ROBOTICS AND AUTOMATION: A NEW PERSPECTIVE

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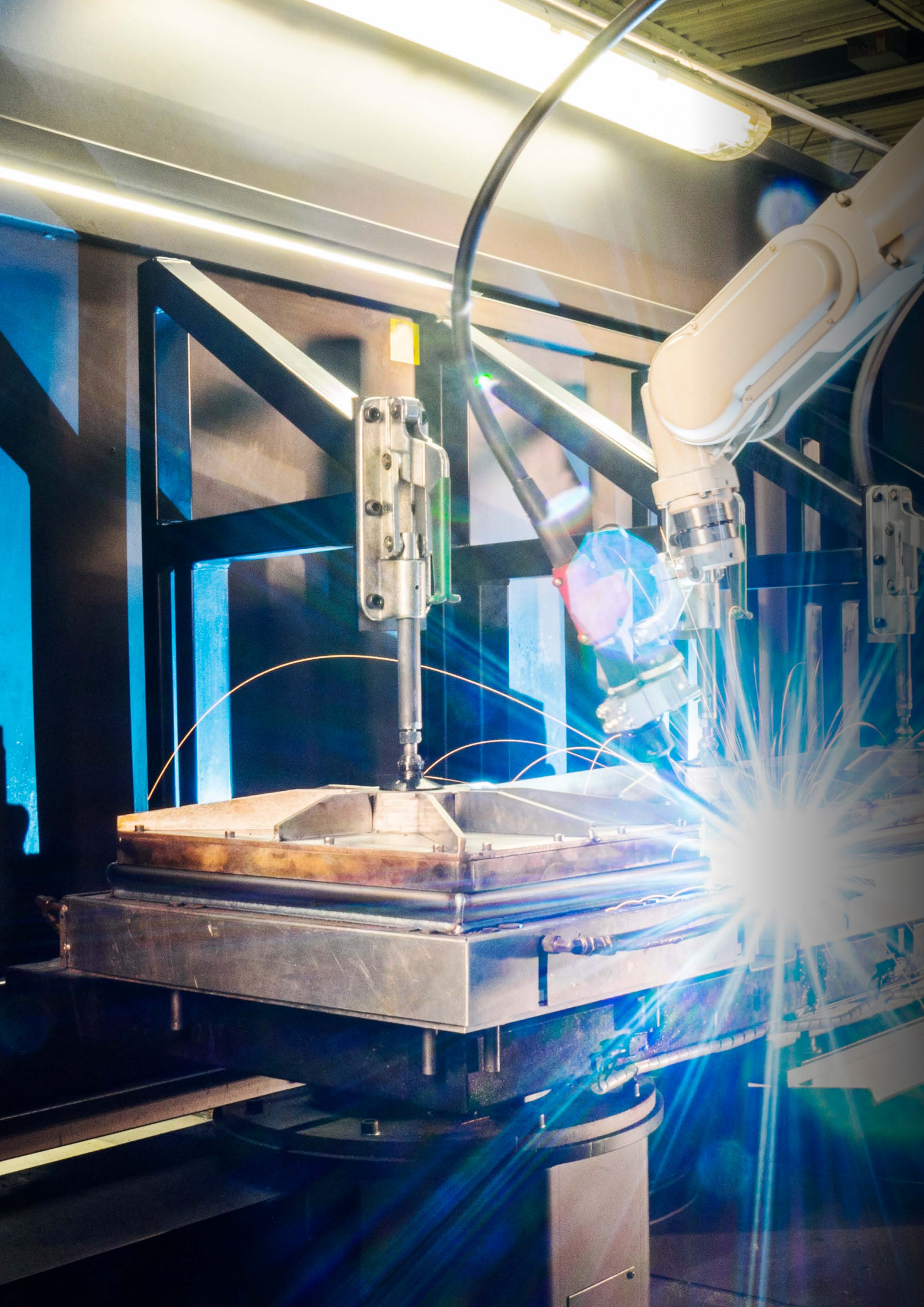


ROBOTICS AND AUTOMATION: A NEW PERSPECTIVE

FOREWORD

Being a hub of innovation and at the heart of UK manufacturing, the Midlands is in a well-placed position to understand the current industrial practises across the UK. A nation with a proud heritage of innovation, with a huge opportunity to strengthen and utilise new processes across the country, especially through the introduction, or further adoption, of automation and robotics systems.

In my role as CEO of the MTC here in Coventry, I am privileged to see first-hand the benefits technology can bring to businesses in all sectors, and of all sizes. It is important that automation and robotics technology is adopted and applied widely in manufacturing to improve the capability, sustainability, and safety, of manufacturing processes across multiple sectors. Throughout my career whenever this technology has been adopted it has created jobs, not replaced jobs: provided an upskilling/reskilling programme is included in the project. Additionally, as part of the High Value Manufacturing Catapult (HVMC), there is ambition to regain a leading global status as a nation that is competitive in this field.

Whilst the UK was traditionally a world leader in manufacturing, our productivity has been surpassed by other countries, and if ignored, this gap will only continue to grow. It is necessary to address the opportunities available within manufacturing to get back on top form, and make advances available to businesses across the UK.

I commend this paper and the recommendations it provides in order to improve automation and robotics usage across sectors. Commonalities across different industries will enable major opportunities within technology development, and in order to fully adopt what is available, there must be a greater awareness of this agenda.

To achieve the target of doubling the contribution of manufacturing to the UK economy by 2030, and increasing GVA (Gross Value Added) in manufacturing, as stated in the recent HVMC strategic plan, automation and robotics must be more widely adopted. As an industry, we need to introduce automation and robotics in order to achieve these targets.

Automation and robotics adoption plays an increasing role in changing the landscape of manufacturing in the UK. This Paper highlights some of the important areas where automation and robotics can be used effectively, and where help is further needed to support the future of manufacturing in the UK.

I would like to thank all those that contributed to this report; to strengthen the manufacturing sector and explore the opportunities that automation and robotics will present. The landscape is changing and it is crucial to keep up with the challenges we face.

Clive Hickman
CEO, Manufacturing Technology Centre (MTC)

EXECUTIVE SUMMARY

Manufacturing plays an important role in developing strong local economies, and is responsible for over half of UK exports. In recent years there has been a huge advance in manufacturing technology, and with this acceleration, new opportunities for improved efficiency and sustainability within the manufacturing industry. The adoption of automation and robotics is key to improving UK manufacturing productivity and tackling grand challenges such as achieving Net Zero. However there are barriers that stand in the way and the adoption of automation and robotics in the UK, compared to other countries around the world, is disappointingly low.

The objective of this paper is to build a comprehensive picture of the current automation and robotics landscape across the UK, to identify opportunities that address the challenges associated with adoption, and highlight some of the benefits this technology can deliver. Experts in their respective fields have written different sections, representing the sector and its various stakeholders. Some of the key points they identified are:

- The UK lags behind the rest of the world when it comes to productivity, and ranks 24th for robot density per 10,000 manufacturing employees.
- There is a need for fundamental change in attitude towards automation and robotics, encouraging positive views, addressing the fear of change, and being bolder in terms of business culture and strategy.
- Adoption of automation and robotics is not as prevalent further down supply chains, with common reasons being cost of implementation and retraining of staff.
- There is a lack of understanding about the impact of automation and robotics, which results in a negative public perception and hesitancy to adopt technology.
- Support is necessary to assist the introduction of new technology, particularly for SMEs, to ensure it is applied effectively and implemented in the most efficient way.
- The challenges of automation and robotics adoption are apparent across multiple sectors.
- It is not necessary to develop and adopt breakthrough technologies, most of the required solutions are already available.
- Engaging the required skills across business is at the heart of the issue for robotics and automation adoption, and investment in training and engaging interest must be a high priority.

From the review of the landscape of automation and robotics in manufacturing, we have defined a series of recommendations that address the challenges that have been identified. These fall into four key categories; skills and education, awareness, finance, and support.

SKILLS AND EDUCATION

To overcome the skills shortage, investment in the national education system from schools to colleges and universities must be a priority to encourage higher levels of interest in engineering and technology. Robotics provides an excellent opportunity to encourage interest and participation in engineering. There must also be partnerships between academia and industry, developing unified standards of apprenticeships and appropriate training opportunities for reskilling employees whose job roles change due to the introduction of new automation and robotics technology.

AWARENESS

All parts of manufacturing must learn from each other to continually develop and understand the best opportunities available. Being aware of the benefits and challenges that face automation and robotics adoption is important for both those in the automation sector, and those in manufacturing more generally, so there should be an increased focus from policymakers, research centres and the media to promote more case studies disseminating the long-term value and major benefits of robotics and automation. There also needs to be better communication between the various stakeholders to enhance and encourage co-operation and communication.

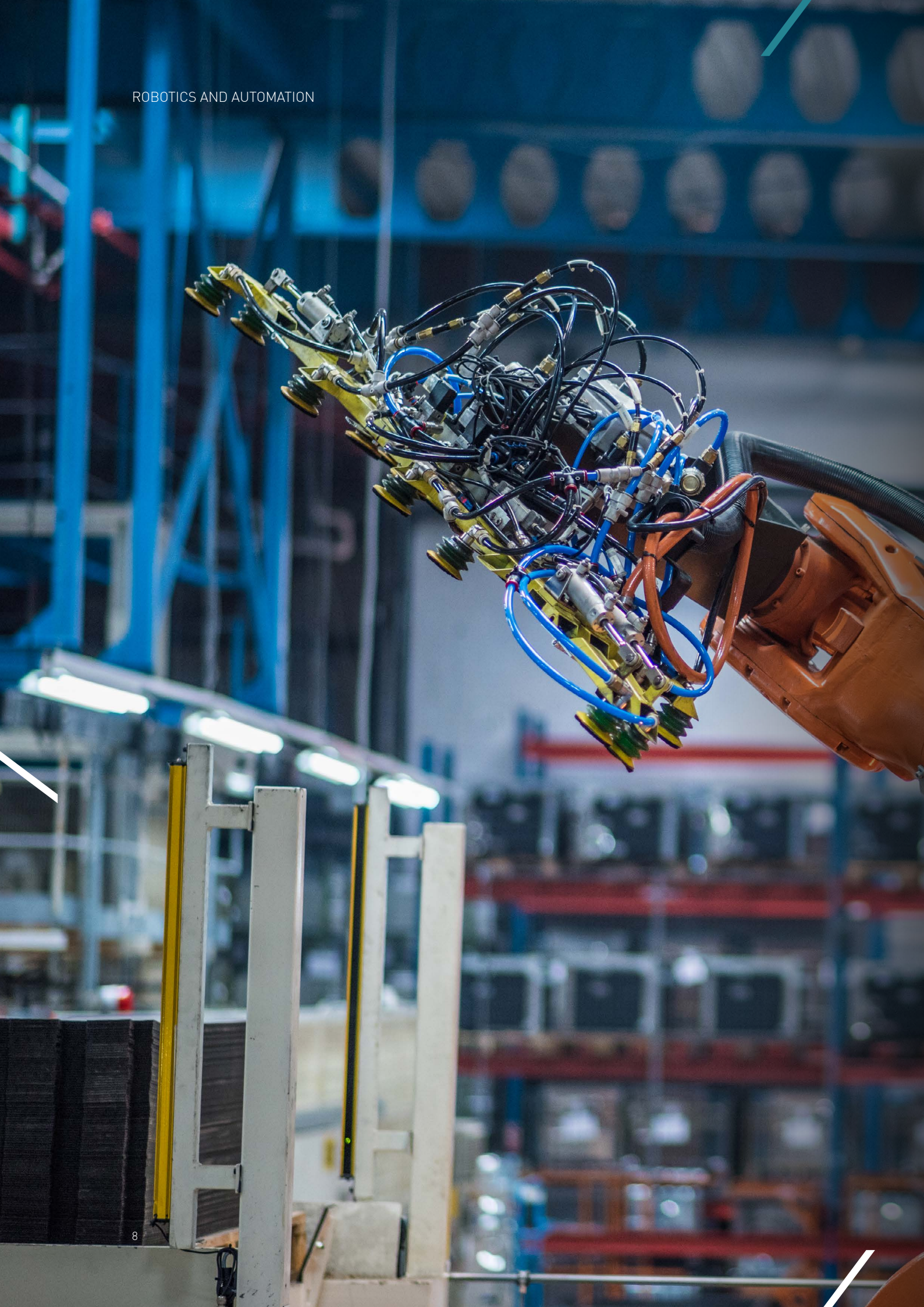
FINANCE

The financial community must be supported in understanding how best to help businesses invest in new technology. Businesses must also be supported in developing the business case for investment, and government support, through mechanisms such as tax reliefs, should continue.

SUPPORT

Support for businesses throughout supply chains must be enhanced to assist in the implementation and operation of robotics and automation solutions, with the High Value Manufacturing Catapult having a key role to play. Mutually supportive and collaborative networks which include academia, RTOs, automation vendors and manufacturing industries must be encouraged, demonstrating and identifying methods and techniques in which automation and robotics can be utilised, with a specific focus on SMEs.

This report provides an updated and broad review of the contribution of automation and robotics within UK manufacturing, and draws attention to key areas that need to be addressed. It is essential that the benefits of automation and robotics are recognised, as the technology provides an opportunity to address the challenges faced by manufacturing. It is vital that the UK does increase adoption to gain the full benefits of automation and robotics to develop a competitive and thriving manufacturing sector, and as a result provide the opportunity to build a prosperous future for our country.



INTRODUCTION

The Government has identified two major challenges that we need to address over the coming years. Firstly, our contribution to the climate crisis with the stated target of achieving a Net Zero carbon economy by 2050 and secondly to improve the prosperity of the country, particularly the deprived regions via the Levelling Up Agenda. UK manufacturing has a significant role to play in the achievement of both of these goals.

In terms of Net Zero, this is about ensuring we produce the goods we wish to consume as energy efficiently as possible. This should not only be related to local manufacture but also the full supply chain for the production of these goods. There is therefore a strong case for the reshoring of significant elements of our production, not only to ensure these goods are produced as efficiently as possible, but also to reduce the energy consumed during the shipment of goods from current production bases, such as Asia.

It is also worth noting that the pandemic has exposed the weakness of our extended supply chains, leading to increasing recognition of the need to improve resilience within our manufacturing by increasing local content by reshoring production capacity.

With regard to levelling up, the decline of UK manufacturing over the last 50 years has largely been the cause of the decline of the more deprived regions. The return of a strong manufacturing sector would increase investment and employment in these areas and therefore disproportionally benefit the regions outside the south east, thereby providing a strong contribution to regeneration.

Our economy has also been declining in parallel with the decline in manufacturing. To ensure future prosperity, we must reverse this decline by improving our balance of payments and reduce our debt to ensure we can fund the quality of life and public services the country has grown to expect. Our limited resources need to be concentrated where returns on investment are the highest. A strong case[1] exists that this can be provided by rebuilding UK manufacturing and in particular light industry. In effect, getting back to making things and selling them.

It is worth noting that manufacturing currently accounts for 53% of the UK's total exports, and average wages are 13% higher than in the rest of the economy[2]. It is therefore not unrealistic to expect that growth in manufacturing could lead to a growth in exports and GDP, as well as improving wages generally.

However, a significant expansion of manufacturing capability cannot be achieved using the current methodologies, which are largely based on manual labour and obsolete equipment. There are two reasons for this; firstly the labour is not available and this situation is unlikely to change as we cannot bring in a large workforce as we have done in the past; secondly this approach would not produce goods that were competitive in comparison to overseas suppliers which must be achieved to grow exports.

To grow manufacturing we have too often looked to new, advanced technologies as the way forward. However there is a view that, "reviving manufacturing in the UK does not need to be based on technical breakthroughs. We have wasted far too much time and resources on the forlorn hope that our salvation lies in new technological miracles which will allow us to overtake our competition in one bound." An alternative and much less risky approach is to look at what we can do today to ensure we can compete in the global market place.

To do this effectively we need to give our workforce the tools to be productive. To maintain agility and achieve efficient operations we need to make appropriate use of flexible automation, including robotics, to ensure we achieve consistent high quality from productive and competitive manufacturing facilities. The Made Smarter Review[3] identified that the application of automation and robotics within UK industry could contribute £183.6bn over the next decade. This is not a new technology, the solutions are available and proven. The challenge in the UK is adoption. If we are to achieve our aspirations of Net Zero and levelling up, then this challenge needs to be addressed.

The purpose of this paper is to provide a review of the current situation in the UK robotics sector. We have engaged a range of experts who have intimate knowledge of the specific aspects of their sphere of activity. These range from research and skills, finance and implementation, to culture and perceptions. Our objective was to build a picture of the current situation to allow us to identify opportunities to address this adoption challenge. We believe this approach is unique and provides a new perspective on, what we believe to be, one of the major challenges facing the UK today.

Mike Wilson
Chief Automation Officer, Manufacturing Technology Centre (MTC)

1 Call to action, John Mills and Bryan Gould, 2015
2 UK Manufacturing Facts 2020/21, Make UK
3 Made Smarter review, 2017

AUTOMATION DEFINITIONS

Automation has a variety of definitions, but is accepted by BARA (British Automation and Robotics Association) as an "automatically controlled operation of an apparatus, process, or system by mechanical or electronic devices that take the place of human labour."[1] It can be used in a vast number of applications and can provide benefits to virtually all industries through integration, maintenance and more, involving a very broad range of technologies to achieve solutions to complex problems.

There are multiple types of automation that can be applied to manufacturing across all industries, defined in the following text. It is a combination of systems, software, processes and technology, that come together to enable an activity with some level of autonomy.

Industrial Automation is the elimination or reduction of repetitive manual processes/tasks in an industrial environment or application through the substitution of labour with capital.

Discrete Automation defines the assembly of components into 'accountable units'. It focusses on the speed and positioning of assembly, where most parameters, e.g. component positions, are fixed. Discrete automation is the automation of fixed individual events.

Process Automation defines the 'control and monitoring of continuous batch processes such as oil refining, paper manufacturing, chemical production and brewing.' Process automation involves key variables within the process such as temperature, pressure and viscosity etc., and is the automation of a whole process.[2]

1 https://www.ppma.co.uk/bara/expert-advice/automation-explained.html
2 https://www.aquentstudiosra.com/WhyInvest/automation.html

ROBOTICS DEFINITIONS

Like automation, robotics has multiple definitions associated with it, which can lead to misunderstandings when it comes to statistics. An Industrial Robot, as defined by ISO 8373:2012 is, 'an automatically controlled, reprogrammable, multipurpose manipulator programmable in 3 or more axes, which can be either fixed in place or mobile for use in industrial automation applications.' Robots vary in their autonomy, with some able to work completely independently from human intervention and others requiring continuous instruction to complete the task.

Industrial robots are 'automatically controlled, reprogrammable multipurpose manipulator programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications', as defined by the IFR (International Federation of Robotics, and International Organisation for Standardisation).

Service robots are able to perform 'useful tasks for humans or equipment excluding industrial automation applications', according to the International Organisations for Standardisation. They require a degree of autonomy and generally include systems based on some degree of human-robot interaction to perform tasks in both professional and personal uses. Service robots can be applied in many different application areas, and have some ability to sense their surroundings in order to complete their tasks.[1]

Cobots are 'collaborative robots', designed for 'direct physical interaction with a human operator, within a shared workspace.' They are produced to be safe for use in environments where humans are present, and therefore have certain constraints built in to their design. Cobots open up an interactive work space, which is very suited to collaboration and can be arranged in a very adaptable manner due to humans being able to interact with the robots.[2]

Autonomous Mobile Robots (AMRs) have the ability to make their own decisions based on their surroundings using machine learning and artificial intelligence. They can act independently without human intervention, and are mobile in terms of being able to move around in a controlled manner.[3]

Robotic Process Automation (RPA) is 'software technology that's easy for anyone to use to automate digital tasks.' As a software tool it has the ability to partially or fully automate repetitive or rule-based human activities such as data entry or simple customer service queries. [4] [5]

RaaS (Robotics as a Service) has the potential to be significant in terms of easy adoption, whereby robotics equipment and maintenance services are leased to companies for use. This business model provides the opportunity for scaling up and down dependant on requirements, and allows versatility to smaller companies who cannot feasibly invest in large, expensive equipment. Loughborough University is embarking on a three year initiative to improve the ease with which robotics are hired and deployed.[6]

1 https://ifr.org/service-robots
2 https://cobotsguide.com/
3 https://waypointrobotics.com/blog/what-autonomous-robots/
4 https://www.automationanywhere.com/rpa/robotic-process-automation
5 https://www.aiim.org/what-is-robotic-process-automation
6 https://www.lboro.ac.uk/news-events/news/2021/june/new-project-will-boost-manufacturing-robots-smes/

1. UK MANUFACTURING

1.1 THE IMPORTANCE OF MANUFACTURING

CHARLOTTE HOROBIN, MAKE UK

Manufacturing is the process by which ideas are materialised through the combination of labour and capital processes, with the aim to create and add value to goods and services. Traditional supply chains were quite literally viewed as 'chains'; linear processes where each function or process was siloed, carried out by one or a small group of manufacturers, and once completed, passed onto the next manufacturer for the next stage. This allowed manufacturers to build competitive advantages through product or service differentiation. However today, supply chains are complex networks and perfectly encapsulate the complexity of UK manufacturing.[1]

UK manufacturing is fundamental to UK prosperity, often cited as contributing circa 10% UK GDP. The sector delivers far greater economic benefit than this figure would have you believe. The UK is the 9th largest manufacturing nation in the world, producing £191bn (pre-pandemic) output and employing 2.7 million people. The sector is responsible for over half of UK exports, generating true wealth, with US purchasing over £54bn UK goods, although the largest single market remains the European Union. The UK remains highly regarded as a world leader in research and development (R&D) and 65% of the country's R&D and 16% of its business investment is within the manufacturing sector.[2]

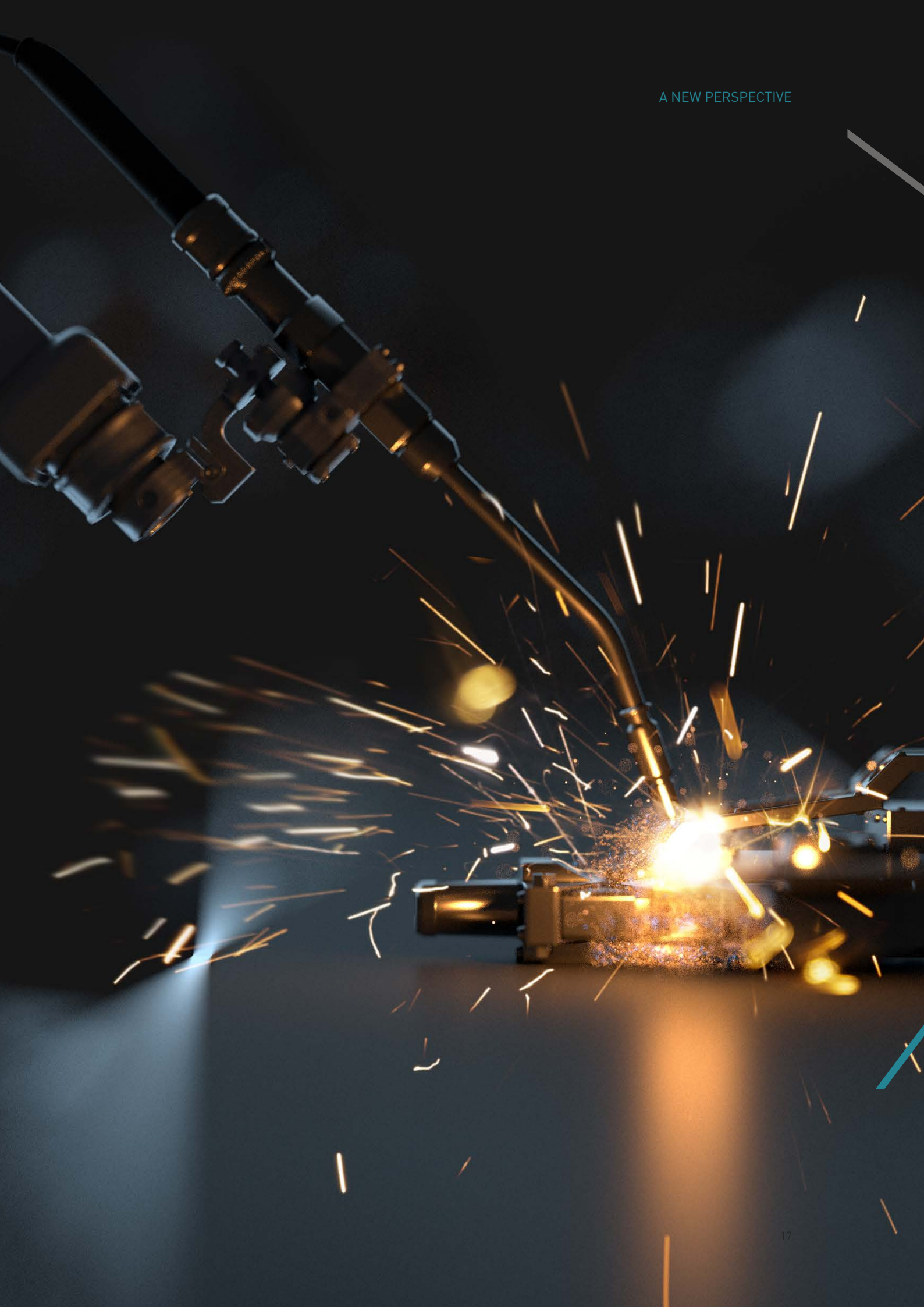
1 Manufacturing Supply Chains Today – the Evolution from Supply Chains to Networks and Potential Disruptors, Make UK & Oracle, 5th May 2020
2 UK Manufacturing The Facts 2020/21. Make UK and Santander, 10th September 2020

Manufacturing is fundamental to developing strong local economies. Whilst it takes a vibrant and diverse economy to make our towns and cities buoyant, the manufacturing sector offers a strong foundation in which other services and sectors tend to flourish. Manufacturers offer strong opportunities to employees, often with higher average pay, consistent shift patterns and a variety of job roles. These employers tend to be very supportive and committed to their local communities, for example many recognise they need to support local education providers to ensure they develop the talent of the future. The quality of the jobs themselves are often high-tech (artificial intelligence, robotics, 3D printing etc.) and require specialist knowledge that has been built over many decades that is not easily replicable elsewhere. As the industry moves towards industry 4.0 and beyond, the manufacturing sector will play a central role in contributing to the UK's skills base since it is also one of the biggest supporters of apprenticeships.

For a small nation the UK regions can feel particularly diverse and are able to boast their own sector strengths, often developed on a strong industrial heritage. The North East and West Midlands are clear obvious strongholds for the UK automotive sector, however their complex integrated supply chains run throughout the UK, across Europe and beyond. The focus for the future will be to continue to secure investment to develop gigafactories which will support electric vehicle production and the subsequent supply chain opportunities that will follow. It is worthwhile highlighting the motorsport industry that also thrives, particularly around Silverstone, with six out of ten Formula 1 teams currently based in the UK. The South West, North West and Midlands are also globally recognised for their density of aerospace supply chains. The Welsh manufacturing economy, not dissimilar to that of the Midlands, relies on the transport equipment manufacturing sector and the associated metal products supply chain. The most resilient subsector is arguably food and drink, as whilst in an economic downturn consumers often alter their buying behaviours, they do continue to purchase food and drink. Scotland, the East Midlands and Yorkshire and Humber all have strong food and drink manufacturing communities, with Lincolnshire picking or processing 60% of all UK food and drink[1]. The food and drink sector, whilst employing the most people of any subsector, invests relatively little into R&D and has a lower level of productivity. The UK also boasts two out of the ten largest pharmaceutical companies in the world, namely AstraZeneca and GlaxoSmithKline. The East of England and North West both benefit from this sector's presence, with both regions performing strongly in manufacturing productivity, underpinned by the pharmaceutical sector's strengths. The East of England also has a density of electronics manufacturing as does the closely located South East, where the capital and surrounding area accounts for a third of the sector's output and turnover.[2] [3]

Regions that have a strong presence of SMEs tend to be less productive, with a view that 'bigger is better' and larger organisations enjoy economies of scale. When looking at investment in industrial digital technologies (IDTs), Make UK's 2020 Innovation Monitor demonstrated areas such as Wales and the West Midlands had lower levels of businesses adopting IDTs. In contrast, the North West demonstrated high engagement, second only to that of the South East - this could be due to the support of the Made Smarter adoption programme, which has subsequently been rolled out to the whole of the North of England and West Midlands this year.[4]

1 Midlands Engine Makes, July 2021
2 Regional Manufacturing Outlook, Make UK & BDO, 19th July 2021
3 Sector Bulletin, Make UK & Santander
4 Innovation Monitor, Make UK & Infor, 5th October 2020



1.2 CULTURE OF MANUFACTURING

To embark on any kind of change, it is worthwhile recognising the roots of current practises. In understanding the culture of the UK and its attitude towards manufacturing, it is possible to determine the most effective way to integrate automation and robotics into businesses. In this section there are two perspectives that discuss how the UK's attitude towards manufacturing has originated, and why culture is important when it comes to the future of manufacturing.

Modern Manufacturing

PROFESSOR CHRIS WHITE, INDUSTRIAL POLICY RESEARCH CENTRE

Manufacturing has an identifiable culture; it is part of the Great British 'brand'. The reality of the sector, with all its many dimensions which are increasingly influenced and reliant on emerging technologies, is far removed from the public's rather nostalgic perception – a perception that needs to change.

The report on *Public Images of Manufacturing in the UK*, written in 2013 by Dr. Finbarr Livesey of the University of Cambridge, acknowledged the challenge faced by the sector, with the image of manufacturing being an ongoing concern:

"Since the turn of the century, concern over the image of manufacturing and the impact of a negative image on the growth of the sector have been explicit in UK government documents and speeches from leading politicians. This concern has been part of the debate on the viability of rebalancing the economy to have a strong manufacturing component."

This image is holding the sector back, but there does seem to be an acknowledgement that this needs to change. From the 'Northern Powerhouse' to 'the Midlands Engine' to the 'March of the Makers', the language being used by politicians in the last decade has seen a marked change in tone and emphasis. However, the popular perception described in the foreword to the All Party Manufacturing Report: Making Good, written in 2013, still rings true:

"No other sector of the British economy holds the social, cultural, and emotional significance with the British public as manufacturing, yet it continues to be in some respects a misunderstood, misaligned and misrepresented part of our national identity. This sector of the economy particularly has a deep and significant relationship to wider cultural factors."[1]

This position is clearly something the sector can be proud of, but there is a need for a fundamental change in the narrative to help shape and transform our industrial culture to meet current demands. It is the public who work in the sector and advise their children to study engineering, or be inspired to set up a business that designs, makes, and exports a product, who have the largest influence.

The misunderstanding about modern manufacturing is not necessarily about what the sector looks like – we know that the dark satanic mills have gone, and understand that clean, efficient, hi-tech factories and laboratories have replaced them. However, the public has bought the myth of the inevitability of companies moving 'manufacturing' abroad. The history of post-war manufacturing is well-rehearsed. In the post war decades, the UK industrialised; manufacturing reached its largest ever share of UK GDP in the 1960s and 1970s, just at the point that regional productivity differences were smallest. After the 1970s, this share rapidly declined, as described by the recent report by the think-tank Onward:

"While many richer countries have deindustrialised since the 1970s, almost none has done so as much as the UK. In 1970 the UK had the sixth largest share of manufacturing in the economy in the G20. Today it is second from bottom. Countries as diverse as South Korea and Ireland have caught up or overtaken

1 All-Party Manufacturing Group Report: Making Good – A Study of Culture & Competitiveness in UK Manufacturing, Pg. 19, 2013

our living standards while growing the share of manufacturing in their economy. Rising countries like India and China have grown their share. While many other rich countries have deindustrialised far less. This may be because the majority of members of the G20 have tried much harder to maintain an industrial base and introduced policies to increase the share of modern manufacturing in their economies."[2]

Labour Party Conference, saying that if the country was to prosper, a "new Britain" would need to be forged in the "white heat" of a scientific revolution.

Wilson's words resonated with the nation's view of the 'culture' of manufacturing; we know that manufacturing is an essential element of our economy; important to employment and trade, driving skills and innovation, impacting society and providing a better

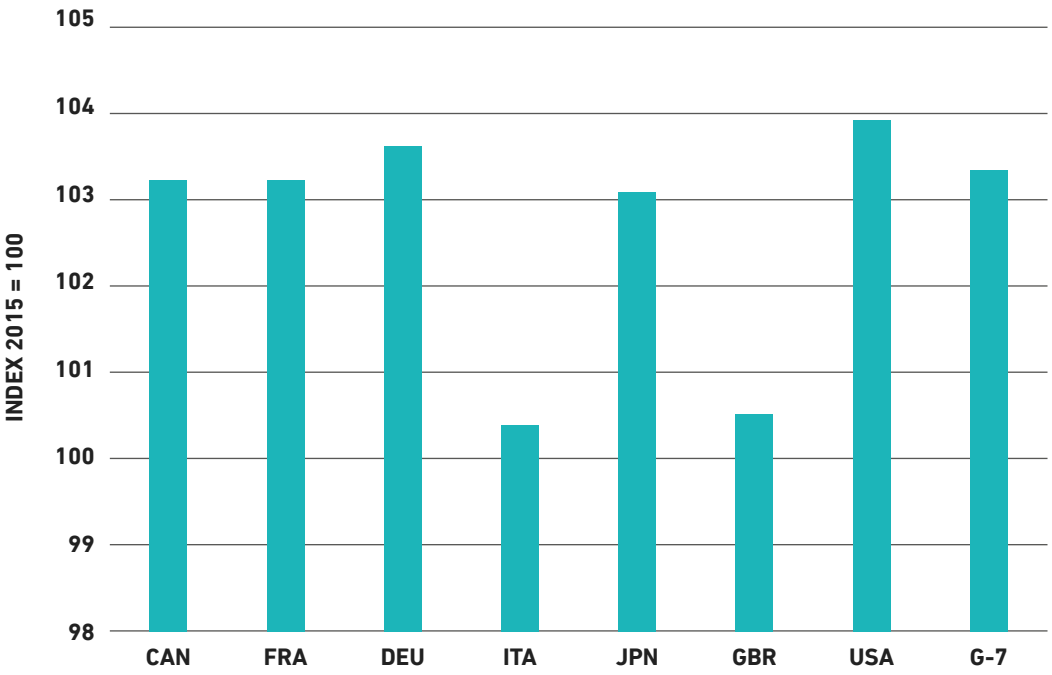


Figure 1: Gross domestic product per hour worked, G7 countries, 2019.
OECD (2021), GDP per hour worked (indicator). doi: 10.1787/1439e590-en (Accessed on 12 October 2021) https://data.oecd.org/lprdty/gdp-per-hour worked.htm

1963 might have been the year when the potential of the sector was last fully appreciated, when the then Prime Minister, Harold Wilson, spoke to the

quality of life, with a heritage dating back to the dawn of the Industrial Revolution.

However, since his call to arms, UK manufacturing itself has not received

2 Making a Comeback, How a Manufacturing renaissance can level up the country, Onward report, August 12 2021 https://www.ukonward.com/wp-content/uploads/2021/09/Making-a-comeback.pdf

the investment it required to keep place, let alone lead. Industrial relations have been poor. International competition has grown rapidly with emerging economies increasingly well placed and structured to create their own manufacturing clusters, with enviable levels of productivity, skills, and quality. Too often in the past, manufacturing has been seen as 'dirty, dangerous, and dull', with a lack of awareness of how things were made.

But now with the revolution having reached its fourth iteration, there is a need for a shift away from words and campaigns to the delivery of a true 'scientific superpower', not least to prepare for a post-Brexit and post-Covid world and a welcome commitment by the Government to reach a spending level of 2.4% of GDP on science and research by 2027.[3]

The 'Industrial Strategy', published in 2017, signalled a shift towards interventionism, and subsequent policy announcements this year have followed a similar, reassuring path: the innovation strategy, the research and development (R&D), people and culture strategy, and the Made Smarter programme, all make for a compelling and coherent approach.

Manufacturing is being identified as part of 'Global Britain's' offer. In June, Science Minister Amanda Solloway MP said: "If the last year and a half has taught us anything, it's that new challenges can arise from anywhere at any time," she continued, "By investing millions in the UK's research infrastructure, we are putting science and innovation at the heart of our efforts to build back better while ensuring that we can respond to challenges now and in the future – from pandemic preparedness to tackling climate change."

The opportunity is here, and because of the pandemic, public perception has changed – calling for an increased resilience in our supply chain. The acceleration of the introduction of automation and robotics into production, and the adoption of new technology generally, will create a revolution in the way it thinks about manufacturing and its culture. Particularly as this culture becomes increasingly intertwined with society.

As Dr Clive Hickman notes in the Midlands Manufacturing Resilience Commission's report, Manufacturing Confidence:

"This Report recognises the impact that the 'future of work' in manufacturing will have on society and communities. On balance, and in my experience, automation and digitisation will increase, rather than decrease employment, but the issue must be handled sensitively and should form part of a national debate."[4]

The future of work and, for that matter, the future of manufacturing, is about to change dramatically. Its culture can no longer be described as 'dirty, dangerous and dull', but one that is clean, safe, and as exciting as our imagination will allow.

3 Post-pandemic economic growth: Industrial Policy in the UK, BEIS, Pg. 9, 2021-22 https://committees.parliament.uk/publications/6452/documents/70401/default/
4 Manufacturing Confidence, Midlands Manufacturing Resilience Commission, 2021 https://www.m2r.org.uk/the-report/

The Importance of Culture

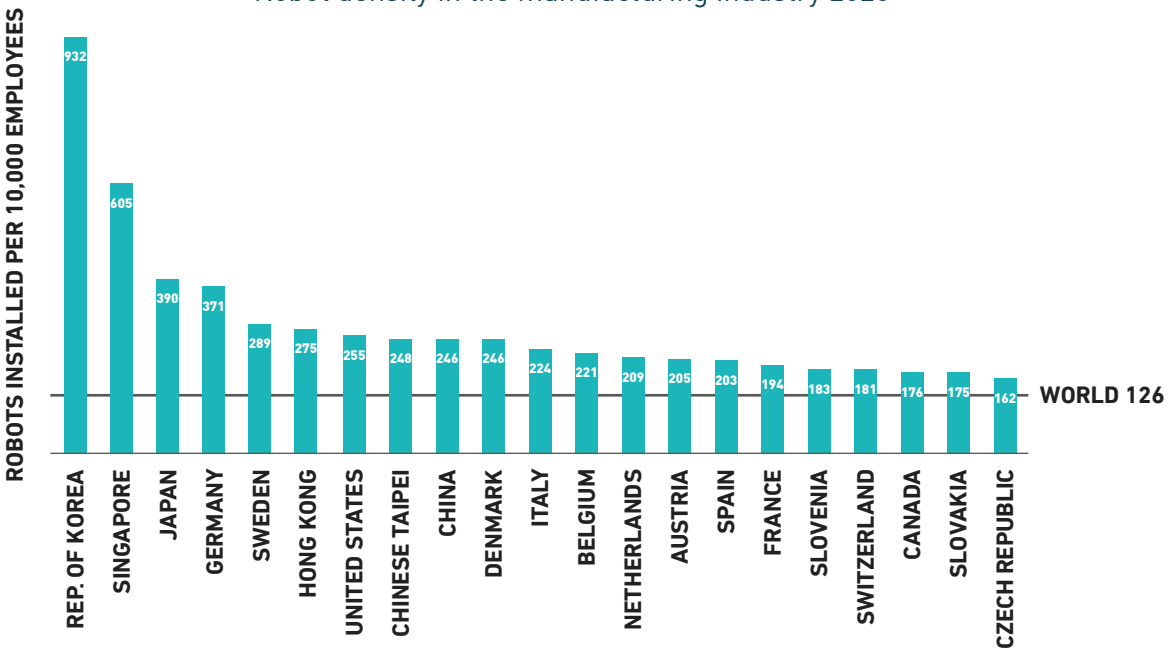
JACK SEMPLE, ENGINEERING AND MACHINERY ALLIANCE (EAMA)

Culture is a key influencer in any company, sector and economy. It can propel progress forward or it can hold it back. It can define what progress is considered to be.

Cultural change seems to be everywhere at present, from the government's approach to carbon emissions in response to climate change, to shifting views about working at home in response to the Covid pandemic. In the same way, business leaders should consider reviewing where their firms are, culturally, in relation to the adoption of robotics and automation. The UK is not well placed at the moment – being 24th in the world for use of robots per 10,000 manufacturing employees[1], and well behind in automation, in which we have only about 6% of the European market and are well behind leading industrial economies such as Germany, France and Italy.

There are many reasons for these low rankings, but a lot may well come down to culture. There is a culture of financial and accounting caution, where the case for investment is not clearly understood; and of engineering conservatism. Pride in, and comfort with, traditional skills and processes and in keeping machines working indefinitely may be dominant in many firms at the expense of looking forward to new ways of working and technical innovation. Looking back rather than looking forward.

Robot density in the manufacturing industry 2020



Source: IFR World Robotics Density 2021 – UK ranks 24th with a density of 101 units
World Robotics 2021 - Industrial Robots

1 World Robotics 2021 - Industrial Robots

At its most extreme, British manufacturing is caricatured as being based on a passion for fettling old machines, fuelled by nostalgia for the triumphs of previous eras. The reality is entirely different, and our best companies show lean, automated and effective manufacturing processes, resulting in components and end products that are among the best in the world. These are the companies to watch.

But the UK's rankings for robotics and for automation don't lie, and the cultural needle needs to shift. However, that does not mean ignoring the achievements of the past. History can show the importance of a culture of commitment to quality, good processes and innovation, based on strong understanding of engineering which can adapt to evolving technologies and customer and regulatory demands.

We know that technology is changing rapidly in most sectors, above all, in terms of digital technology. The firms that understand and embrace that will be the ones that prosper. They will have the basis for demonstrating to customers, suppliers, and investors that they have a culture that is attractive and geared for success. They will also be able to attract the best talent, which can drive further improvement.

All these factors are going to be important as the UK and economies around the world come out of the pandemic. Change looks set to accelerate in response to shifting market demands, investment in sustainable technologies, and the reshaping of supply chains. The companies that are able to react quickly to changing demands and ramp up volumes reliably, and meet ever more demanding quality standards, will be those that have started the journey on robotics and automation.

The total UK market for robotics & autonomous systems (RAS) is forecast to grow at a compound annual growth rate of more than 40% per annum between 2020 and 2030, according to the Department for Business, Energy and Industrial Strategy; by 2030, BEIS predicts it will have reached a market size of almost £3.5 billion.[2]

This does not look to be a time to be standing still as a business. At the Engineering and Machinery Alliance (EAMA), we are hearing of a growing number of firms starting to invest in robots and automation, often having put that investment off in the past. It is the revival of a bolder, more adventurous business culture which is in the best traditions of British engineering, and which is much-needed.

2 UK Innovation Strategy, Leading the future by creating it, BEIS, Pg. 93, 2021 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1009577/uk-innovation-strategy.pdf

2. ADOPTION OF AUTOMATION AND ROBOTICS

Robotics and automation innovations can be applied effectively in a variety of ways, and some of the opportunities for adoption available in manufacturing are discussed in the following section. In addition are the views of three major robot businesses, two of which are UK subsidiaries of leading global robot companies, and the leading robot suppliers - and also system providers - in the UK. The third is the UK representative of the largest cobot supplier globally. These provide an informative view of the challenges facing robot adoption in the UK and also the potential that could be realised.

2.1 OPPORTUNITIES IN ENGINEERING

JAMES SELKA, MANUFACTURING TECHNOLOGIES ASSOCIATION (MTA)

The global pandemic and uncertainties caused by Brexit have dramatically altered the manufacturing landscape in the UK. There has always been a demand from industry for an increase in productivity and improvement in quality, however these are now coupled with a greater need to work remotely and the various issues associated with recruiting and retaining the right skills in the workforce.

Automation and robotic technologies are obvious candidates to address these industry demands. The deployment of these technologies into the work environment could provide industry with an opportunity to be more competitive and productive in the national and global marketplace, allowing businesses to redeploy the existing workforce to higher skilled jobs, and also enable these employees to work remotely. Furthermore, when considering the adoption of these technologies on a national scale, they will allow for shorter supply chains as products are manufactured closer to home, helping to reduce mileage and ease coordination, which means less impact on the environment and therefore also contributing towards the UK's Net Zero target.

CONTINUOUS INNOVATION

Automation and robotic technologies are continuously evolving, being refined, and improved. In 1974 robotic technology had a five axes capability and load capacity of 6kg.[1] Today's robots are designed and manufactured to suit a variety of application areas. Some of them can now have up to 30 axes of freedom, or even be used to carry thousands of kilos. The skills required to use and operate robotic technologies are also far simpler today than those required previously. The latest robots simply need to be shown how to do the task, rather than require lots of coding.

Automation technology is far more than just robots. Automation is the bringing together of sensors, software, computing power, and mechanical sub-systems, to create an engineering system which functions with no, or very minimal, human input. Good examples of automation systems can be easily seen in many of today's household goods we might interact with, such as washing machines. Historically clothes were washed by hand – a process that took time and was relatively hard work. Today though, clothes are simply placed into the drum of a washing machine, along with the cleaning products, the washing programme is selected, and an hour or so later everything comes out clean.

The development and innovation of the technologies which makes up an automation system, such as sensors, cloud computing and wireless communication, is improving at a rapid rate. These developments are enabling automation systems to be deployed to complete increasingly complex tasks – a trend which is only set to continue.

TECHNOLOGY ADOPTION

The level to which robotic and automation technologies are deployed and utilised across manufacturing sectors is reasonably mature at the top end of each sector. Viewing any OEM factory in the UK, whether automotive, aerospace, food & drink, pharmaceuticals, or defence, you will see robotic and automation technology in action. A great example of this is at the MINI Plant in Oxford, where, in the "body in white" assembly

1 Robot History, Timeline https://ifr.org/robot-history

area, there are over 1200 robots working in collaboration to produce the base structure of a MINI every 63 seconds!

However, the adoption of automation and robotic technologies is not as prevalent further down the manufacturing supply chain. The common issues cited when understanding why automation and robotics solutions aren't adopted are generally to do with the cost to purchase, the skills required to use and maintain them, the cost of retraining staff, the loss of productivity while changing from manual to automated, and finally, a culture of fear around technology displacing jobs.

BIG OPPORTUNITY

One of the biggest opportunities for automation and robotic technologies lies in the UK manufacturing supply chain. If more of this supply chain can start adopting and using these technologies, then we will very likely see a jump in domestic productivity. To give an indication of just how big this opportunity for adoption is, in 2019 the world average for the number of installed industrial robots per 10,000 employees in manufacturing was 113. The world leaders were Singapore with 918, with the highest level of adoption in Europe being in Germany, with 346. The UK lags well behind with just 85. To give this further context as to current growth in use of robots in manufacturing, Germany went from 309 installed robots per 10,000 employees in 2016 to 346 in 2019 – a change of 37. The UK in comparison went from 71 to 85, an increase of just 14.[2]

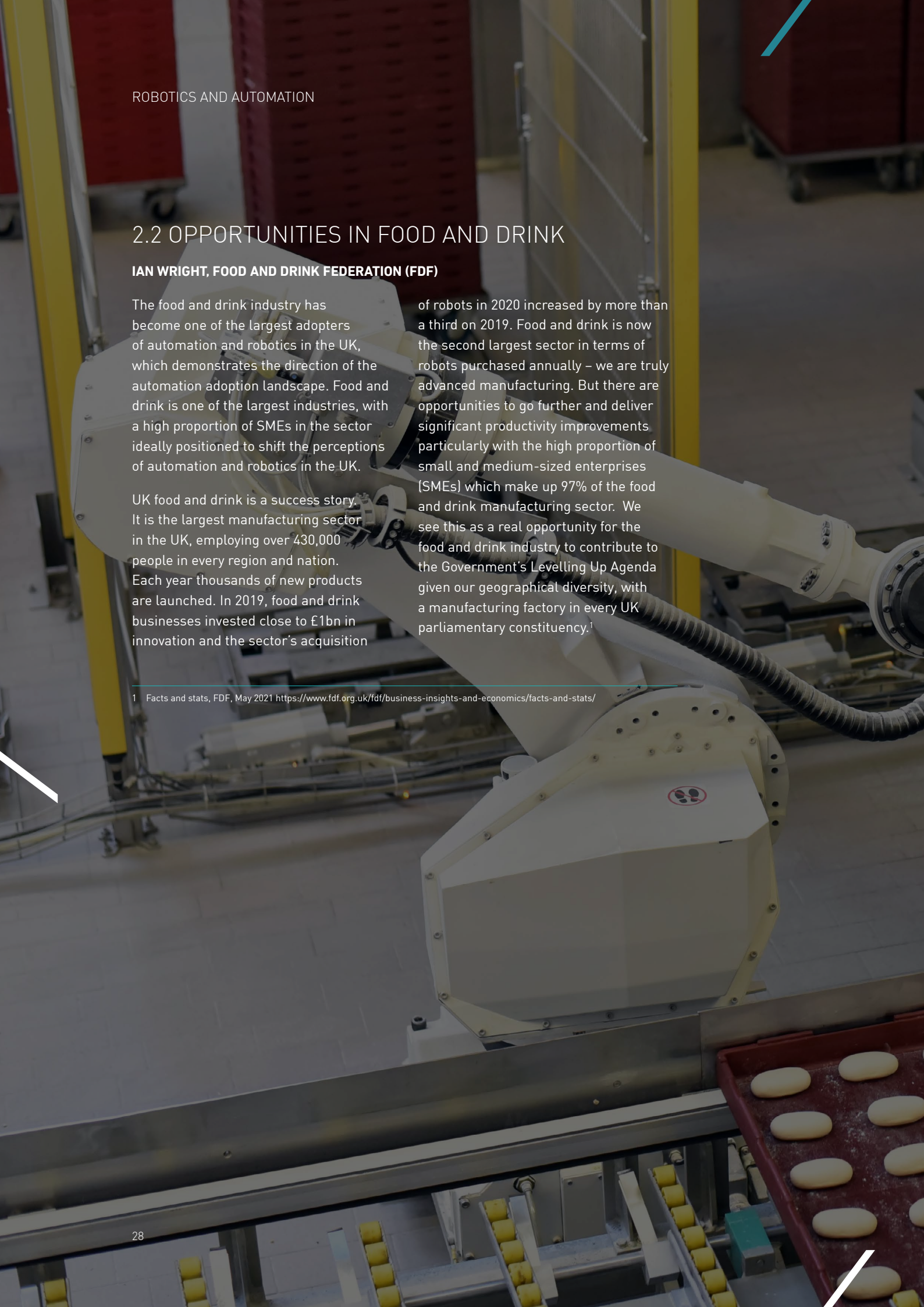
With the costs of automation and robotic technology falling, and the level of skill required to use it effectively much lower than before, now is the moment for the UK manufacturing supply chain to fully embrace these technologies. These technologies will give the UK manufacturing supply chain the opportunity to retrain and redeploy their workforces into higher skilled jobs, achieve productivity gains through 'lights-out' production, increase product quality through more consistent manufacturing processes, increase their flexibility through allowing manufacture of a greater variety of products, and improve company decision-making as a result of the manufacturing process and therefore delivery of goods being more predictable. Looking at increased adoption of automation and robotics technologies on a national level, the UK will be able to become a bigger player in industrial manufacturing globally.

THE FUTURE

Technologies which further enable automation and robotics, such as artificial intelligence and cloud computing, are developing at a rapid pace. As these technologies advance, automation and robotics technologies will become even more sophisticated. There are already robotics technologies in development which mimic the human hand, those which have an element of self-repair, and those that self-optimise their process through simulation. In the future you can easily imagine a block of material being delivered to a robot cell, which then converts it into a finished verified product with no manual intervention.

As the UK moves into a post Brexit world and adapts to the huge shift in working practice caused by the pandemic, it has a huge opportunity to become a world leader in manufacturing through the adoption of automation and robotic technologies. In the future, these technologies will be essential for any company who wants to be competitive in what is, after all, a global manufacturing market.

2 Robot Race: The World's Top 10 automated countries, January 2021 https://ifr.org/ifr-press-releases/news/robot-race-the-worlds-top-10-automated-countries



2.2 OPPORTUNITIES IN FOOD AND DRINK

IAN WRIGHT, FOOD AND DRINK FEDERATION (FDF)

The food and drink industry has become one of the largest adopters of automation and robotics in the UK, which demonstrates the direction of the automation adoption landscape. Food and drink is one of the largest industries, with a high proportion of SMEs in the sector ideally positioned to shift the perceptions of automation and robotics in the UK.

UK food and drink is a success story. It is the largest manufacturing sector in the UK, employing over 430,000 people in every region and nation. Each year thousands of new products are launched. In 2019, food and drink businesses invested close to £1bn in innovation and the sector's acquisition of robots in 2020 increased by more than a third on 2019. Food and drink is now the second largest sector in terms of robots purchased annually – we are truly advanced manufacturing. But there are opportunities to go further and deliver significant productivity improvements particularly with the high proportion of small and medium-sized enterprises (SMEs) which make up 97% of the food and drink manufacturing sector. We see this as a real opportunity for the food and drink industry to contribute to the Government's Levelling Up Agenda given our geographical diversity, with a manufacturing factory in every UK parliamentary constituency.[1]

1 Facts and stats, FDF, May 2021 https://www.fdf.org.uk/fdf/business-insights-and-economics/facts-and-stats/

One of the great strengths of the sector is its resilience. This has been amply demonstrated by its success in keeping the nation fed throughout the global pandemic. However, the pressures from the pandemic, changing trade arrangements and, increasingly, the disruption to the labour market, should not be underestimated. Although they have kept producing, for many businesses the real success has simply been survival: they face the recovery from Covid-19 and the post-EU exit period with great trepidation.

Taken together, these pressures are simultaneously an incentive and a blocker for change. The need for greater adoption of automation and robotics in food and drink is more acute, but capability to plan and finance such improvements are under intense strain. Complex supply chains and tight margins mixed with disruption from Covid-19 and post-EU exit are trial enough. Mix these with the longer-term challenges around sustainability and Net Zero, and the undertaking to plan and make the investment decisions necessary to innovate can seem almost herculean.

Nevertheless, sustainability and achieving Net Zero are key governmental, business and societal priorities that simply must be addressed. Automation and robotics will have a critical role to play. As the momentum around businesses decarbonising their manufacturing facilities builds, we will see a growing interest in electrifying processes which are currently run on fossil fuels. Combined with an increasing cost of energy, this will further drive the need for more efficient technologies and management controls for appliances when switching from fossil fuels to electric alternatives.

The pandemic has cemented the place of food and drink as integral to national wellbeing in a way that has not been seen in this country for generations. We have finally, as a nation, recognised that if you can't feed a country you don't have a country. The challenge is how to do so efficiently and effectively: investment in automation and robotics will be at the heart of delivering that change.

But investment in research and development is concentrated in two ways that disadvantage our industry. First, it is weighted heavily towards certain sectors such as pharmaceuticals and automotive. Secondly, it is targeted in particular regions of the UK. For example, it is the golden triangle that receives the lion's share of investment with more than half going to London, the East and the South East. As the UK aims to boost R&D spend from 1.7% to 2.4% of GDP[1], food and drink manufacturing must take this opportunity to increase its share, nationwide.

We must not forget that developing the capabilities and technologies themselves is only one part of the puzzle; technological and process innovations only deliver on their potential once they are adopted by businesses, at scale. In a sector that is predominantly SMEs producing an astounding panoply of products, the easy answer might be to say that food and drink manufacturing is just different to other areas of manufacturing and we have nothing to learn from them. This approach would be a grave strategic mistake, and all parts of manufacturing must seek to learn from each other, apply and adapt existing technologies and importantly collaborate and share ideas. This is why the FDF is a founder member of the National Manufacturing Skills Taskforce, working with other manufacturing groups to provide

1 BEIS research and development (R&D) budget allocations 2021-2022

leadership and to make a positive impact to the skills challenges facing all of the sectors of manufacturing.

The role of the MTC and its partner catapult centres is critical in supporting food and drink businesses, and the FDF is delighted that our two organisations are aligned and working closely to the same goals. The FDF works with the MTC in bringing together the innovation support across England, Scotland and Wales into a single 'Food and Drink Innovation Gateway'; a great example of what can be achieved through collaboration. The Gateway will make it easier for businesses to access the wealth of support available through the Catapult Network and academic institutions, while also enabling us to better understand the needs and trends to continuously improve provision.

There has never been a more critical time to innovate and 'The UK Innovation Strategy' recognises that we must seize this moment, and that business must make innovation central to everything they do. Businesses across food and drink manufacturing are all too aware of this. The Innovation Strategy calls for "world-class regulation", and I agree, we must give businesses the space to plan and adopt innovation. Then together we can deliver a sustainable, affordable, and secure food system, that will keep the nation fed for generations to come.


ABB

2.3 A CHANCE FOR UK MANUFACTURERS TO MAKE THINGS BETTER

NIGEL PLATT, ABB ROBOTICS

Automation and robotics present significant scope for boosting productivity in manufacturing and logistics applications. Offering the potential for faster, more consistent and efficient production with less waste, robots provide companies with the flexibility to adapt to changing conditions, making them especially well-suited to addressing many of the structural weaknesses revealed by the Covid-19 pandemic and the disruption caused by situations such as Brexit.

As robotic hardware, software and artificial intelligence technologies increasingly combine, new possibilities are opening for deploying robots in manufacturing applications. Today's robotic solutions can be used to achieve highly automated end-to-end manufacturing, with options encompassing everything from low payload cobots and fast picking Delta robots, through to modular solutions and complete cells for handling multiple operations. Examples of tasks that can be handled robotically include parts storage and retrieval, machine tending, welding, finishing and painting, quality inspection, and logistics functions such as storage and retrieval, picking and sorting. The development of smart automated guided vehicles (AGVs) and autonomous mobile robots (AMRs) is also helping to boost efficiency, enabling the seamless transfer of parts or sub-assemblies between different production stations, and ensuring that they are delivered where they need to be, on time and without error.

Globally, the benefits that this joined up approach to production can bring is seeing a steady growth in the adoption of robotics and automation outside of their traditional automotive stronghold, by branching into a variety of industries, including food and beverage, pharmaceuticals, electronics, logistics and construction, and looking for ways to integrate robots into their operations.

TACKLING SME CONCERNS

Innovations such as cobots and simplified programming and user interfaces are also helping to address many of the concerns around complexity and affordability that have deterred small and medium enterprises (SMEs) from investing in robotic automation, providing them with an easy and scalable path for learning how to integrate robotic automation into their operations. Cobots especially provide the opportunity for inexperienced users to tackle the 'low hanging fruit' of simpler applications, with the experience gained enabling them to develop their understanding of what can be achieved with more complex set-ups.

TAKING THE PAIN OUT OF CHANGE

The growing availability of tools such as digital twins, virtual reality (VR) and augmented reality (AR), and offline programming and simulation software, is also helping companies to find ways to optimise robot performance by enabling them to develop and test different configurations to find the best solution for their requirements. This ability to model and refine robotic processes to find the optimum configuration is particularly beneficial for industries subject to rapid changes in consumer demands, such as the food and beverage and logistics industries. In these industries especially,

requirements can change quickly due to shifting consumer demands, requiring production or handling lines to be adapted to accommodate new products or packages.

ROBOTS AND PEOPLE – THE BEST OF BOTH WORLDS

With the ability to manage an expanding range of tasks and work consistently around the clock, robots provide an ideal solution for enhancing working environments and productivity. Ongoing developments in robotic usability, performance, and capabilities including vision, force control and path following, have helped to broaden the applicability of robots across a range of tasks and applications, enabling them to be used to fill gaps in workforces caused by skills shortages. In many cases, this can enable companies to make better use of their existing skilled workforces by using robots either to take over lower value or dirty and more dangerous tasks, or else to provide additional much needed production capacity.

At a leading UK agricultural manufacturer, for example, introducing a robot to handle complex welding operations for a hedge cutting attachment enabled the company's experienced welding team to be deployed onto other lower volume, niche products. The resulting improvements, which included a 66% reduction in production times, helped the company to expand its production capacity, with extra products able to be handled by the robot, and the manual workers being used for fast turnaround tasks and those which are too large for the cell to handle.

Another example is in the construction sector, where robots are being used by companies throughout the construction value chain to help tackle the industry's growing skills crisis. By taking over tedious and potentially dangerous tasks, robots are enabling companies to make better use of their existing resources by deploying them to handle other higher value tasks. Multinational construction company Skanska, for example, uses robots to produce cages of reinforcement bars (rebars) that help to hold concrete structures together. By automating the rebar production process, the time needed to produce the cages has been cut, from 16 hours per tonne using manual labour to just 1 hour per tonne. The resulting labour saving means the company can use its workers for other tasks and projects.[1]

Furthermore, by combining robots with digital technologies such as 3D printing and building design software, these companies have also been able to build an expanded range of structures with less waste, enabling them to increase their offering to customers whilst lowering their production costs, and improving their environmental and quality performance at the same time.

1 Skanska rewrites the rules of rebar tying, 2021 https://new.abb.com/news/detail/78314/cstmr-skanska-rewrites-the-rules-of-rebar-tying

PREPARING THE UK FOR A ROBOTIC FUTURE

With many UK manufacturing companies citing a shortage of expert robot operators as a key reason for not switching to robotic automation, there is a need to ensure that both current and future generations of workers can access the training they need to be able to use robots. For this reason, robot manufacturers, including ABB Ltd., have devoted considerable effort to designing training programmes aimed at all levels of ability, enabling operators to develop their skills from basic through to advanced levels. At the grassroots level, specific efforts have also gone into developing packages for schools, colleges and universities, combining both robots and programming tools to equip students with the knowledge and experience needed to develop, build, and maintain robotic solutions for manufacturing applications.

At university level especially, from undergraduate degree to PhD research, this can also have the benefit of helping to identify new ways for robots to be used to deliver improvements or solve problems. University research, for example, was the starting point for a new flat panel display recycling solution that has been developed by an Irish start-up. The company's solution combines robotic automation and AI to enable the sustainable dismantling of computer and TV flat panel displays, separating out harmful chemicals and valuable components for recovery and reuse rather than sending them to waste.

CASE STUDY

Robotic machine tending cells help metal castings manufacturer to transform productivity

ABB's Feedline machine tending robot cells have helped a manufacturer of cast metal products to dramatically improve its productivity. Working 24 hours a day assisting in the loading and unloading of grinding machines used in the manufacture of iron and iron castings for the automotive industry, the cells have enabled Castings PLC to increase its output by 50% with a 50% reduction in cycle times.

As a Tier 1 supplier to the heavy truck sector, Castings PLC specialises in the production of ductile iron and ductile iron alloy components for vehicle chassis and engines. The company typically produces medium sized batches, ranging from 2,000 up to 50,000 parts per batch, as well as machining of parts from 1kg up to 30kg in weight.

The decision to use robotic automation was prompted by a drive to find ways to better utilise the company's workforce. Previously, the company's CNC grinding machines were loaded and unloaded manually, with one operator assigned to handle two machines. This was incurring long periods of dead time, limiting the productivity of both the operator and the machines. There was also the ever present risk of operator injury caused by lifting and carrying heavy components into and out of the machines.

To help evaluate whether robots could achieve these aims and help win board approval, Castings PLC first installed a pilot cell in 2015. Utilising an ABB robot, imaging system and conveyor belt, the cell proved it could deliver the flexibility that Castings PLC was looking for.

Adam Vicary, Managing Director for Castings PLC advises, "Using robotic automation on variable batch runs is nothing to be afraid of. Thought needs to be given about how your process could use automation and where it could fit in."

The success of the trial cell led to a further 12 machine tending cells being installed by May 2017, all commissioned with the help of ABB. The cells are used to handle a range of components up to 5kg, with each currently programmed to handle 90 different part types, which can be processed on any machine.

A key benefit of the cells is their ease of operation. Programming can be mastered within a few days, enabling operators to quickly change over the cells to handle different component types.

Thanks to the improvements brought by the cells, worker effectiveness at Castings PLC has been transformed. One operator can now handle up to four machines, effectively halving the amount of labour required. The automated cells also mean that production can now also be run around the clock, which has seen the company significantly increase its production output.

Vicary concludes, "Our experience shows that robots are not just for high volume processes – provided you give the right thought and consideration to how robots can be used, there is very little that they can't be used for."

"USING ROBOTIC AUTOMATION ON VARIABLE BATCH RUNS IS NOTHING TO BE AFRAID OF. THOUGHT NEEDS TO BE GIVEN ABOUT HOW YOUR PROCESS COULD USE AUTOMATION AND WHERE IT COULD FIT IN."

Adam Vicary
Managing Director, Castings PLC

2.4 APPLICATIONS, INNOVATION & SUPPLY CHAIN

PETER WILLIAMSON, RARUK AUTOMATION

APPLICATIONS

Over recent years, developments in robotics and automation have made the opportunity to automate processes much more accessible for companies and industries that have previously struggled to automate. Either cost, complexity, or sheer size of the equipment, has prevented many companies from investing. Through the arrival of collaborative robots and autonomous mobile robots, and the improvements in the ease of programming and implementation of more traditional robotics and automation solutions, far smaller companies with less budget and internal knowledge have been able to benefit from automating their processes.

One such company, B-Loony, a small company producing party bunting and catering supplies, was able to grow significantly through the implementation of collaborative robots and bespoke feeding systems. The implementation of robotics and automation here proves that the benefits of increased productivity and attracting new business are available to companies of any size across any industry.

INNOVATION

As well as companies not previously utilising this technology being converted, the new technology also allows certain industries with unique challenges to become more automated.

The food industry in the UK has a severe shortage of labour, particularly in unskilled areas such as fruit picking. An issue that has historically been solved by the use of low cost labour is now having to investigate automation due to the reduced labour supply in recent years.

The innovative use of robotics has allowed food producers to reduce their reliance on a dwindling labour market by adopting automated picking solutions. Indeed, a new breed of agricultural robots and automation, utilising developments on GPS and AI technology and cloud computing, are rapidly growing.

This is a challenging environment, where tasks that appear simple and at a lower skill level (determining whether the food is ready to be harvested, identifying the item, how to handle / pick etc.) are very complex to automate. Historically, due to the complexity versus the cost of labour conundrum, there has not been a need or desire to automate. However, as the saying goes, necessity is the mother of all invention. The need to find alternative methods to pick fresh produce to ensure that it doesn't perish in the fields is high in the UK. The increased costs of lost production, as well as those created by the shortage of labour, are justifying more investment.

SUPPLY CHAIN

The continued shortage of labour affects all areas of the supply chain. Addressing the issue by the application of automation and robotics is a solution that is applicable to supply chains in all sectors.

Increasingly, taking goods from storage to production, or from production to shipping, is being fulfilled by automation solutions. Throughout the supply chain, from production to centralised fulfilment centres managed by 3PL (third party logistics) companies through to delivery, automation is playing an increasing role. The use of autonomous or unmanned robots to move goods, automated storage solutions to house and distribute product, and robotic picking, packing, and palletising solutions, are continuing to revolutionise the supply chain.

CASE STUDY

Robots wave the flag for automation at B-Loony

B-Loony Ltd. has built its business as a leading printer of promotional latex and foil balloons. In recent years, the company has achieved significant growth by expanding into additional markets, particularly restaurants, bars, catering and food services.

The company prides itself on quality and compliance and is subject to regular audits by major retailers and other customers. B-Loony has also recently achieved FSSC 22000 certification for its food-safe gourmet food flag manufacturing process. Orders for this product quickly increased, and as a relatively intricate manual assembly operation is required, logic pointed towards automation as the way forward.

"The problem we faced with finding an automated solution, was precision," explains James Clephan, Operations Director at B-Loony. "The flag's skewer has to be placed on the exact centre of the adhesive flag, so that when it folds over the edges align neatly."

Four UR3 cobots from RARUK Automation now serve this area of the business on a 24-hour shift pattern.

James Clephan pointed out that support from RARUK Automation was valuable in adopting automation, saying, "As this was our first foray into robotics, they initially lent us a UR3 so that we could gain confidence from the unit and see that it worked in the way we wanted. This proved to be an invaluable experience."

Mr Clephan is keen to point out that his strategy of automating tasks which were previously performed manually is not to reduce headcount, but to gain market share.

"The collaborative aspect of the UR3 cobots is pertinent in this respect," he says. "Any workers who have had their jobs replaced by a cobot today work alongside the units. They have been upskilled and now manage the automation function of the operation. Some were naturally sceptical at first, but now they've seen it for themselves, our workforce has bought into the idea."

B-Loony exemplifies how SME manufacturers can realise the benefits of flexible automation. Adopting cobots has enabled the business to continue manufacturing in the UK, and remain highly responsive to customer demands for personalised products, all while growing its market share.

"ANY WORKERS WHO HAVE HAD THEIR JOBS REPLACED BY A COBOT TODAY WORK ALONGSIDE THE UNITS. THEY HAVE BEEN UPSKILLED AND NOW MANAGE THE AUTOMATION FUNCTION OF THE OPERATION. SOME WERE NATURALLY SCEPTICAL AT FIRST, BUT NOW THEY'VE SEEN IT FOR THEMSELVES, OUR WORKFORCE HAS BOUGHT INTO THE IDEA."

James Clephan
Operations Director, B-Loony


FANUC Robot M-710iC/50
Intelligent Robot

2.5 PROVIDING SOLUTIONS

TOM BOUCHIER, FANUC

FANUC UK sees first-hand the increased demand for bespoke solutions, articulated robots, and collaborative robots. Although this appetite is present, we frequently receive enquiries from companies wishing to automate without a clear understanding of how they should approach this technology. When you consider the significant impact that automation can have on a business, it is vital that it is done correctly.

When entering the world of automation, we believe the best approach is to start an open dialogue. Our unique position to collaborate with key manufacturing stakeholders means companies are aided in determining the most appropriate automation options for them. A philosophy of building more than just a sale has resulted in a partnership approach with integrators and OEM's with the final aim being for FANUC UK to act as the bridge to automation.

The biggest challenge to overcome as we approach the future of widespread adoption of automation, is how far the UK lags behind international competition in terms of robot density. There are three key areas that we must focus on if we are to propel UK manufacturing back to its prominent position on the world stage: perceptions of automation, skills and funding.

British businesses are competing on a world stage and we believe industrial automation is fundamental to enabling the UK's capability of matching the productivity of global manufacturers. Following this approach means the most effective way to boost industry as a whole is to increase the number of robot installations across all sectors. This includes businesses that have been traditionally more receptive, such as with the automotive sector, but also in other areas such as the medical, food and beverage, and plastics sectors, and any business associated with manufacturing processes, which have yet to embrace the productivity and other benefits of automation.

Justification for automation is often underpinned by the need to increase productivity or profit. Traditionally, UK companies have taken a piecemeal approach to automation, implementing incremental improvements into the manufacturing process, which have helped generate financial returns in relatively short periods. Globally, manufacturers overseas allow long periods to achieve a return on investment, which has meant that much larger line or factory type automation projects have developed with much greater longer-term returns generated. It seems the rest of the world takes a more positive approach to "go big or go home".

Fear of change, especially with regards to technology uptake, is present among many people working in the UK manufacturing sector, but this can be addressed through training. Our attitude is that robots replace roles not people, and removing a labour-intensive element of someone's job with a new skill such as programming will offer much more long-term value and purpose. Access to the latest technology is available to help businesses grow and they have a responsibility to help companies take advantage of the opportunities within UK manufacturing.

The progression of IoT software also presents an opportunity to quickly improve the efficiency of a manufacturing process. FANUC's Field System, for example, collects, keeps, and processes a wide range of production data at source, on the shop floor, so FIELD provides operators with access to highly accurate real-time data and analytics.

If British manufacturing is to continue to be globally competitive, it is critical that the productivity gains associated with automation are utilised and the subsequent growth of those businesses realised. However, this prominent position cannot be achieved through a singular approach. Government, educators, and R&D centres need to support manufacturers which intend to invest in automation. It would be beneficial for robot suppliers to ensure their offerings are appropriate for each customer. Overall, the industry as a whole must take a collaborative approach.

In conclusion, the benefits of automation and robotics are being seen across multiple industries, with it being recognised that collaboration is key to achieving increased productivity levels across sectors in the UK. SMEs represent a large proportion of potential automation and robotics adoption, and thus require support in introducing new technology into their supply chains. Labour and skills shortages are a main challenge when it comes to adoption, as opposed to an aversion to robotics and automation systems or lack of jobs available. Adapting to these challenges is essential in order to maintain, let alone grow, manufacturing industry, and training packages must be supported by businesses and government alike.

CASE STUDY

End-of-line automation picks up productivity at Zidac Laboratories

An anticipated rise in demand for Portsmouth-based Zidac Laboratories' products meant that existing production lines would struggle to cope with the rapid surge in demand, potentially leading to a shortfall in important products in the fight against coronavirus.

Alongside hand sanitiser, Zidac Laboratories are also specialists in mask relief spray, surface disinfectant, and a range of personal care products that all form part of a safety-critical portfolio. This meant that any form of factory closure was out of the question. Jurica Weissbarth, Managing Director at Zidac Laboratories, explains, "We needed to ensure the health and safety of our staff, which meant making adjustments to our facility in order to maintain effective social distancing. We also couldn't afford to reduce capacity or output, which was why we decided to invest in automation."

Given it was the first piece of end-of-line automation to be implemented into its factory, Zidac Laboratories turned to Solent Automation to deliver the perfect solution. Following an assessment of Zidac Laboratories' production line, two FANUC LR Mate 200iD industrial robots were specified, supplemented by a FANUC M20iA and a M710iC to improve productivity in the packaging element of the operation.

Scott Sidwell, Chief Technical Officer at Solent Automation, explains: "One of the major benefits of standardised automation is the speed with which it can be installed. We programmed the FANUC cells on Zidac products at our own premises, which meant that when we delivered them to site they were ready to operate straight away.

"It took just eight weeks from receiving the order through to having a fully-functional robotics system in place. This was crucial for Zidac Laboratories given the developing situation with regards to COVID-19 in the UK. The fact that the solutions were standardised also meant that it was a straightforward case of moving the cells on a forklift to where they needed to be with the facility."

Jurica continues: "The robots systems made sure that we could be a COVID-secure factory, where staff remained 2m apart at all times. Even while we have prioritised the safety of our staff, end-of-line automation has allowed us to double production output, and has proved vital over the last 12 months in continuing to deliver products to our customers.

"It has also had a transformative effect on employee wellbeing. Not just from the perspective of enabling them to continue working in a safe way, but it's also meant they are doing less labour-intensive tasks. The robot systems are doing the heavy lifting and repetitive jobs, ultimately improving the day-to-day working life of our staff."

"ONE OF THE MAJOR BENEFITS OF STANDARDISED AUTOMATION IS THE SPEED WITH WHICH IT CAN BE INSTALLED. WE PROGRAMMED THE FANUC CELLS ON ZIDAC PRODUCTS AT OUR OWN PREMISES, WHICH MEANT THAT WHEN WE DELIVERED THEM TO SITE THEY WERE READY TO OPERATE STRAIGHT AWAY."

Scott Sidwell
Chief Technical Officer, Solent Automation

KEY ISSUES

The following section reviews some of the key issues that face the adoption of automation and robotics in industry. Many different factors influence the landscape of the manufacturing sector, and the following areas have a large impact on the future of automation and robotics, from ensuring the skills are available, to publicising the outcomes. Experts in each area have provided their perspective on how automation and robotics are viewed and supported.

3.1 EDUCATION

PROFESSOR PHIL WEBB, CRANFIELD UNIVERSITY

When considering the provision of education and training in automation and robotics, we first need to ask some questions; what is robotics and automation, is it actually a discrete subject area, and what does a robotics and automation engineer look like? The answer to this is not straightforward as it depends on many variables such as the types of hardware and the applications that we are working with. The National Careers Service[1] gives 'Robotics Engineer' the subtitle 'Automation Engineer' and defines it as 'Robotics engineers design and build machines to do automated jobs in industries like manufacturing, aerospace and medicine'. But this statement is simplistic, as it does not differentiate between the types of application domain and physical environment in which the engineer or technician are working. In manufacturing, the robotics engineer is usually contributing to a wider automation system but equally, an automated system may not contain a single discrete robot but use common techniques such as sensing, AI, or control. Alternately, an engineer working in the service industry may be purely focused on robots and their implementation as standalone systems. Thus, there is a potential disconnect and blurring between automation and robotics.

Historically most robotics engineers and technicians have had backgrounds in electrical or mechanical engineering, but as robotics has become more widespread and sophisticated, more are being drawn from computer science and from non-engineering disciplines such as psychology and human factors. It is probably true to say that the majority are still from engineering backgrounds, particularly at technician level, but with the increasing interest in more human-in-the-loop automation and robotics, it is likely that the number with psychology and social science influences will increase. We therefore need to consider how we can provide sufficient breadth of knowledge at the required levels and how we need to structure educational approaches to give a 'systems' view and appreciation that is accessible to as wide a spectrum of backgrounds as possible. Our focus here is on manufacturing but this should not constrain ourselves, or indeed allow education providers and government to fall into the existing trap that manufacturing automation and robotics are relatively unsophisticated compared with the service robot sector, which attracts much greater attention.

1 Robotic Engineer https://nationalcareers.service.gov.uk/job-profiles/robotics-engineer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amazon rme
amazon rme

There are a range of potential different educational provisions for manufacturing and industrial robotics and automation, for example apprenticeships, higher education and further education. There is also an increasing interest in introducing robotics in schools alongside the drive to build a more technology literate and aware population. These are to be commended and certainly act as a primer and way of steering young people towards not only robotics, but also engineering, as a career. The modern apprenticeship is often cited by government as the 'way forward' to overcome skills shortages in industry, but it is interesting to note that there are currently no recognised standards for robotics apprenticeships[2].

The assumption has possibly been that other standards that are more electromechanically and maintenance-based are appropriate, which perhaps reinforces the view that robotics is not in itself a 'discipline'. It may also be that they were originally biased towards traditional technician type roles, but this is open to challenge. Technicians working in robotics are often required to work with complex systems and need to be able to master multiple specialist skills such as programming and knowledge of AI, as well as more traditional craft skills. The development of level 6 and level 7 apprenticeships is likely to further increase the need for a separate standard. The situation with BTEC is different and there are a large number of courses at level 3 and 4, which either focus on robotics, or contain a high percentage of material applicable to robotics. It is also worth considering that these are likely to be an adjunct to an apprenticeship and a possible answer in part to the gap mentioned earlier. At undergraduate level there are a significant number of courses (240 are currently listed by UCAS for entry in the academic year 2022/2023), that are either badged as robotics degrees or contain a high proportion of robotics. The number of these is growing every year as universities recognise that this is a potential growth area. However, only a small number of these courses have a focus on manufacturing and industrial robotics, and closer analysis shows that some of the courses listed have a relatively low robotics content, with the robotics tag being used for marketing purposes. At Masters level the situation is quite similar, with 54 courses listed for academic year 2022/2023. Most of these courses are taught as conversion courses with graduates coming in with strong engineering backgrounds. This may also explain why there are a number that are specifically focused more towards manufacturing automation and industry (e.g. Aberdeen, Cranfield and Sheffield Hallam).[3]

So, in summary, there are some good educational offerings and opportunities, but the overall structure is fragmented and there is no apparent consensus on what industrial robotics looks like from an educational perspective, or indeed from an industry perspective. It is imperative that industry and academia come together through routes such as the apprenticeship standards and develop a more unified and coherent definition, and consensus, of what skills the robotics and automation engineers of the future need and what differentiates them. The professional institutions also have a role to play, but with the complication that the discipline is claimed by both IMechE (Institute of Mechanical Engineers) and IET (Institute of Engineering and Technology), perhaps rightly so.

2 Search the Apprenticeship Standards https://www.instituteforapprenticeships.org/apprenticeship-standards/
3 UCAS https://digital.ucas.com/coursedisplay/results/providers?searchTerm=Robotics&studyYear=2022&destination=Undergraduate&postcodeDistanceSystem=imperial&pageNumber=1&sort=ProviderAtoZ&clearingPreference=NextYear

3.2 RESEARCH AND DEVELOPMENT[1]

DR NIELS LOHSE, LOUGHBOROUGH UNIVERSITY

Most of the basic research and concept development related to automation and robotics is funded by the Engineering and Physical Sciences Research Council (EPSRC) in the UK[2]. Projects typically focus on early research at Technology Readiness Level (TRL) 1 to 3, whereas Innovate UK is funding translational projects that focus on TRL4 to 6. There is also a growing number of dedicated Research and Technology Organisations (RTOs) such as the Catapult Centres, which also focus on accelerating the translation of successful proof of concept work (TRL3) to unlock their industrial potential.

The European Commission (EC), through its new Horizon Europe framework programme, is also funding collaborative research projects addressing challenges in automation and robotics. The European Research Council (ERC) is funding fundamental research (TRL1-4), while topical Research Actions (RA) and Research and Innovation Actions (RIA) focus on TRL4-6 and TRL5-7 respectively.

Looking at the UK funding landscape, the most relevant automation and robotics projects are generally associated with the EPSRC research topic 'Robotics & Autonomy'. Other topics, such as 'Manufacturing Machine & Plant' and increasingly 'Artificial Intelligence', also cover some relevant research. All three are currently in the top 10 of research topics by funding (Automation & Robotics: £233m, Manufacturing Machine & Plant: £425m, and Artificial Intelligence: £603m). Automation and robotics has a much lower number of funded projects (93) compared to the others (254 and 310, respectively). This is reflecting the fact that a proportional larger number of higher value projects have recently been awarded in the automation and robotics topic area. This includes eight programme grants totalling £48m, five Research Hubs totalling £74m including associated Nodes, and eight Centres for Doctorial Training (CDT) totalling $43m.

1 All data is based on EPSRC grants: https://gow.epsrc.ukri.org/NGBOChooseTTS.aspx?Mode=ResearchArea&ItemDesc=Robotics Accessed: 14/09/2021
2 https://epsrc.ukri.org/funding/

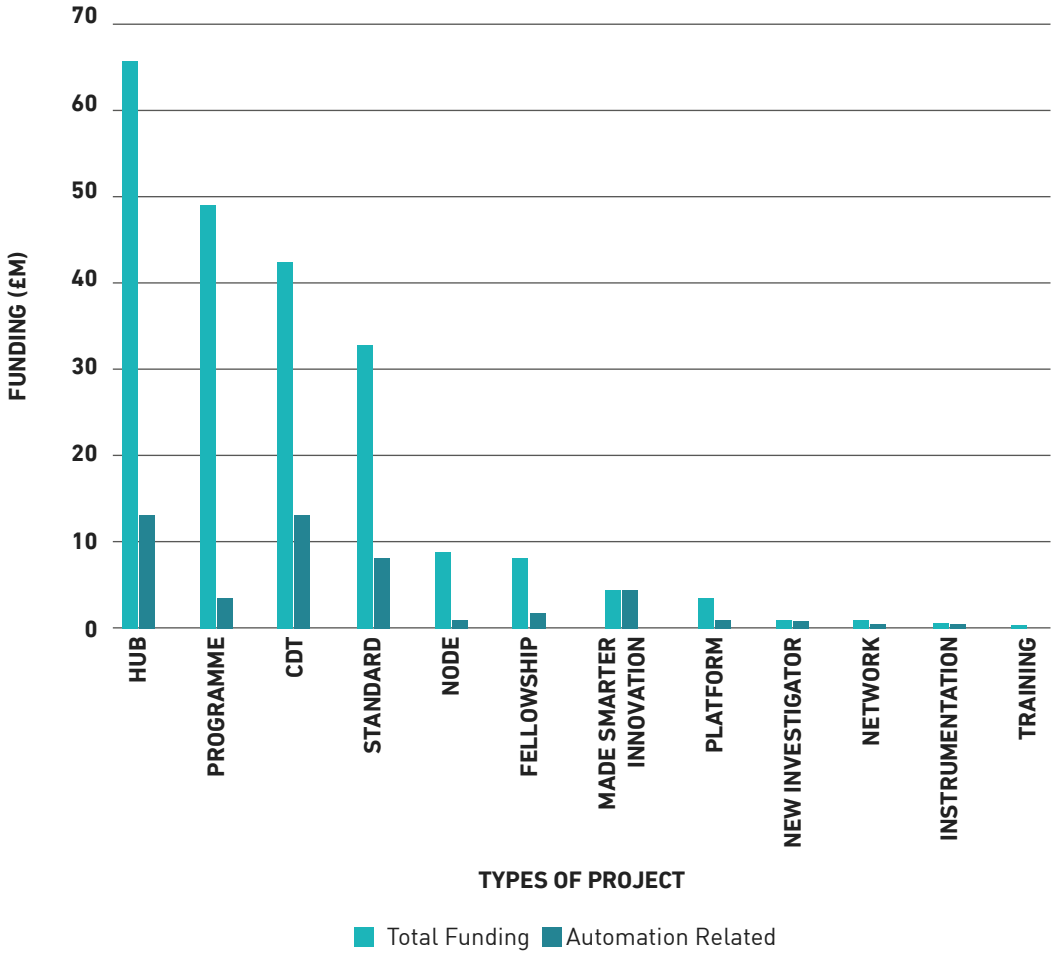

Figure 3: EPSRC A&R project funding by project type

Four of the five Research Hubs focus on robotics and AI for harsh environments, and the most recent Hub with four Nodes focuses on Trustworthy Autonomous Systems (£27.2m). Two of the harsh environments Hubs focus on robotics challenges for nuclear environments (£26.9m), one on offshore robotics challenges (£17.1m), and one on space robotics challenges (£8.5m). Most of the CDTs focus on general robotics and autonomous systems research except for the CDT for Embedded Intelligence (Loughborough) and the CDT for Agri-Food Robotics (Lincoln). This clearly demonstrates a strong commitment to further training in fundamental robotics, but it is less obvious how this will translate to more industry focused automation and robotics research and innovation skills.

Analysing the aims and objectives of the current EPSRC project portfolio in automation and robotics, less than 25% (by funding) directly focus on industrial automation and robotics topics. Only a small number of projects, mostly related to manufacturing, entirely focus on industrial automation challenges. Most notably, a new 'Made Smarter Innovation - Research Centre for Smart, Collaborative Industrial Automation' (£4.8m) has recently been funded as part of the Industrial Strategy Challenge Fund (ISCF). Other projects focus on 'High-accuracy robotic system for precise object manipulation (HARISOM)', 'Human Centred Robotics for Next-generation Flexible Manufacturing', 'Industrial Robots-as-a-Service (IRaaS)', 'huMAN-inspired robotic MANipulation for advanced MANufacturing (MAN^3)', 'Robotic disassembly technology as a key enabler of autonomous remanufacturing', and 'Visual-Tactile Synergy for Handling Flexible Materials'.

A proportion of the research effort in automation and robotics is focused on specific sectors such as healthcare robotics, autonomous driving, and aerial drones that are often not directly transferable for industrial automation and robotics. Other projects focus on fundamental topics such as verification and validation, perception, autonomy, grasping, manipulation, and human-robot interaction. Clearly many of these topics, while often investigated in a more service-robotics context, have the potential to increase the capability of industrial automation and robotics systems.

It is good to see that several new investigator awards, supporting early career academics, focus more on industrial automation and robotics topics, which perhaps indicates a change in emphasis away from pure fundamental robotics.

Unsurprisingly, many new research projects focus to some degree on exploring emerging new AI approaches to solve robotics challenges. Others focus on emerging sensing and actuation technologies such as soft robotics and tactile sensing.

Looking at the industry sector involvement in automation and robotics projects, 'Aerospace, Defence and Marine' (~16%) is leading, followed by 'Information Technologies' (~14%), 'Manufacturing' (~12%), and 'Healthcare' (~12%). 'Construction' (~3%) is a growth sector whereas other sectors, such as agri-food, are currently not clearly tracked by EPSRC.

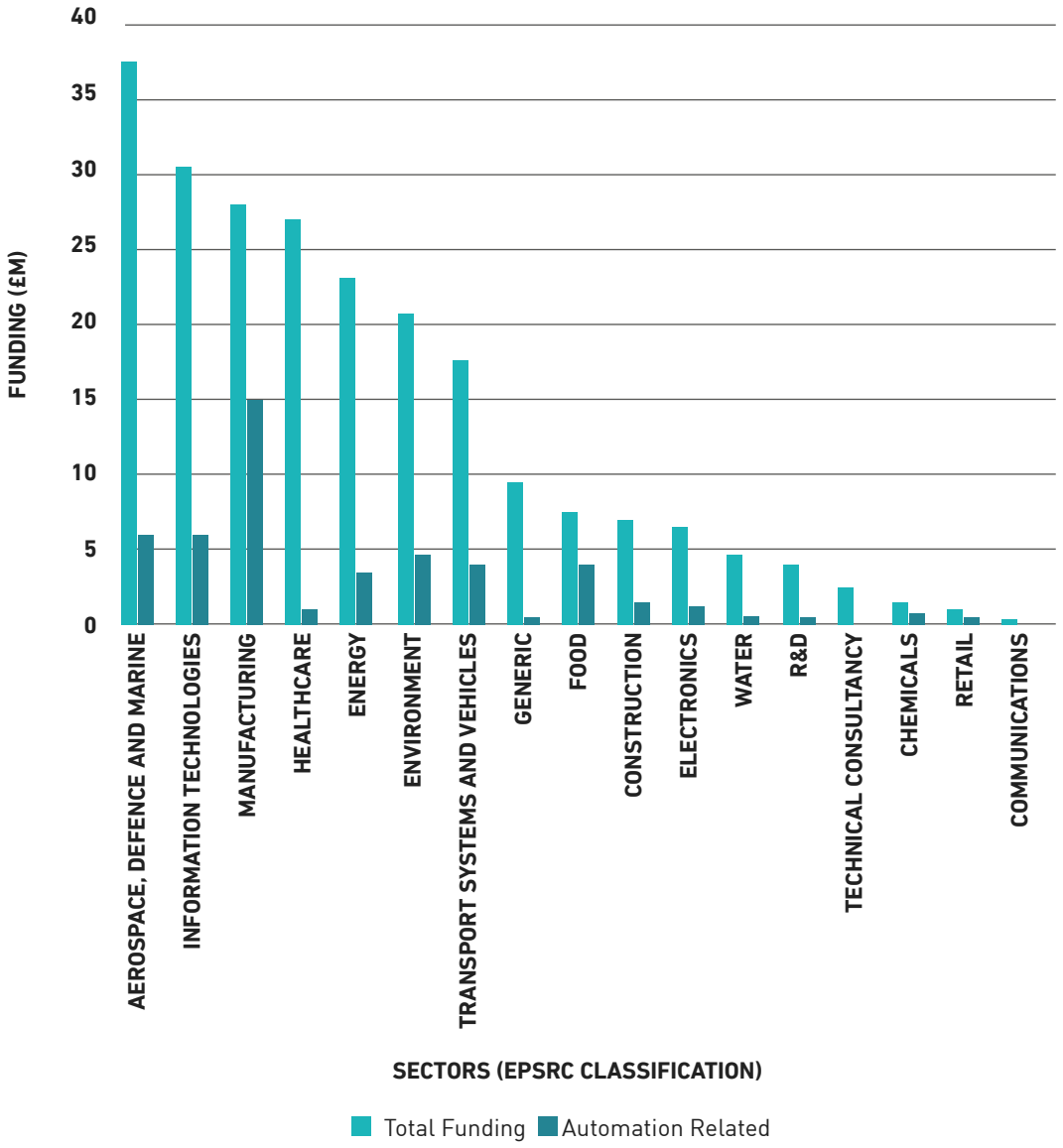

Figure 4: EPSRC A&R proportional amount of funding related to sectors based on project classifications

In conclusion, it appears that there might be a disproportionate emphasis on service-robotics type challenges, or very sector specific projects such as the harsh environments emphasis, for most of the big Research Hubs that make up around 20% EPSRC automation and robotics funding. Likewise, it is positive to see that many projects appear to be supported by industry. Involvement of small and medium sized enterprises (SMEs) should, however, be further encouraged. Overall, developing more 'manufacturing' and also 'construction' sector focused robotics projects is likely going to have the biggest impact on increasing industrial robotics and automation focused research and innovation.

3.3 NETWORKS SUPPORTING ROBOTICS IN THE UK

GEOFF PEGMAN, RUROBOTS

UK and European non-profit networks provide support to stakeholders with a dynamic approach of support, in-keeping with the constantly changing automation and robotics landscape. The list of networks found here is neither comprehensive nor stable, but representative of some of the key networks and associations relevant to the manufacturing community.

United Kingdom

BARA

The British Automation and Robot Association is the longest established robot association in the UK and represents industrial robot manufacturers and system integrators in the promotion of robot use in industry. The membership of BARA is corporate and primarily industrial based, although it does have academic members. BARA undertakes activities that support the uptake of robotics and automation in the UK and the dissemination of best practice on the adoption of robotics. BARA provides expert guidance on the use of robotics, runs seminars and webinars on robotics use and safety issues, and also runs a certification programme for system integrators.

BARA is now part of the PPMA group of associations and, as such, is an active co-organiser of the PPMA Show.[1]

NATIONAL ROBOTICS NETWORK

NRN is an end-user led network aimed at championing the adoption of robotics across a wide range of industries through the development of robust, multi-sector supply chains. The aim is to increase the uptake of robotics in the UK through the provision of more cost-effective robotics solutions brought about by, to the extent that is possible, de-siloing application specific robotics products and systems.

The NRN organises topic workshops and has funded the production a landscape document focusing on common end-user robotics developments and is working on a multi-sector robotics roadmap.

Membership of the NRN is corporate and open to end-users, technology providers and academics.[2]

ROBOTICS GROWTH PARTNERSHIP

The Robotics Growth Partnership is a government-sponsored network bringing together government, industry and academia to develop an action plan to bring the disparate parts of the robotics community and push the development of robotics and smart machines. The RGP membership has been working on the development of a white paper outlining the action plan and has held a number of consultation workshops with various stakeholder groups.

The remit of the RGP is fairly wide covering, which includes, amongst other things, the creation of digital assets and a proving ground for facilities supporting development of robotics and smart systems, as well as addressing education and training issues.

Membership of the RGP is currently by invitation only.

KNOWLEDGE TRANSFER NETWORK

The Knowledge Transfer Network aims to spur innovation in the UK by connecting researchers, developers and end users and to encourage the efficient exchange of information. The Robotics and Artificial Intelligence Innovation Network (formerly the RAS SIG) is a network of primarily industrialists and academics aiming to increase the innovation capacity of UK industry through the use of robotics and AI. It does this through workshops, white papers and the RAI Showcase, the UK's largest conference promoting the use of robotics and AI technologies in industry.

In its previous guise as the RAS SIG, the network published the RAS 2020 Robotics and Autonomous Systems Strategy which laid out a UK robotics strategy and roadmap. Recently the RAI-IN has

1 https://www.ppma.co.uk/bara.html
2 http://www.nationalroboticsnetwork.org/

developed an online robotics landscape tool[3] which shows major UK robotics players and resources.

Membership of the RAI Innovation Network is on an individual basis, but only open to representatives of corporate bodies (both industrial and academic).

UK-RAS NETWORK

The UK Robotics and Autonomous System Network is an academic network with the primary aim of providing academic leadership in RAS, expand collaboration with industry, and integrating and coordinating activities at several high-profile academic RAS centres in the UK. The UK-RAS network also promotes the awareness of robotics to both industry and the general public, primarily through a series of white papers and the high-profile UK Robotics Festival. It also holds an annual RAS conference and supports robotics competitions in schools.

Membership of UK-RAS is open to UK Universities.[4]

IET ROBOTICS & MECHATRONICS TECHNICAL NETWORK

The Institute of Engineering Technology is a professional organisation with the aim of influencing the engineering community in the advancement of engineering, promoting engineering to the government and society at large, and supporting individual professional development. The membership of the IET is drawn from both academia and industry.

The IET Robotics and Mechatronics technical network exists to promote robotics & mechatronics both to the engineering community and to the wider public. Its main activities are seminars, often hosted by its regional networks, and publications.

Europe

There are many robotics focussed networks situated in Europe. However, most have a national or regional focus. This sub-section highlights two that are open to UK participation.

EU-ROBOTICS

eu-Robotics is an industry / academia network originally set up as the private side of the Robotics Public - Private Partnership (SPARC) to guide the European Commission in the development of the €700m robotics work programme in Horizon 2020.
eu-Robotics produced two comprehensive Roadmaps which have not only guided the H2020 work programme, but have also been adopted by several industrial companies as the basis for their own robotics developments.

In recent years the remit of eu-Robotics has widened to include the development of a roadmap to enhance the uptake of robotics by European industry (particularly focussing on the non-AI areas of robotics), and to undertake awareness and promotional activities for industry, policy makers, press and the general public. The work with the European Commission continues to be a core mission of eu-Robotics and eu-Robotics has become a founder member, along with four other associations, of a new association (The AI, Data and Robotics Association - ADRA) which will work with the Commission on developing the work programme for the expanded Horizon Europe programme.

Membership of ADRA is also open to corporate members.

3 https://ktn-uk.org/programme/rai-landscape/
4 https://www.ukras.org/members/apply-for-membership/

The core membership activity are the Topic Groups, which encompass application, technology and societal topics. The topic groups produce information briefing papers and mini-roadmaps which contribute to the overall roadmap development. Other key activities are the European Robotics Forum, which is the largest annual gathering of robotics professionals in Europe; European Robotics Week, which is focussed on promoting robotics to the general public; and the European Robotics League, which promotes robotics competitions in Europe.

Membership of eu-Robotics is open to corporate members from both academia and industry. The constitution of eu-Robotics ensures that all major decision require a majority of both the academic and industry partners and that each type of vote has equal weighting.[5]

EUNITED ROBOTICS SECTOR

EUnited Robotics Sector is an industrial network with the primary focus of promoting robotics in Europe and has an industrial robotics focus. It has a key lobbying role and aims to communicate the industry view on relevant policy and funding issues. It produces position papers on robotics related issues.[6]

Membership is open to industry members from the robotics sector including robot manufacturers, component suppliers and system integrators.

As can be seen, there are a number of active networks in the UK which represent and coordinate activities for stakeholders in the sector. There are overlaps between the groups which does lead to some companies and individuals participating in more than one network. Each of the networks tends to promote its own agenda and, in general, there is little communication between the networks. This can lead to a lack of a coherent representation of the UK robotics sector to external groups such as the financial sector, trade bodies and, most significantly, government. This lack of cohesion and the sometimes confusing and mixed messaging does mean that robotics in the UK does not achieve the recognition and support that it deserves and certainly requires to achieve success. To maximise their collective effect, these various groups should interact more actively, firstly to ensure they truly represent the wide range of activities and businesses operating in UK robotics, and secondly to provide a clear and consistent message to government and relevant external groups to drive the development of the UK robotics sector forward.

5 https://www.eu-robotics.net/eurobotics/about/index.php?idart=29
6 https://www.eu-nited.net/eunited+aisbl/about-eunited/index.html

3.4 TECHNOLOGY ADOPTION

PROFESSOR SAM TURNER, HVMC

The UK lags behind most of its global peers in terms of technology adoption, in particular in robotics and automation, with the UK not featuring in the top 20 nations for industrial robotics deployment (measured by robot density).[1]

The Made Smarter review in 2017[2] reviewed barriers to adoption of industrial digital technologies, including advanced automation. The review cited lack of skills, uncertainty in selecting trusted partners and suppliers, and a lack of clarity on the business case as primary barriers. These three issues still appear to be highly relevant today. The business case question is one that often prevents manufacturers from setting out to invest in automation. For mid-tier manufacturers, a lack of certainty of order book and long term contracts makes the investment decision harder, and the recent crisis has led to a shortage of cash in manufacturing businesses, putting further pressure on the ability to invest in automation and robotics technology. Larger businesses with greater certainty on order book and available capital do not have the same issue. In addition, larger manufacturers invest in R&D (Research and Development) and often have manufacturing engineering functions with the required skills to engage with suppliers and integrators, and commission and own automation solutions once in place. All of these advantages and investments for larger manufacturers are born of greater confidence in future order book, clear 'make vs buy' strategy and leadership that understands and believes in investment in technology as essential to drive business performance.

The COVID-19 crisis and Brexit have also brought different pressures on some manufacturing businesses in terms of the availability of its workforce. In terms of Covid working, this was largely a short term issue, with manufacturing businesses needing to get 'back to rate' without full workforce availability and with distancing restrictions in place. Some sectors, in particular food & drink, have faced staff shortages post Brexit that have heightened the need for automation. The pull towards increased automation is also likely to create higher skilled jobs for maintenance, programmers and integrators.

To enable an increase in automation adoption, manufacturers need access to trusted support to evaluate which parts of the business are most ripe for automation and robotics and to help to develop the business case for investment.

Supporting manufacturers with the relevant skills is at the heart of this issue and those skills are required within different parts of the business. Firstly, leadership teams need support in understanding the opportunities that automation and robotics technology can bring to their business, such that they can identify the priority use cases for investment, and they also need support in building an appropriate investment case that includes reskilling of operational and engineering staff. Many automation projects fail due to a dependency on the skills of the supplier or integrator, meaning that when the project is complete the expertise to maintain or maximise value from the investment has not taken root in the business. This is the

1 UK Manufacturing The Facts 2020/21. Make UK and Santander, 10th September 2020
2 Made Smarter review, 2017

second critical area for skills support; training the engineering, operational and maintenance staff who will ensure that the solutions deliver the return and may start to identify additional opportunities for investment within the business.

Investment support for businesses is also important; lenders who understand the investment case and who can support companies who don't have long term order books are essential to break out of the spiral of under investment, declining productivity and lost orders or margin. Educating the finance community is important to make sure that funds are available and that lenders can in turn educate and support their customers. Government support and incentives for the finance community to support medium term investment in manufacturing businesses are needed to share some of the risk and extend beyond the likes of the British Business Bank to high street lenders.

There is an important role to play for Government through initiatives such as Made Smarter, which need to be scaled to provide the support to manufacturers in adopting technology, providing access to required skills, and workforce development and safe environments for solution providers and manufacturers alike to test, develop and de-risk the deployment of solutions.

Whilst UK manufacturers can achieve great productivity gains from deploying currently available technology, there is also an opportunity to create more UK home-grown solutions, fusing automation and AI and developing affordable solutions targeting the UK market.

Building clusters of manufacturers with the skills, finance and confidence to invest alongside automation providers and integrators can start to stimulate more competitive UK supply chains. The HVM Catapult network can provide the trusted support to manufacturers; demonstrating solutions to relatable problems, advising on potential use cases for investment and connecting to like-minded manufacturers or solutions providers and integrators. There is also a role to be played, working with integrators and providers to make sure that solutions are available that address the most common manufacturing challenges, whether that be productivity, responsiveness or quality. The co-development and demonstration of affordable and deployable solutions targeting the broad base of UK manufacturers who have underinvested, and support for a healthy supply base of integrators, will make large inroads into the UK automation and robotics adoption challenge.


KUKA
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3.5 FINANCING AND THE ATTITUDE TO INVESTMENT

DAVID ATKINSON, LLOYDS BANK

UK business investment has remained below that of key competing economies in recent years, and the uncertainty driven by Brexit, and more recently by the response to the global pandemic, has created additional downward pressure.

Perhaps as a result of suppressed levels of investment, UK productivity has also been identified as a challenge remaining below par when viewed against other G7 economies.

As the UK economy moves towards the recovery phase and growth returns, reflections of the impact of both Brexit and the pandemic response are creating an inflection point in regard to business investment.

The impact of the global pandemic response has caused many business to review their resilience and to consider how they can "build back better" to better protect them from future pandemics and other similar economic shocks.

The context for this review is important. Investment has been both lower and slower as a result of recent events creating a potential reserve of funding for improved investment levels moving forward. The cost of credit also remains low, allowing firms to access additional funding in cost effective ways and to enable investment in a way that preserves working capital and further aids business resilience. As businesses review their strategy to build resilience and improve productivity, so too has the UK Government moved to provide support for business investment.

Recent announcements have provided significant and material incentives for many businesses to invest in new plant and machinery (P&M). The introduction of the new "super deduction" allows that qualifying businesses can access tax deductions of up to 130% first year relief on new P&M. The new regime will remain in place until March 2023, allowing time for both planning and procurement of new potentially business changing assets. Firms should seek guidance from their accountants and tax advisors. Similar improvements in first year allowances also provide for deductions of up to 50% for special rate expenditure providing additional support for new investment decisions[1].

As the UK recovers post pandemic, and as UK firms come to terms with a post Brexit reality, productivity and resilience will need to be key considerations. In a recent Lloyds Bank survey, 51% of manufacturers surveyed stated they had plans to increase investment over the next 12 months[2].

There will be a clear role for automation and robotics as firms consider how best to build their resilience and how they can both boost productivity on socially distanced factory floors, and meet the anticipated growth demands reflected in mid-2021 PMI reports (indicating industries' leaders anticipating order book growth at strong levels). Other economic confidence indicators must also be considered, respecting the significant historic and worsening skills shortages, driving the focus on productivity outputs through the use of automation and robotics to improve their competitive edge as they reach out to new markets and review their operating models as we move past recent events.

Sustainability has also become much more urgent a consideration, driven by events and the opportunity to act created by the pandemic. The 'Build Back Better' initiative[3] offers the chance to address the sustainability challenge, and the ESG (Environmental, Social, and Governance)[4] agenda has become an additional key consideration by both adding to the imperative to invest, and challenging the nature and focus of investment.

If larger corporates want to operate and demonstrate fully improved carbon footprints, they will need the whole of their supply chains to buy in and adopt good practices. It has already been identified that the combined carbon footprint of SMEs on upstream impact is responsible for being up to 5.5 times greater than corporate organisations[5]. If SMEs don't invest and utilise new technology, with automation and robotics seen as an integral part of those strategies, they risk being left behind. Therefore efficient, productive, and resilient solutions will best support the 'build back better' approach and enable firms to compete and thrive moving forward.

Finance providers like Lloyds Bank have significant interest in UK manufacturing and invest heavily, both through investing in industry to support skills development through its £10m / 10-year strategic partnership at the MTC to support the training and upskilling of apprentices & existing engineers, and having also recently expanded the use of its Capital Import Finance facility which removes the risk of funding new plant and machinery assets that they are buying from overseas suppliers.

1 https://www.gov.uk/guidance/super-deduction
2 Internal Survey of Lloyds Bank SME Manufacturing Clients 2021
3 https://www.gov.uk/government/publications/build-back-better-our-plan-for-growth
4 https://esg.org/
5 The Treasurer 2021 https://issuu.com/thinkpublishing/docs/act_the_treasurer_issue_2_2021/54

New and potentially complex equipment can have extended lead times, and Capital Import Finance provides a structured solution to fund the initial costs and pre-payments using trade finance solutions and then to fund the assets, once commissioned, over an agreed term using asset finance. With the added protection of trade instruments such as letters of credit, the risks of acquiring potentially complex plant and machinery from an overseas supplier are reduced.

Looking to the future, investment in automation and robotics to deliver efficiency, productivity, and improve both the UK's competitive edge and progress on sustainability, needs to be an action for the many and not the few. Lloyds Bank, in conjunction with our partners, will continue to support clients in their understanding of the practical and financial opportunities that investment in automation & robotics can deliver. The current beneficial tax regime, which we hope will continue, may provide an incentive for more of industry's finance teams to join with their innovation and production colleagues on the factory floor to lead the charge to a more efficient future.

A great example of forward thinking SMEs tackling this recently is Newport-based SME craft brewery, Tiny Rebel, that has recently invested in new canning and boxing lines to meet growing and changing demand patterns. The new automated lines allow the business to react more quickly to upticks in demand and provide the capacity to take opportunities to grow revenues as their market develops.

Purchased with the support of an Asset Finance facility, the assets will be funded over time, reducing the impact on working capital and allowing time for revenue flows to improve as the new machinery is commissioned and becomes operational.

3.6 INDUSTRIAL RELATIONS

PARESH PATEL, UNITE THE UNION

Unite the union is a 'democratic and campaigning' union that protects workers' rights and supports employees in the workplace. It represents over 300,000 manufacturing workers across the economy, from automotive and aerospace to chemicals, pharmaceuticals, steel, print, packaging and general engineering. As a result, the Union brings the collective talent, experience and industrial knowledge of our members, shop stewards and officers to the negotiating table with both employers and government, where they build the union organisation that workers need.

To do this they must consider our demands for investment into: research and development; ongoing skills development; new greener technologies; and future products, and take these beyond the workplace to corporate and government decision makers.

This skill, experience and dedication has been put to the test with the outbreak of the coronavirus pandemic. Unite's priority throughout has been to protect people's lives, jobs and livelihoods – achieving safety in the workplace and winning government support for our jobs, industries and local communities. Unite's ideas around 'industrial strategy' and a 'green deal for manufacturing' give a vision of what we can win through a just transition for workers as we recover and rebuild a better future for all. This encompasses a range of social interventions that are necessary to secure workers' rights and job security by providing opportunities as industry changes, for example upskilling and reskilling when economies move to sustainable production as a result of climate change.

Unite's 10 point plan addresses long-term industrial strategy and includes reference to automation adoption. Point 8 outlines that, "Artificial Intelligence and other technological advances will only benefit the whole of society if linked to strong protections and advances for workers. This includes job security, shorter working time, job sharing without loss of pay, opportunities for reskilling and democratic oversight over information gathered about us."[1]

The speed and nature of technological developments recently has led to talk of a new wave of automation termed 'Industry 4.0'. Technological advances, especially in robotics, sensors, AI and cloud computing, are driving this movement. In 'The Future of Employment: How susceptible are jobs to computerisation?' Dr Michael Osborne and Dr Carl Benedikt Frey state that automation could lead to 35% of UK jobs being lost within the next two decades. A trend that is likely to have accelerated as a result of the pandemic, as our use of technology has increased. We have to make sure new technology, from 'collaborative' robots to AI and biometrics, is not a route to 'competitive gains' at workers' expense.

Unite is clear that to avoid the worst case scenarios, workers and their trade unions must play a central role in the implementation of new technology (any innovation that affects the jobs of workers), with associated 'New Technology Agreements', and share the rewards.

Unions and good employers recognise that the introduction of new technology can present challenges and opportunities. To this end, employers and unions must agree, via a New Technology Agreement, that the introduction of new technology should not be made unilaterally but by mutual agreement, monitored by Shop Stewards, with time and resources to engage in issues arising.

1 Manufacturing Matters - Fighting the Future of UK Manufacturing. An Industrial Strategy Published byt the Unite Manufacturing Combine. https://www.unitetheunion.org/media/3196/9121_manufacturing-matters-strategy_final.pdf

The employer needs to agree to work actively to use new technology for the benefit of all within the organisation, including both directly and indirectly employed workers. The following principles are some that both the employer and the union must agree on:

- The introduction and control of new technology on the shop floor will only be made with agreement of the employer and the union on behalf of its affected members.
- The employer will reinvest savings from any introduction into areas that promote or provide more jobs within the organisation.
- New skills or responsibilities will be recognised through negotiated pay increases.
- That new technology will only be introduced if the overall number of jobs are protected and the benefit to one group does not come at the expense of another.
- Workers are ensured proper training and are compensated for new skills.
- New technology introduction will be fair and equal, with no negative health and safety issues.
- New technology will be used, where relevant, to create new jobs and reduce working time, but not pay.[2]

New technology is going to generate a lot of wealth. Unite is developing a political-industrial strategy for a future that works, fighting to ensure this wealth is used to help workers and their families, for example by reducing work time without loss of pay which can help workers remain in work when new technology reduces the number of human tasks to be done. Automation needs to deliver for ordinary people, not just make bigger profits for corporations.[3]

2 Unite Work Voice Pay Guides – Draft New Technology Agreement https://www.unitetheunion.org/work-voice-pay/work-voice-pay-guides/
3 ONS report on automation shows workers need radical response including a shorter working week https://www.unitetheunion.org/news-events/news/2019/march/ons-report-on-automation-shows-workers-need-radical-response-including-a-shorter-working-week/


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3.7 MEDIA

WILL STIRLING, STIRLING MEDIA

Industry tends to think of automation as "industrial automation", a suite of technology that automates manufacturing processes including motors, drives, controls, conveyors, cranes, sensors and other equipment, that is separate to robots. Robots form the most visible segment of automation equipment and attract media more than the other, more prosaic hardware. This is because more PR (press release activity) is created about robots and people can associate with robots more easily than, e.g. a brushless DC motor. As a subjective observation, the mainstream media reports on robots first, but when the media covers automation it tends to focus on the automation of IT, the use of artificial intelligence and automating jobs and tasks in the economy, rather than the industrial automation found in factories.

A feature of modern media coverage of automation and robotics is the expansion of terminology and crossover between terms. Thirty years ago, a writer covering a story on automation and robotics would have industrial robots and some factory automation like pallet loading to choose from. Within the scope of automation today there is artificial intelligence, machine learning, big data, neural computing, robots or 'bots' within programmes to execute the algorithm, collaborative robots and more. These terms often get used side-by-side and they are sometimes conflated. For example, many articles comment on robots as an essential part of "Industry 4.0" or connected factories. Industrial robots have been in use since the 1960s and, as such, robots are not necessarily a "smart" technology – although the sensors built into cobots make them "smart".

For the topic of automation and robotics, the press can be divided broadly into the mainstream and the trade media.

If we consider that the core role of automation and robotics in industry, especially in manufacturing, is to increase productivity, the mainstream media rarely report this. Titles such as *The Times*, *The Financial Times (FT), The Guardian* and *The Economist* cover a far wider thematic base of robot stories, especially where robots affect society. Sensation and shock sells newspapers, so they cover themes like the impact of robots on jobs – especially how they will take people's jobs – military robots, robot ethics, prosthetic exoskeletons, automating supermarket order picking, grocery delivery, artificial means to taste food and more. Rarely does the mainstream media print an "industrial factory robot" story, unless it is a novel application – for example the FT ran stories on robots used in the manufacture of solar panels and clothing (Uniglo) – or about Ocado-style picking robots. Robots and employment, and how artificial intelligence will affect society are the two most common robot topics in the mainstream media.

Mainstream media robot stories are regular but perhaps infrequent, given the impact robots are having on society. For stories featuring "robots", The Guardian's coverage is low, with less than one story a month (although their Google search engine does not list articles in date order), The Economist has between one and seven a month, and The FT the most robot stories, with 17 in one month in 2021.

The trade media – the B2B (Business-to-Business) magazines covering engineering, manufacturing and automation content – are overwhelmingly directed by press releases, content they receive from robot and automation suppliers that typically focus on factory and productivity applications of robots. Within this, editors say that content is now approximately 75-80% on industrial robots and the remainder on cobots. Applications like surgical and medical robots, maintenance and non-factory robots, feature very little. The range of "wider automation applications" in the trade press is expanding, such as case studies on automated robot welding, while the main focus is still on moving parts into and out of machines and pallet loading i.e. replacing a low-skilled, erstwhile human tasks.

The Engineer magazine takes a slightly different approach to the manufacturing magazines. Nearly all of its recent robot content is about developing autonomous systems in a range of industries including agriculture, mining, military and nuclear. These are then split between land, air systems and sea systems. The applications can include novel uses like monitoring and maintenance, such as the BladeBUG for remote monitoring of offshore wind turbine blades, subsea robots and rescue robots.[1]

Robots with eye-catching applications typically get more media attention. The hexapod microrobot for performing maintenance inside aero-engines, developed by Rolls-Royce, and the recent future valuation of Cambridge Surgical Robots to over £1 billion, both had wide media coverage.

1 https://www.theengineer.co.uk/bladebug-completes-successful-offshore-wind-trials/

So the mainstream press is covering a wider range of topics about robots, and favour stories that effect society and are controversial, such as the role of robots in the military and even whether robots can reproduce, while the trade press still focuses on factory-based automation supplied by vendors, with a little variation to non-factory applications and greater recent coverage of "worktop-based" cobots.

To promote how robots improve manufacturing productivity, there needs to be communication between industry, the automation and robotics lobby, and the mainstream media. Policymakers, research centres and PR companies need to work harder on the stories' big selling points, majoring on the money, time and even jobs the robot investment has or will have to save the company. If the automation and robotics lobby wants to promote the idea that robots create new jobs, it needs to create compelling PR that explains how, with evidence, and with support from industry. Some people are suspicious that this is possible, given that manufacturing employment has declined steadily over time. "Robots saves UK's biggest food factory £3m a year – and creates jobs" is a grabbing headline because it appears counter-intuitive.

I recommend making more video-based case studies because more content today is watched on video, and media titles all want high-quality video stories to boost readership and clicks.

There is potentially a large amount of fresh, interesting content about robots and automation, and their interaction with business and society. Ultimately, once the journalist has written it, a good communicator is needed to promote the story to publications proactively, not least because editors do not simply publish good press releases when they receive so many every day.

CONCLUSION AND RECOMMENDATIONS

Manufacturing is vital to the UK; it accounts for over half the UK's exports, and 65% of the nation's research and development. It is fundamental to developing strong local economies within the regions of the UK, and offers a strong foundation around which other services and sectors are able to flourish. The manufacturing sector provides jobs with higher average pay compared to other UK sectors and contributes to the development of the skills base.

However there is an underlying need for a change in strategy due to the perceived inevitability of manufacturing moving overseas to lower cost economies. Other countries have demonstrated how living standards can be improved, whilst at the same time growing the contribution of manufacturing to their economy. As a result they have overtaken the UK.

The pride we display in maintaining traditional skills, processes and machines working indefinitely has come at the expense of adopting new technology and ways of working. However there is an urgent need to change this approach; increasing the use of automation and digitalisation to ensure manufacturing can be competitive and grow. Businesses that understand and embrace the importance of quality, good processes and innovation, with an ability to demonstrate an attractive and robust culture to stakeholders, are the ones that will prosper. Those that are agile and able to react quickly to changing demands will thrive, and automation and robotics solutions can help to enable this.

It is in the best interests of UK engineering to embrace a cultural change towards a more ambitious, bolder investment strategy, starting with the implementation of robotics and automation. This does bring challenges, such as the cost of purchasing new technology, the change from manual to automated processes, and a culture of fear around the technology replacing people's jobs. However, it is paramount that both current and future generations can access training that both reskills and upskills to compliment the new technology being adopted.

Although some sectors and larger businesses have successfully implemented automation and robotics solutions, adoption is not as prevalent further down the supply chain. The benefits of automation and robotics technologies are accessible throughout the manufacturing supply chain and, with the cost of adoption falling and implementation and operation being simpler than ever before, now is the time for UK manufacturing to adopt these technologies. The adoption of automation and robotics are becoming a necessity for any business that wants to be competitive in the global manufacturing market.

However it is acknowledged that the ability to finance and plan for the implementation of changes can be difficult, and often businesses have taken a piecemeal approach. Plans for adoption must be long term, achieving greater returns due to bolder investments. Widespread adoption on a national level will help the UK to become a bigger presence, and a potential leader, on the global industrial manufacturing stage.

By reviewing the input of the experts who have contributed their knowledge and informed opinions to the report, four key issues that would assist and accelerate the future adoption of automation and robotics have been identified. These are:

- Skills and education
- Finance
- Awareness
- Support

Within each of these issues, specific actions have been identified from the contributions provided, which will each help to progress the adoption of automation and robotics within UK manufacturing. The recommendations that follow are applicable to all stakeholders including government, technology providers, research and educational establishments, the finance community and, not least, manufacturers, and are intended to guide relevant policy and future initiatives.

SKILLS AND EDUCATION

There is a general understanding that the lack of knowledge and skills within manufacturing, to procure, implement and operate automation and robotics systems, is a major issue.

RECOMMENDATION 1

Demystify automation and robotics technology for businesses, employees, users, and the public through educational material, providing a basic understanding of what automation and robotics is, from a manufacturing perspective, and demonstrating how adoption will benefit.

RECOMMENDATION 2

Bring industry, education, academia and the professional institutions together to determine a coherent definition and consensus on the skills and education that are necessary to provide industry with the tools required to meet future needs, particularly in relation to automation and robotics.

RECOMMENDATION 3

Support and extend robotics exposure in schools, and enhance pathways into engineering education, using robotics as a vehicle to encourage students, with the objective of increasing the output of engineering technicians and graduates with awareness of automation.

RECOMMENDATION 4

Develop short courses or similar packages to provide the opportunity for manufacturing businesses to upskill their existing staff with the capability to implement and operate automation and robotics systems. These must be developed and delivered in a way that provides easy access and minimises disruption to existing workplace activities.

RECOMMENDATION 5

Research activities on industrial automation and robotics application need to be enhanced with a focus on solutions that can potentially be used across multiple applications and sectors. Increased effort is needed to achieve communication with potential adopters to ensure these developments are exploited.

FINANCE

RECOMMENDATION 1

Ensure the finance community has a better understanding of the benefits of automation and robotics, and is willing to support longer-term investment strategies in manufacturing businesses. Partnerships between lenders who can support long term investments and businesses who are looking to adopt automation and robotics technology should be developed.

RECOMMENDATION 2

Government should continue to provide tax reliefs which are targeted at supporting investment in manufacturing plant equipment, including robotics and automation.

RECOMMENDATION 3

Guidance and support should be provided to businesses to both identify the most appropriate areas for investment in robotics and automation, and particularly to develop the business case to support these investments.

AWARENESS

RECOMMENDATION 1

A concerted effort must be made to address the fear of change and the perceived threat of unemployment through an awareness activity explaining the benefits of automation and robotics adoption. We should be building a consensus, when considering the adoption of new technology, which must involve all the relevant stakeholders including government, unions and trade bodies, working in cooperation with the media to ensure accurate and representative information is presented.

RECOMMENDATION 2

The technology vendors working with the manufacturing sector, relevant trade bodies and the media must ensure accessible information is made available to support the above recommendation, including video-based case studies and high quality images, to increase awareness and engage a wider audience.

RECOMMENDATION 3

Better communication between the various networks, in the broadest sense, should be established to enable coherent representation from the UK robotics sector to external groups. This should be extended to cover all interested parties to enable all stakeholders, including the manufacturing sector, to learn from each other through collaboration and shared knowledge, ensuring that the most is being made of the automation and robotics technology that is available.

SUPPORT

Often manufacturers approach the automation vendors wishing to automate, but without a clear understanding of how they should approach the challenge. Given the significant impact automation can have on a business, it is important that it is approached and executed correctly.

RECOMMENDATION 1

Support should be provided to UK manufacturing businesses in the whole process of adopting automation, from the first steps of identifying the appropriate applications and gaining workforce support and involvement, through to developing the business case and producing a requirements specification, to the selection of an appropriate supplier and the implementation of the solution. This support should be provided by independent organisations such as the MTC and its partner centres in the High Value Manufacturing Catapult.

RECOMMENDATION 2

Provide ways to achieve collaboration and knowledge sharing across manufacturing industry and the automation supply chain to develop, demonstrate, test and de-risk affordable and deployable automation solutions, targeting the broad base of UK manufacturers who have under-invested.

RECOMMENDATION 3

Specific encouragement for SMEs to adopt automation and robotics technology, perhaps by extending the reach of the 'Made Smarter' programme.

RECOMMENDATION 4

Build on and extend existing networks to enable sharing of knowledge and information across industry, not just manufacturing, to learn from previous failings and identify new ways for robotics and automation to be used to solve problems and deliver improvements in productivity and skills. Ensure that this applies to all stages of the supply chains and that automation and robotics adoption is encouraged at all levels.

The growth of manufacturing is important for the future prosperity of the UK. To achieve this growth we need to improve our competitiveness and productivity. The enhanced adoption of automation and robotics is a key requirement and must be addressed at all levels in the supply chains throughout the manufacturing sector. SMEs especially must be supported in investing in new technology, and the development of the relevant skills, otherwise they risk being left behind.

Evidence[1] [2] shows that automation and robotics will increase rather than decrease employment, but the issue must be handled sensitively and form part of a national debate. Automation and robotics adoption needs to be an action of the many, not the few. This report is intended to encourage debate, and we at the MTC will be looking to engage with all stakeholders to progress the recommendations. We must utilise these technologies to build a future where UK manufacturing can no longer be described as 'dirty, dangerous and dull', but one that is clean, safe, and as exciting as our imagination will allow.

1 Automation, labor productivity and employment - a cross country comparison. Kromann, Lene & Skaksen, Jan & Sørensen, Anders. (2011).
2 The Impact of Robots on Productivity, Employment and Jobs. International Federation of Robotics, (2017), updated 2018.

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ROBOTICS AND AUTOMATION: A NEW PERSPECTIVE

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