK engineering and manufacturing to realise its potential.

There is no silver-bullet solution, but if the government is committed to long-term strategic industrial and infrastructure plans, it must look at the wider picture. Government needs to consider carefully the implications of Tata Steel's closure on our domestic supply chains and ensure the country has the necessary skills and raw materials to support overall growth.

For more information go to: www.imeche.org

Train the workers for the new revolution

Tim Thomas, director of employment and skills policy at EEF, the manufacturers' organisation, says government action is urgently needed to meet the skills challenge of Industry 4.0

Britain is on the cusp of a global, technology-driven fourth industrial revolution, with eight in ten manufacturers saying it will become a business reality by 2025. In the global battle for dominance, the expectation is that innovative firms will be able to take the lead and help position Britain as the manufacturing and technology hub of Europe.

This will bring clear benefits to the sector and the wider UK economy. The rapid advance in technology will play to Britain's strength as a high-value manufacturer, with suppliers able to produce more bespoke products and deliver more rapid and cheaper prototyping. It will increase the importance and value of manufacturing within the UK, enable more production to be "re-shored" or brought back from overseas, and lead to increased demand for highly skilled workers.

It opens up a wealth of opportunity for the UK – but here's the rub: Britain's ability to take advantage and be a frontrunner in Industry 4.0 is not a foregone conclusion. Quite the opposite, in fact – six out of ten manufacturers tell us that there's a very real danger of the UK being left behind.

Manufacturers can see a number of hurdles to overcome if we are to remain in the race.

Not least of these is managing the impact that Industry 4.0 will have on the supply and demand for skills. While increased demand for highly

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Britain is on the cusp of a new industrial revolution led by innovation in manufacturing

skilled workers will be great news in terms of job opportunities, pay and the potential boost to the UK economy, for manufacturers it is a double-edged sword. This is because our sector is already struggling to attract enough skilled workers, and the situation as our demands – and those of rival sectors and competitor economies – skyrocket is only going to get worse unless urgent action is taken now.

The UK's ability to be a power player in the digital industrial revolution hinges on the government working with industry to get to grips with the skills crunch affecting our sector. Over the next three years alone, industry bosses expect a significant increase in the demand for skills. At the same time, almost three-quarters of them are worried about how this demand is going to be met, with the supply of skilled workers in some areas already drying up.

This concern is built on experience. Almost three-quarters of manufacturers have found it difficult to recruit skilled workers in the past three years. They are challenged by both the quantity and quality of candidates, with firms regularly forced to contend with a lack of technical skills, an insufficient number of applicants and a lack of relevant experience – a perfect storm.

At the same time, government statistics show that the number of "hard-to-fill" vacancies in manufacturing remains stubbornly high at 35 per cent – unchanged from 2013 and worse than in 2011, when it was at 30 per cent.

This situation is set to deteriorate even further, as manufacturers expect a significant increase in their own demand for skilled workers over the next three years. Almost six in ten expect to need more people management, leadership and production-related technical skills (59 per cent in each case) over the next three years alone.

They predict similar increases in demand for craft and technician (53 per cent), sales and marketing (52 per cent) and IT and software skills (47 per cent) over the same timeframe. These spikes in demand reflect how manufacturers will want to make strategic hires to drive forward their productivity and growth plans. Unfortunately, however, this will place even greater pressure on an already diminished skills pool, leaving almost three-quarters of manufacturers concerned about accessing the skills their businesses will need.

Firms are already attempting to overcome their skills challenges by offering a range of incentives to attract and retain highly skilled employees. These include competitive salaries, training, opportunities to work in other areas of the business and flexible working. Apprenticeships are also going to play a critically important role in helping firms to close the skills divide over the longer term.

> We are just about treading water and the struggle is only going to get harder

If manufacturers had not been taking these steps we would arguably already be over the cliff edge, not just approaching it. But it's also increasingly clear that, despite the best efforts of the UK's manufacturers, our sector cannot resolve this issue on its own.

Far from getting to grips with the issue, the government has largely left manufacturers to try to soften the impact of the skills crunch on their own. At the same time recent policy changes, such as the National Living Wage, the apprenticeship levy and the proposed immigration skills charge, have added to our sector's burden and done little to support employers.

Worryingly, despite multiple warnings about the UK's yawning skills gap, the dial hasn't moved since 2012. Manufacturers continue to struggle to find the right people with the right skills, and undoubtedly this has led to lost opportunities for employers, would-be employees and the UK economy.

We are today just about treading water and the struggle is only going to get harder without a step-change. The demand for skills is going to soar in response to manufacturers' ambitions around Industry 4.0. Getting the right quantity and quality in place will be critical, which is why manufacturers are urging the government to take firm action now.

The government must match the ambitions of industry and ensure that the UK's education and training system delivers the skills that employers require. Policies must help, not hinder firms. They should provide support, rather than hitting employers with additional costs that could potentially hold them back. At the same time, the government must start thinking like business and take a long-term view.

This means ensuring that the UK isn't just geared up to deliver the skills that employers require today, but has a strategy in place to be able to keep pace with Industry 4.0 and the accompanying skills requirements in five, ten and 15 years' time.

The UK's skills crunch needs a consistent and concerted approach. Manufacturers already have workable ideas on how it can be tackled. In the short-term, the main priority is to scrap the proposed immigration skills charge and introduce grants to tackle under-representation in apprenticeships. Mid-term, the Institute for Apprenticeships should identify gaps in provision and capital funding for further education, and the roll-out of National Colleges should follow employer demand. Longer term, we want to see targets for secondary schools for the number of Key Stage 4 pupils going on to apprenticeships.

These are practical solutions that the government could and should commit to today. The clock is ticking. The reality is that Britain needs to start putting a long-term industrial strategy in place now, if it is to capitalise fully on the opportunities to be had from the digital industrial revolution.

Our sector's ability to remain on top of the fourth industrial wave hinges on the decisions made now and over the next decade. The government must work hand-in-hand with our sector to alleviate the pressure that Industry 4.0 will place on skills. If it fails to act, today's skills crunch will rapidly tip over into a crisis – and with that the UK runs the stark risk of being left behind.

ADDED SCIENTIFIC

Taking a layered approach

Additive manufacturing is a new process and has fresh challenges. **Chris Tuck**, director and co-founder of Added Scientific, explains

Additive manufacturing (AM) and 3D printing are synonymous terms which refer to a number of distinct technological processes broadly defined by their capacity to construct components in a layer-by-layer fashion, using digital design data. While some of the technologies have been used for more than 20 years in rapid prototyping and new product development, AM now represents a practical process to manufacture end-use production parts with unrivalled geometric freedom, minimal waste and, crucially, without the requirement of dedicated tooling.

As the business case for it grows, so does the list of industry sectors seeking to develop their own AM strategy to understand how it can benefit them. Today, the sectors that are actively pursuing it range from food to aerospace and medical devices. The time for directors and chief executives to take notice and act on AM has arrived.

As a production process, it has the potential to deliver bespoke and economic manufacturing solutions for low to medium production – even down to single unit volumes. The ability to produce complex, customisable and personalised niche products using digital data means AM can provide a compelling competitive advantage over traditional manufacturing processes. There are, however, numerous barriers to the adoption of AM; at first glance it will always seem to struggle to compete with traditional mass manufacturing methods on cost, especially when changes to supply chain management are not factored in. AM has been championed as a disruptive technology, but the reality is that AM can, and is already, a complementary capability alongside existing manufacturing methods.

There are, of course, still a number of technical challenges to overcome. First and foremost is training. The education and understanding of the new possibilities which can be realised with AM are manifestly important for businesses to get the most benefit from the technology and its inherent advantages; the real message can often be lost in a sea of media-driven myths and hyperbole.

On a more technological note, novel materials with desirable properties amenable to the wide range of different 3D printing technologies are also required to support the advancement of AM across disparate industries. While additive processes are capable of exploiting a number of different material types (metals, polymers, ceramics), the relative available palette for any one technology is often limited, confining the utility of AM for some applications and potentially offering an opportunity for significant innovation. Another challenge for the implementation of AM is that it requires a high level of design knowledge and expertise, in addition to innovative software tools, to unleash its true benefits to the potential user. Current design systems (including common computer-aided design software) are often not suited to the capabilities of AM and do not exploit all of the freedoms available.

Moreover, many of the AM processes are far from perfect; the optimisation and development of build rates, packing efficiency within the build envelope, current equipment capability and build robustness are vital to the commercial success of this burgeoning technology.

What does AM mean for business? It means the redesign of existing parts produced by difficult fabrication processes for simplified manufacturing and product assembly. It means the realisation of new product designs with complex morphologies for better components with higher performance, which are produced faster and with less waste. It means new business models, supply chain logistics and greater agility to react to market changes and consumer demand. It means the harnessing of digital manufacturing to address new markets and provide tailored solutions in virtually every sector imaginable. Are you ready?

For further information go to: www.addedscientific.com

EDT automotive

A mission for emissions

David Holmes, managing director of EDT Automotive, looks at the future of clean engines

The UK automotive industry is rightly lauded as a huge manufacturing success story. We currently build around 1.5 million cars a year, of which three-quarters are exported.

A massive £2.5bn a year is invested in research and development, with an ever greater focus on low carbon.

Hybrid and electric vehicle sales are increasing year-on-year and these technologies have stolen a march on hydrogen.

Where the energy comes from when you plug them in is a moot point (hint: often coal, gas or nuclear power stations).

The Dutch parliament has discussed banning sales of new petrol and diesel cars, but efficiency improvements over the past decade mean these conventional fuels are set to rule our roads for many years to come.

Consumers are clearly interested in keeping emissions to a minimum, as illustrated by the outrage over the VW emissions scandal last autumn.

Official vehicle manufacturer emissions figures are now about as trusted as their miles-per-gallon figures.

For motorists wanting real world benefits, an engine decontamination treatment offers a practical engineering solution. Our hand-built engine cleaning machines will lower emissions and improve the fuel consumption on any combustion engine – cars, vans and HGVs, including hybrids.

In these days of advanced diagnostics, it is something you can see and feel, with motorists reporting a smoother ride and improved all-round performance.

EDT Automotive recently won a prestigious Green Apple Award for environmental best practice, and Roger Woollens of the Green Organisation described it as "a no-brainer", because the treatment pays for itself in fuel savings.

Operated by a professional mechanic, our machine heats an environmentally friendly mineral-based solution to 42 degrees and pulses it through the oil galleries at 40 psi.

It is then passed through an ultra-fine (three micron) filter which removes up to half a litre of thick black sludge: carbon and metallic particles, varnish, even the odd broken-off dipstick – stuff that doesn't come out in an ordinary oil change.

The results are very close to doing a manual engine strip, with fuel economy increased by up to 25 per cent, power increased by up to 6bhp and torque increased by up to 7ft-lb.

There are significant emissions savings too. On petrol cars it reduces carbon monoxide by an average 69 per cent. On diesel cars it reduces smoke by an average 58 per cent. These are tailpipe measurements from before and after tests conducted by UK MOT stations.

In effect, EDT restores the oil system back to its original specification. We use the analogy of removing cholesterol – detoxing your engine. As well as a consumer service, many of our garage partners are using it to prepare cars for sale and to reduce their fleet running costs.

Winning the Green Apple brought us a lot of attention and we were subsequently invited to appear in an Institute of the Motor Industry (IMI) film.

If you visit our website, you can see the newsreader Natasha Kaplinsky praising our green credentials. It turned out that the reporter's dad was a mechanic, so he had the treatment on his Vauxhall Astra. He said it was "absolutely amazing, really sweet, feels like new".

We only launched EDT in 2013 and have already treated more than 25,000 cars. We are now well on the way to establishing a true nationwide network – of both main dealers and high-quality independent garages, including many Bosch service centres.

The fact we've done that so quickly tells you everything you need to know about the quality of the product. We've also just launched a new auto transmission-cleaning machine, which makes gear changes smoother and more responsive.

Our message to motorists is: when booking your annual MOT, look for a garage that also offers EDT engine and gearbox cleaning.

www.edtautomotive.com