

4IR in the Workplace: Ensuring employers and employees benefit

Scott Corfe



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CONTENTS

ACKNOWLEDGEMENTS.....	3
ABOUT THE AUTHOR	3
FOREWORD FROM THE SPONSOR	4
EXECUTIVE SUMMARY.....	5
CHAPTER 1: INTRODUCTION	10
CHAPTER 2: BENEFITS FOR EMPLOYERS – ENDING THE UK’S PRODUCTIVITY CRISIS.....	12
CHAPTER 3: WHAT’S IN IT FOR WORKERS?.....	22
CHAPTER 4: THE CHALLENGES FOR EMPLOYERS AND EMPLOYEES	29
CHAPTER 5: THE ROLE OF POLICYMAKERS – GETTING TO A PLACE WHERE 4IR BENEFITS EMPLOYERS AND EMPLOYEES.....	37

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Scott was voted one of the top three forecasters of UK GDP by Focus Economics in 2016.

FOREWORD FROM THE SPONSOR

Fourth industrial revolution (4IR) technologies, from artificial intelligence to the Internet of Things (IoT), are changing how we work for the better. 5G, the next generation of wireless connectivity, will bring faster mobile internet speeds and network response times than ever before. These technologies have the potential to deliver real productivity gains for organisations across the UK. To help policymakers ensure that both employers and employees realise the full benefits of 4IR innovations, we commissioned a new report from the Social Market Foundation.

This report is the second in a series on the impact of 4IR in the UK. It builds on the first report, “4IR in the Home”, which examined how new innovations are improving our quality of life in areas like care, transport and the home. The latest report, “4IR in the Workplace”, looks at how new technologies are enhancing the performance of businesses and employees. For example, big data analytics are helping retail businesses respond faster to trends in customer demand. And by taking on routine tasks, artificial intelligence is freeing up employees’ time so they can focus on creative, stimulating work that relies on human insight.

Vodafone is an industry leader in technologies like 5G and IoT, and we have seen first-hand how 4IR advancements in the workplace can benefit people as well as organisations. Rising productivity, a reduction in repetitive, monotonous tasks, more fulfilling work – these are all possible thanks to digital innovation and ultra-fast connectivity. As this report makes clear, employers and employees have a great deal to gain from this latest wave in industrial development. With strong business leadership and the right legislative environment, we can all enjoy the benefits.

Neil Blagden, Chief Operating Officer, Vodafone UK

EXECUTIVE SUMMARY

Key points:

- **Fourth Industrial Revolution (4IR) technologies could transform Britain's workplaces, with changes for employees and employers alike** – if policymakers take the right decisions.
- **Employees** could get more leisure time, more fulfilling work and a safer workplace. They will need new protections from potential problems such as skills becoming redundant and undue workplace monitoring.
- **Employers** could see their organisations become more productive and profitable. Smaller employers in particular will need to embrace technology more fully.
- **Policymakers** should deliver new workplace rights, better infrastructure, improved training opportunities and updated competition policies fit for the 21st Century.

Terms:

4IR refers to the latest technologies which are building on the digital revolution that commenced in the second half of the 20th Century. This includes internet-connected household appliances (“the internet of things”), driverless cars, big data, robotics and artificial intelligence.

Context:

The UK has a productivity problem. On a per hour worked basis, labour productivity has broadly flatlined since the global financial crisis of 2008/09 – leading to the worst decade of productivity growth since the early 1800s.

4IR technologies could help address that productivity problem in several ways for employers:

- **A big data revolution.** Increased use of big data and data analytics can enhance business performance through a number of channels:
 - **Cost savings** – using data to identify sources of wastage within supply chains, such as underutilised labour, investments that are not yielding significant benefits and energy & water leakages.
 - **Time savings** – for example, through being able to analyse real-time data rather than having to wait for it to be collated. In the retail space this could include real-time analysis of barcode scanner data to identify trends in demand and potential supply shortages for different products.
 - **New product development** – using data to inform product design and improvement.
 - **Understanding market conditions** – such as predicting potential upturns and downturns in product demand, and adjusting business behaviours accordingly.
- **Gains from using artificial intelligence and machine learning.** Businesses are already using and exploring how artificial intelligence can improve company performance. Examples include:

- **Ocado looking to replace barcode scanning with AI “vision” to speed packing processes.**
 - **Virgin Holidays using AI to tailor marketing emails to deliver maximum impact** – an investment which has led to a 10% increase in email open rates.
 - **“Robo financial advisers”** – with companies such as UBS using AI financial advice to provide lower cost financial solutions to clients.
- **Robot-related productivity gains** as an increasing proportion of tasks are automated. However, use of robotics in the UK is more limited than in other nations. Data from the International Federation of Robotics show that in 2016 there were just 71 installed industrial robots per 10,000 manufacturing employees in the UK, about a fifth the 309 seen in Germany.
 - **Autonomous vehicle -related productivity gains.** Automated commercial vehicles have the scope to be more efficient and productive than man-driven ones. Autonomous freight vehicles, for example, might be able to travel continuously for longer, given the absence of issues such as driver fatigue which necessitate rest breaks. Fleets of autonomous vehicles might also be increasingly shared across businesses, called upon when required, helping to reduce costs associated with owning company cars. Drones are increasingly being explored as a tool for businesses. Given their ability to travel in the air to avoid road traffic, drones can offer an efficient solution for transporting goods across geographies. Retailers such as Amazon are exploring how drones can be used to make such deliveries to consumers.

Greater productivity through technology in the workplace could deliver a range of potential *employee* benefits:

- **A return to real pay rises.** The use of 4IR technologies provides significant opportunities to improve productivity levels in the workforce. This could help drive the UK out of the lost decade of wage growth and back into a world where living standards start to show sustained improvements again.
- **Leisure time – the four-day week.** Through the automation of tasks, and higher levels of productivity, use of 4IR can enable the UK to produce more goods and services while at the same time working fewer hours than at present. Increasingly, people could be able to spend less time at work and more time with families and engaging in leisurely pursuits. Conceivably, a four or three day working week could become the norm over the coming decades.
- **The end of tedium – more fulfilling work.** As well as boosting incomes and leisure time, 4IR has the potential to make the hours that we do spend working more enjoyable and less dominated by monotonous tasks.
- **Supporting family life and eroding pay gaps** - By enabling people to work fewer hours, more flexibly, 4IR can help ensure that family life flourishes in the 21st

Century – allowing individuals to spend more time with their relatives and friends.

There might be particularly strong benefits for those that need to care for others – whether that be a parent looking after children, or an individual looking after a spouse or elderly relative with care needs. Being able to work from home, and work more flexible hours, can increase the ability of these individuals to participate in the labour market and gain income and skills from work. Being able to work from home while caring for family might allow more women to remain active in the labour market while also supporting their families – helping reduce the current gender pay gap that exists in the UK.

- **A safer and healthier workplace** - The use of robotics and connected devices has significant potential to make the workplace safer. Robots will increasingly undertake relatively dangerous manual tasks, such as lifting and moving heavy objects. In an office environment, the use of connected devices can help ensure workers take appropriate rest breaks from computer screens to avoid eye strain, and to inform staff to move away from the desk to get some physical exercise. There is significant scope for artificial intelligence, data analytics and connected devices to help improve mental health at work – for example through checking if some employees are working excessive hours or not taking a lunch break.

We also identify a range of challenges as 4IR is rolled out in the workplace:

- **Infrastructure barriers limiting the rollout of 4IR.** Britain lags other European countries in the race to deliver full-fibre networks that generate speeds of 1 gigabits per second, with only 4 percent of UK premises connected, compared with 71 percent in Spain and 89 percent in Portugal. The UK had the 35th highest average broadband speeds across the world in 2018, slipping down from having the 31st highest speeds in 2017. With the UK falling behind competitor economies, there is a strong need for policy intervention to ensure further improvements in digital infrastructure.
- **Skills barriers and the need for reskilling.** The rise of automation is going to require a wide range of individuals to adopt new skills, both IT and non-IT related, in order to remain employable. Traditional career paths within companies are likely to be disrupted, as middle management roles and routine entry-level roles are increasingly automated. The notion of a job for life, or even a career for life, is rapidly fading. .

Despite this, the UK's education system is not fit for the future. We still have a system of learning which revolves around acquiring qualifications in younger age and then abandoning formal education in one's late teens or early twenties. That needs to change, particularly as we enter an era in which the reskilling of older individuals becomes increasingly important.

- **The risk of smaller companies falling behind.** Many small businesses are not even taking advantage of long-established technologies, let alone new ones such as AI

and data analytics. Some 2.6 million SMEs across the UK are still not accepting card payments, for example.

- **Question marks over the extent to which employees will get a “fair” share of the benefits from 4IR.** There are concerns that new technologies could see wages and productivity becoming de-coupled. One way that this could occur is if new technologies erode employee bargaining power in wage negotiations. If job security is perceived to be much lower in a world of rapidly-advancing automation, and if workers see others made redundant as a result of automation, employees may become more reluctant to request a pay rise.
- **Worse outcomes for some workers.** We note that 4IR could worsen quality of work for some in the labour market. For example, connected devices could be used to monitor workers in a way that many would deem intrusive, or to impinge on “out of hours” time such as evenings, holidays and weekends. Data analytics and its use to optimise resourcing could see a growing proportion of the workforce shifted onto zero-hours contracts – leaving more individuals facing income volatility.

To ensure the benefits of 4IR are maximised, and the challenges minimised, we recommend that government and policymakers:

1. **Develop a cross-government 4IR working group to develop a clear action plan for driving forward the Fourth Industrial Revolution in the UK**, with sub-committees for infrastructure, the business environment, homes and health & social care, as well as potentially other areas.
2. **Develop a broad 4IR infrastructure strategy that takes account of all relevant aspects of infrastructure** – such as fixed and mobile connectivity, roads, car design, public transport, energy infrastructure and planning requirements.
3. **Require employers to consult with employees on the use of new forms of workplace surveillance and monitoring.** In addition, government should create a series of employee panels to examine how use of 4IR is impacting the quality of work in the UK – for example, monitoring the extent to which technology is being used to shift individuals onto zero hours contracts, or impose new heavy-handed forms of employee monitoring.
4. **Require large companies in the UK to report on the extent to which profit and productivity gains are translating into higher employee wages** – applying social pressure on companies to share productivity gains with employees. The current government should also examine the case for making its proposed cuts to corporation tax contingent on better employee outcomes, such as wage rises and job security.
5. **Give the National Retraining Scheme a broader remit, to offer a wide range of retraining opportunities across the whole economy** – including through the widespread provision of online, evening and weekend learning solutions.
6. **Provide tax relief on costs associated with self-funded work-related training for new skills**, to encourage more individuals to reskill and prepare for the changing

job market as 4IR is rolled out.

- 7. Work with town planners and local government to explore the role that co-working spaces can play in improving SME access to and use of new technologies such as high quality videoconferencing facilities.** This should include exploring the role that the government can play in turning some of its own buildings into co-working spaces.
- 8. Ensure the CMA has sufficient resource and remit to deal with the emerging competition challenges posed by new technologies.**

CHAPTER 1: INTRODUCTION

The world of work is about to go through a period of profound change. The rise of robotics, big data and artificial intelligence in the so-called “Fourth Industrial Revolution” (“4IR”) is set to dramatically alter the way that we live, work and learn.

Done right, 4IR could dramatically improve our working lives – boosting wages, putting an end to the UK’s underwhelming productivity levels and leading to a greatly improved work-life balance. With its world-leading universities, there is scope for the UK to become a global leader in some of the high growth industries of the future such as artificial intelligence. Increased use of telecommunications technologies such as high-quality video conferencing could do away with tiring business trips which keep workers apart from their families. And a growing ability to undertake work flexibly and remotely will make it much easier for carers, parents and the elderly to continue to participate in the labour market. There is scope to use 4IR to strengthen family life and close the gender pay gap.

Yet at the same time, 4IR brings with it substantial challenges for employers, workers and policymakers. As has been widely discussed in recent years, the rise of robotics and artificial intelligence could disrupt the labour market dramatically as millions of jobs are automated. Depending on its implementation, 4IR could exacerbate existing inequalities in the economy – widening substantial wealth gaps between households and businesses. While 4IR can improve working lives for many, increased use of technology to monitor workers and regulate working hours could worsen the working lives of others - ushering in an era of income uncertainty and loss of privacy. Heavy-handed monitoring of employees in some workplaces – down to the level of toilet breaks being timed – has raised questions about the intrusiveness and ethical behaviours of some employers using new technologies.

There is a strong role for policymakers to play in limiting and preventing the potential challenges and negative impacts associated with 4IR, while ensuring that the benefits can be maximised. This includes via ensuring that the UK has the right infrastructure and skills in place to utilise new technologies to their maximum effect.

In this report, we explore the benefits, challenges and policy implications of 4IR in the *workplace*. In particular, we explore the extent to which 4IR can deliver gains for both employers *and* employees, and the extent to which 4IR can benefit smaller businesses as well as larger ones. To gain broad support, policymakers need to ensure that 4IR brings widespread benefits, rather than widening existing inequalities in the economy.

This is the second in a series of reports that the Social Market Foundation is undertaking on the Fourth Industrial Revolution, following our May 2018 report on the implications of 4IR in the *home*¹.

The structure of the report is as follows:

- **Chapter 2** examines the employer benefits of 4IR in the workplace, particularly with respect to improving workplace productivity.
- **Chapter 3** explores the potential employee benefits from 4IR in the workplace.

¹ SMF (May 2018), “4IR in the Home: Maximising the Benefits”

- **Chapter 4** examines the challenges associated with the rollout of 4IR in the workplace.
- **Chapter 5** examines the policy implications of 4IR in the workplace, setting out a range of recommendations for government.

What do we mean by 4IR?

The Fourth Industrial Revolution (4IR) is a term that is gaining mainstream use as the technology that underpins it is becoming more and more relevant in our day-to-day lives. Yet many of us do not know what the Fourth Industrial Revolution is, or are confused by the terms used to describe the technologies that comprise 4IR – the internet of things, big data and machine learning, for example. This report seeks to address this issue.

A simple way to consider progress is that:

- The First Industrial Revolution saw water and steam used to power and mechanize production.
- The Second used electric power to create mass production.
- The Third used electronics and information technology to automate production.
- The Fourth Industrial Revolution is building on the Third, the digital revolution that has been occurring since the middle of the last century.

4IR is characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres – artificial intelligence, big data, machine learning and “the internet of things” which is seeing an increasing proportion of household and business appliances connected to the internet.

According to the World Economic Forum, there are three reasons why today’s transformations represent more than a prolongation of the Third Industrial Revolution but rather the arrival of a Fourth and distinct one: speed, scope, and systems impact. On speed, when compared with previous industrial revolutions, the Fourth is evolving at an exponential rather than a linear pace. In scope, it is disrupting almost every industry in every country, with robotics and artificial intelligence potentially changing the types of jobs available in our economy dramatically – and the skills needed to perform them. The breadth and depth of these changes could transform the entire system of production, management, and governance.

Definitions of the types of technologies comprising the Fourth Industrial Revolution vary from source to source, though in this research our focus lies on:

- The internet of things – household appliances that are connected to the internet, enabling them to send and receive data. Examples include “smart” washing machines and thermostats which can be controlled remotely, for example via a smartphone.
- Big data – the use of large datasets (e.g. of consumer behaviours) created and analysed using new technologies.
- Artificial intelligence – complex algorithms capable of decision-making and learning over time.
- Robotics – the use of machines to automate tasks.
- Autonomous vehicles such as “driverless cars”.

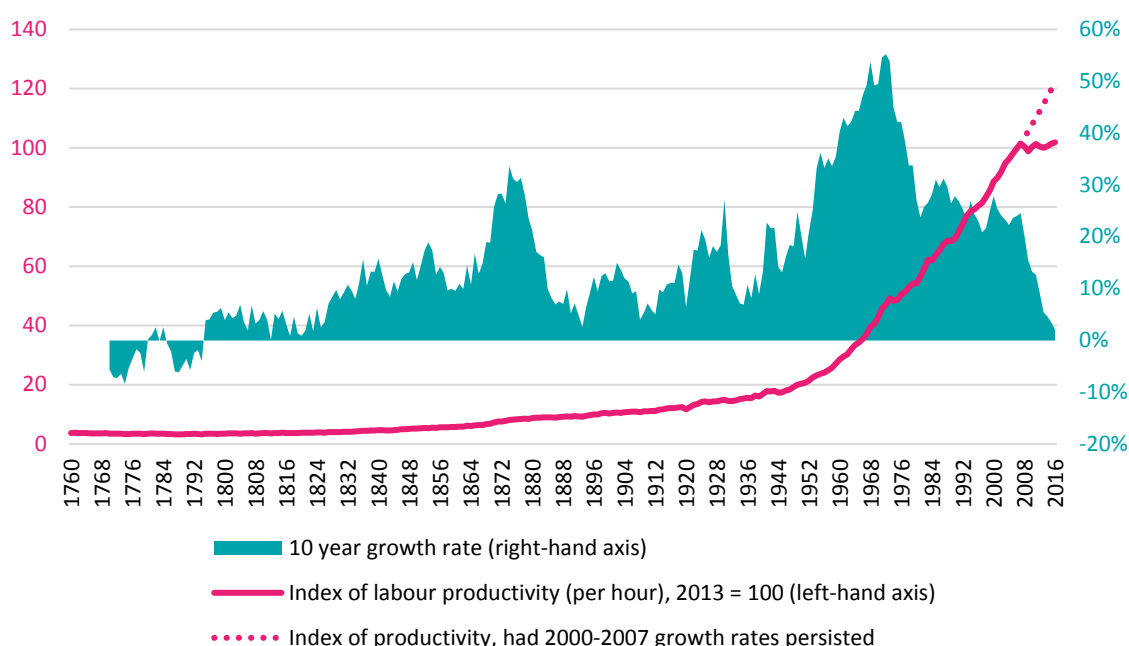
CHAPTER 2: BENEFITS FOR EMPLOYERS – ENDING THE UK’S PRODUCTIVITY CRISIS

This chapter explores the potential employer benefits that could be realised through the adoption and increased uptake of 4IR technologies in the workplace. In particular, it explores the role that new technologies can play in ending the current workplace productivity crisis.

Getting business productivity back on track

The UK economy is in the midst of a productivity crisis; on a per hour worked basis, labour productivity has broadly flatlined since the global financial crisis of 2008/09 – leading to the worst decade of productivity growth since the early 1800s.

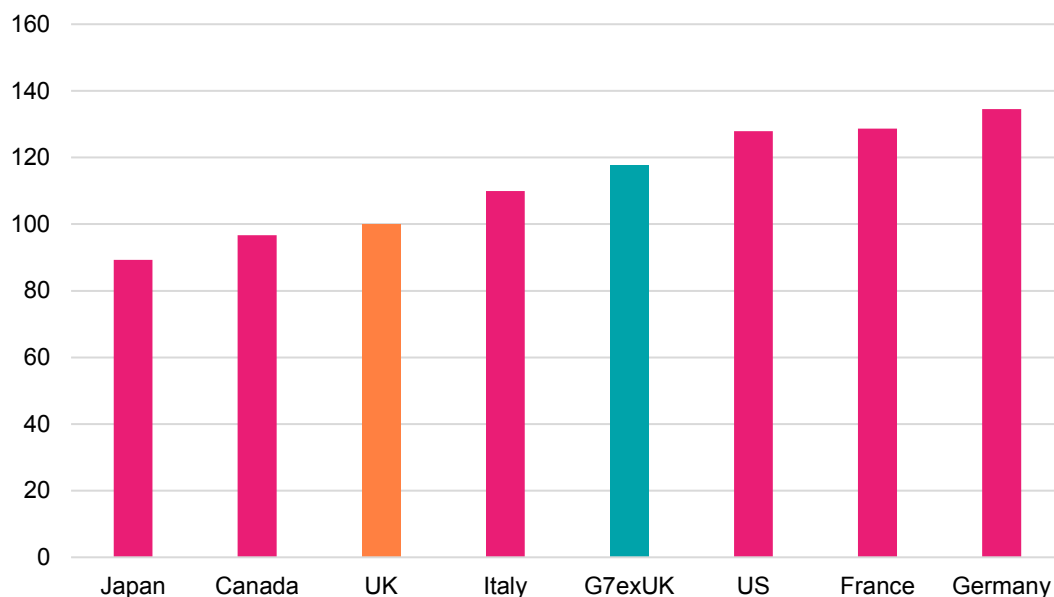
Figure 1: Index of productivity (output per hour worked), 2013 = 100



Source: Bank of England, “A Millennium of Macroeconomic Data”

This has a substantial impact on the bottom line for UK plc. If, following the financial crisis, productivity had grown at a similar rate to the pre-crisis trend, workers would be producing about 20% more for each hour worked – as Figure 1 illustrates – with associated gains to employer turnover and profits.

Not only is UK productivity flagging by historical standards, but also by international standards. Among the G7 group of nations, productivity levels in the UK are significantly below those seen in the US, France, Italy and Germany. The typical German worker can produce more economic output in four days as a UK worker can in five days. Put simply, if the UK were as productive as Germany, the typical working week could be cut from five days to four days and workers would still be able to produce more than they currently do.

Figure 2: Index of productivity (GDP per hour worked), 2016, UK = 100

Source: ONS

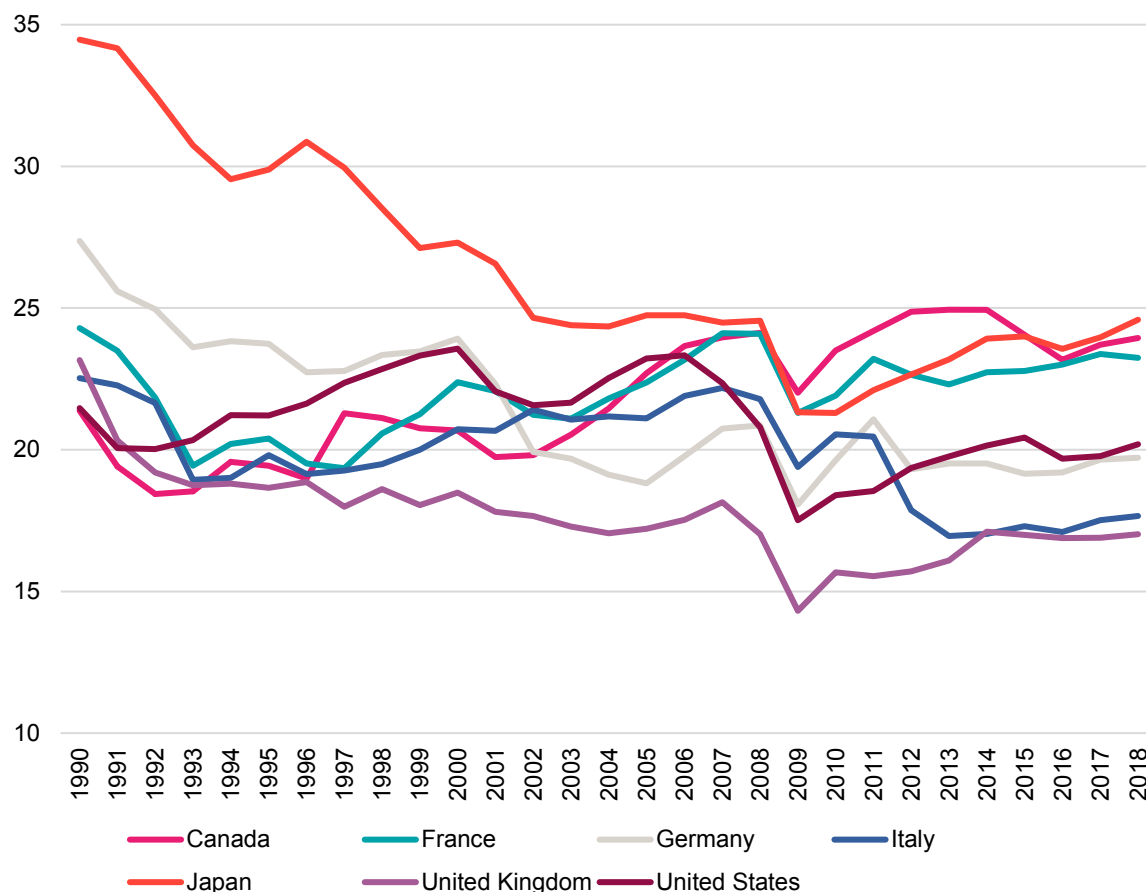
The causes of the productivity crisis in the UK have been discussed at length in recent years, given that it is weighing on economic growth and, in turn, living standards. Explanations are wide ranging and include:

- The negative impact of the 2008/09 downturn on the financial services industry, which had been a key driver of productivity growth in recent years.
- Rising employment in relatively low-wage low-productivity sectors of the economy such as care, and an increasing proportion of low-income self-employed workers.
- Declining North Sea oil production weighing on economy-wide productivity levels.
- Inaccurate reporting of statistics. Some have argued that the productivity crisis might not be as dramatic as reported in official figures. This could be the case if, for example, official statistics underreport productivity growth in hard-to-measure technology and services industries.
- The “lifestyle economy” – whereby a growing proportion of the workforce might be actively choosing to work in relatively low productivity, low pay jobs – for example because they find such work less stressful and more enjoyable².
- Low skill workers entering the labour force as unemployment has fallen, driving down average productivity levels.
- Underinvestment by UK firms in productivity-enhancing technologies and an overreliance by UK firms on business models that revolve around low investment in technology and employee training (i.e. business models that revolve around having a relatively low wage, low skill workforce).

² <https://blogs.spectator.co.uk/2017/11/changing-lifestyles-not-zombie-companies-are-the-reason-for-low-productivity/>

The latter point is perhaps the biggest concern for policymakers. IMF data show that the UK consistently had the lowest investment share of GDP of all G7 economies over the past two decades. While investment accounted for 23% of GDP in 1990, the IMF estimates that it will account for just 17% of GDP in 2018.

Figure 3: Investment as a % of GDP



Source: IMF World Economic Outlook Database

Unless businesses take a longer-term view of the UK economy, and make investments which support long-term over short-term profits, the UK risks falling further behind other countries in terms of its workplace productivity. As we discuss, evidence suggests that UK businesses are falling behind those in other countries in terms of investing in and adoption of the latest technological innovations, such as big data analytics and robotics.

How 4IR will help employers

4IR has huge potential to end UK plc's productivity crisis – if businesses are willing and able to make the necessary investments. As well as “4IR sectors” such as robotics having huge growth potential in themselves, 4IR is set to shake up the way business is undertaken across the whole economy.

The data revolution in business

A “big data” revolution is currently taking place, where businesses increasingly have access to vast pools of data and analytical tools that they can use to make sense of it. Access to data has increased drastically following the rise of the internet and computing power, with firms now able to access previously inconceivably large quantities of information.

In the retail space, for example, businesses now have substantial amounts of information on consumer spending patterns, preferences and behaviours which they can use to tailor their pricing, product offer and store locations. In manufacturing, detailed data analysis is being used to check product quality, track defects and plan supply chains.

Use of big data and data analytics bring with it a wide range of productivity benefits, including:

- **Cost savings** – using data to identify sources of wastage within supply chains, such as underutilised labour, investments that are not yielding significant benefits and energy & water leakages.
- **Time savings** – for example, through being able to analyse real-time data rather than having to wait for it to be collated. In the retail space this could include real-time analysis of barcode scanner data to identify trends in demand and potential supply shortages for different products.
- **New product development** – using data to inform product design and improvement.
- **Understanding market conditions** – such as predicting potential upturns and downturns in product demand, and adjusting business behaviours accordingly.
- **Being able to provide more bespoke, targeted products for individuals rather than one size fits all solutions.**

Despite the potential productivity benefits that could be realised through better use of big data and data analytics, survey evidence suggests that UK businesses are less data-driven than their peers in other countries. According to the PwC Data and Analytics Survey, just 30% of UK executives described their organisation as highly data-driven. This compares with 45% in the US and 53% in China³.

Furthermore, UK businesses are for the most part currently using data in a relatively basic way. While 59% of executives surveyed by PwC stated that their business used data for description and diagnosis in decision-making processes, just 24% went further and used data for predictive analytics. A smaller proportion still (13%) went further and used *prescriptive* analytics – using prescriptive approaches to make automated decisions, with associated gains to productivity. There is clear scope for UK businesses to go much further in their use of data over the coming years.

³ <https://www.pwc.co.uk/issues/data-analytics/insights/big-decisions-2016.html>

Artificial intelligence and machine learning

Artificial intelligence and machine learning – the use of statistical techniques to give computers the ability to “learn” – are being increasingly used by businesses to speed up processes and inform decision making.

The Fourth Industrial Revolution is set to see a dramatic increase in the ability of computers to make “intelligent” decisions, raising a number of questions about the extent to which 4IR, unlike past automation, could have a substantial impact on the nature of white-collar professions. Jobs that had previously been thought to be well beyond the reach of automation such as law, marketing, financial advice, accountancy and medicine, could soon change significantly through use of AI. As the case studies below show, already companies across a range of sectors are using AI and machine learning to improve their product offers, reduce costs and in turn bolster productivity – an initial glimpse at some of the possibilities being realised as the Fourth Industrial Revolution gains momentum.

Case studies: Use of AI in business

Ocado replacing barcode scanning with AI “vision” to speed packing processes

Online grocer Ocado is in the process of developing a computer vision system that could eventually completely replace barcode scanning by workers in its warehouses. The machine learning project will see computers gradually learning to recognise different grocery products based on their appearance – speeding up the process of picking and packaging in warehouses. Unlike barcode scanning, computers would not need to get a product in a precise position (so a barcode can be read) in order to identify it.

Virgin Holidays using AI to construct marketing emails

Virgin Holidays is using AI technology from UK startup Phrasee to automate the writing of its marketing email subject lines. The technology looks at emotions, sentiments and phrases in order to predict what kind of copy email recipients will best respond to.

Using data and AI to produce well-tailored subject lines for marketing emails has led to a 10% increase in open rates for marketing emails – a key metric of how successful a marketing campaign has been.

Robo financial advice at UBS

Financial services firm UBS has, in 2018, launched a robo financial advice service – through which the company hopes to be able to provide affordable finance advice to individuals with a lower level of wealth than its traditional customer base.

The service, called UBS SmartWealth, uses data on an individual’s needs and risk profile to provide tailored advice and investment products. Individuals with a minimum of £15,000 to invest can use the service, a fraction of the £2 million required to open a UBS private bank account.

The AI-driven power station

In March 2018, energy company EDF announced the creation of a new AI start-up, Metroscope, aimed at consumers in industry, such as electricity producers.

Metroscope uses AI to provide reliable, automatic diagnostics, immediately and accurately – to identify hazards affecting industrial processes and long-term damage to components. Using the technology, technicians will be more likely to resolve hazards before they become actual faults affecting a plant’s (for example a power station’s) productivity.

The rise of the robots

Increased use of robotics has the potential to increase business productivity as a growing proportion of physical tasks are automated. Robots improve productivity when they are used in tasks that they can perform more efficiently and to a higher and more consistent level of quality than humans. One clear example of this is the increased use of robots in the manufacture of automobiles.

Figure 4: Robots in automotive manufacturing

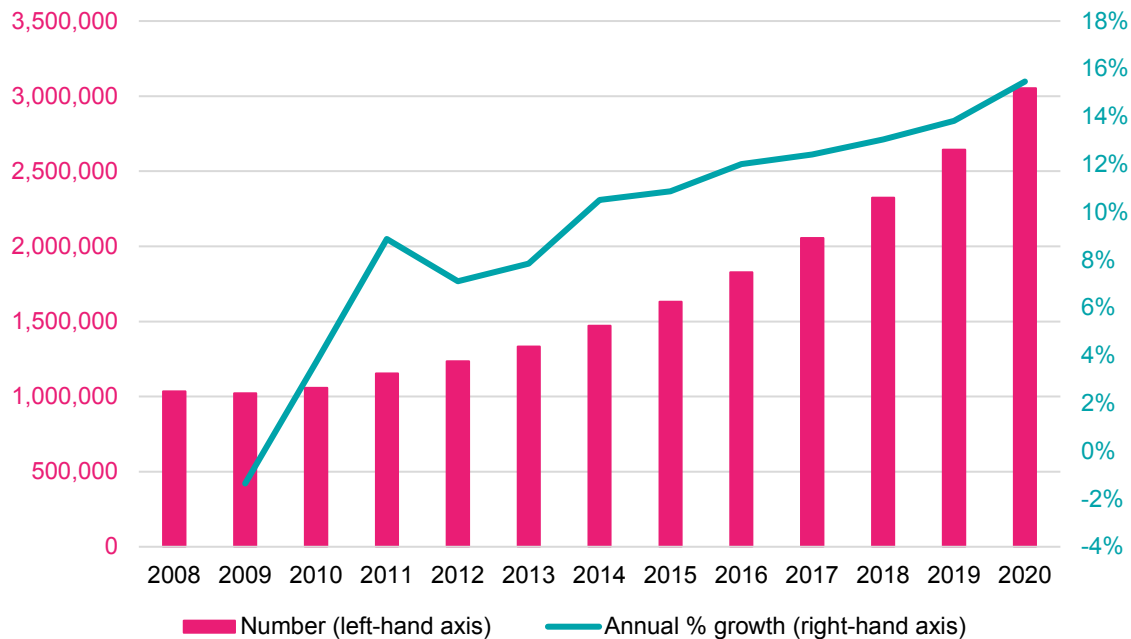


The role of robotics in driving productivity growth across the globe is clear. In a study focused specifically on robotics for the Centre for Economic Performance at the London School of Economics, Georg Graetz and Guy Michaels concluded that robot densification increased annual growth of GDP and labour productivity between 1993 and 2007 by about 0.37 and 0.36 percentage points respectively across 17 countries studied, representing 10% of total GDP growth in the countries studied over the time period. This is comparable to the 0.35 percentage point estimated total contribution of steam technology to British annual labour productivity growth between 1850 and 1910⁴.

Given improving technologies and the potential productivity gains that they can generate, there has been an unsurprising increase in robot usage in recent years. Data from the International Federation of Robotics (IFR) show the number of operational industrial robots across the globe more than doubling from 1 million to 2.3 million between 2008 and 2018, with the number of robots expected to breach the 3 million mark by 2020.

⁴ Graetz and Michaels, 2015, "Robots at Work"
<http://cep.lse.ac.uk/pubs/download/dp1335.pdf>

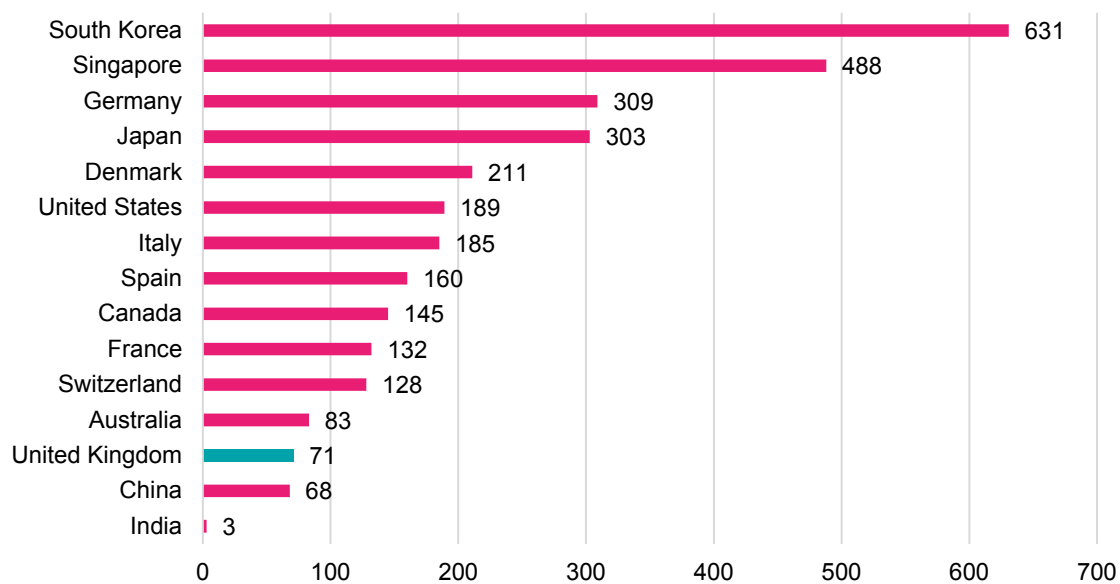
Figure 5: Estimated worldwide operational stock of industrial robots (estimate for 2017, forecast for 2018-2020)



Source: International Federation of Robotics

However, despite strong global growth and clear productivity gains, use of robotics in the UK is more limited than in other nations. Data from the IFR show that in 2016 there were just 71 installed industrial robots per 10,000 manufacturing employees in the UK, about a fifth the 309 seen in Germany. As the figure below shows, the UK lags behind a range of developed economies in terms of its uptake of robotics. Addressing the “robot shortfall” in UK manufacturing could go some way towards addressing the country’s productivity crisis.

Figure 6: Installed industrial robots per 10,000 employees in the manufacturing industry (2016)



Source: International Federation of Robotics

Autonomous vehicles and drones

One particular type of automation that is gaining interest is autonomous vehicles (such as “driverless cars”) and autonomous drones.

Automated commercial vehicles have the scope to be more efficient and productive than man-driven ones. Autonomous freight vehicles, for example, might be able to travel continuously for longer, given the absence of issues such as driver fatigue which necessitate rest breaks.

Fleets of autonomous vehicles might also be increasingly shared across businesses, called upon when required, helping to reduce costs associated with owning company cars.

Drones are increasingly being explored as a tool for businesses. Given their ability to travel in the air to avoid road traffic, drones can offer an efficient solution for transporting goods across geographies. Retailers such as Amazon are exploring how drones can be used to make such deliveries to consumers.

By being able to survey regions that are difficult to access by road, drones offer a range of business benefits. For example, drones can be used to survey areas of land and sea to identify natural sources – with associated benefits for the mining and oil extraction industries.

Figure 7: A delivery drone



The internet of things - connected devices to improve employee health and energy efficiency

The so-called “internet of things” is seeing a growing proportion of household and commercial devices connected to the internet. Examples include smart light bulbs and smart thermostats which can be controlled remotely, smart speakers with voice recognition technology and voice-over-IP phones which can be used to make phone calls over the internet.

Being able to control lighting and heating remotely can help businesses make energy savings and in turn reduce costs. Smart sensors can help regulate the proper temperature in offices and other commercial spaces and adjust lighting to suit a room's occupants as well as those expected to arrive soon. Sensors tracking room usage and employee behaviours can help firms establish potential efficiency savings that can be realised through, for example, redesigning commercial spaces – eliminating the need for costly time-and-motion studies undertaken by consultants.

The internet of things also has a role to play in improving workplace fitness and reducing time spent off work due to poor health. For example, if sensors detect that an occupant at a desk has been still for too long, it can alert the individual that it's time to take a break and move around. Such alerts could be given by a computer screen, or by wearable devices.

More shared resources and a growing collaboration economy across businesses

With a growing portion of devices in commercial environments connected to the internet, there is scope for businesses to increasingly share assets with each other via an internet-enabled sharing economy. Connecting devices to the internet facilitates a sharing economy, by making it easier for asset owners to track the location of items, as well as levels of usage and wear & tear.

As discussed earlier, one manifestation of this is car sharing in a commercial context. But it also extends to sharing commercial spaces such as offices – with companies able to electronically book desks, meeting rooms and other spaces in a co-working environment on an as-needed basis. This can result in substantial commercial real estate savings for companies.

Co-working spaces are already taking off in the UK. According to Cushman & Wakefield, London is the global capital for co-working spaces, easily outstripping New York in terms of both space and number of operations. Across Central London, flexible workplace providers took more than a fifth of office space last year. A total of 2.5 million sq ft of space was let in 2017, tripling the previous year's volumes⁵.

Not only does co-working and the sharing of commercial assets allow firms to save money and boost their productivity levels, but it also opens up more opportunities for collaboration between businesses – particularly important in knowledge-intensive sectors such as technology. The ability to discuss ideas and joint working opportunities with other businesses offer additional potential productivity gains.

Summary

On average UK businesses are productivity laggards compared with those in the US, France, Germany and Italy. A key driver of this is likely to be relatively low levels of investment in the economy – including in emerging 4IR technologies.

While 4IR technologies offer a wide range of opportunities for UK businesses to increase their productivity levels, the UK currently has a relatively low level of uptake compared

⁵ <http://www.cushmanwakefield.co.uk/en-gb/news/2018/01/coworking-report>

with other countries. For example, use of robotics in manufacturing is substantially lower than in countries such as Germany, Japan, France and the US. With respect to big data, a smaller proportion of UK-based business executives describe their companies as being data-driven than in other markets such as the US and China. In order to bolster productivity and improve business performance, it is crucial that the UK economy catches up.

CHAPTER 3: WHAT'S IN IT FOR WORKERS?

The previous chapter examined how 4IR has the opportunity to address the UK's productivity crisis, and improve the productivity of the nation's businesses. In this chapter, we focus on *employees* of companies in the UK, and the benefits that they could realise as new technologies such as robotics, AI and big data analytics are rolled out across the workforce.

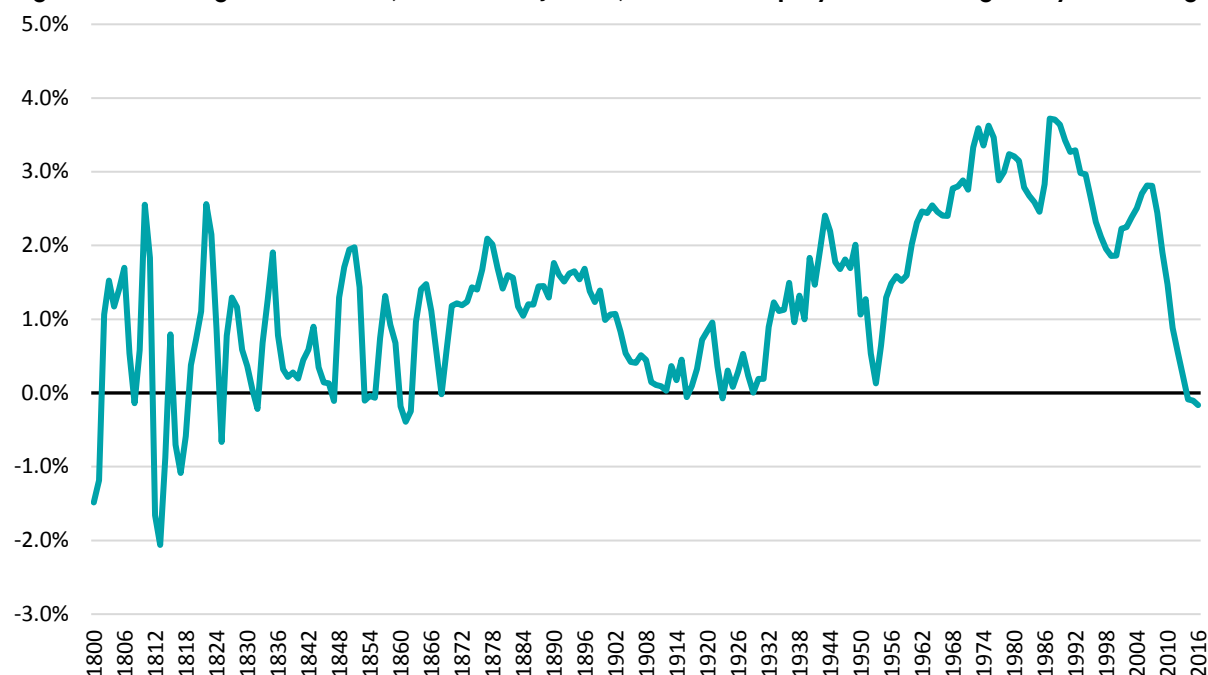
Critically, for 4IR to be a success, it has to gain the support of the workforce. If employees believe that technology is acting *against* rather than *for* their interests, then there is a risk of political pressure building to hold back its implementation – for example, curbing the extent to which processes can be automated at the expense of jobs undertaken by workers.

As we argue in this chapter, we believe, done right, 4IR has significant potential to make the working day more enjoyable – flexible, less tedious and more inclusive. Technological progress always involves change in the way we live and work – what is key is managing these changes in a way that maximises benefits while protecting and helping out those that stand to lose out from change.

A (potential) return to real pay rises

Alongside the productivity crisis described in the previous chapter of this report, the UK is going through a *wage crisis*. After adjusting for inflation, average employee wages in the UK remain lower than they were before the global financial crisis. The country has gone through a lost decade of wage growth – the weakest period of pay rises since the early 1800s.

Figure 8: Annual growth in real (inflation-adjusted) full time employment earnings, 10 year average



Source: Bank of England, "A Millennium of Macroeconomic Data"

The productivity crisis and the wage crisis are strongly linked. Unless productivity levels in the UK start to pick up, sustained increases in employee wages are likely to remain elusive; after all, firms can only sustain continued pay rises if workers are producing more goods & services which can be sold to cover a growing pay bill. Increasing the National Minimum Wage and National Living Wage might help boost pay levels for lower paid workers, but they risk leading to job losses if lower paid workers do not become more productive.

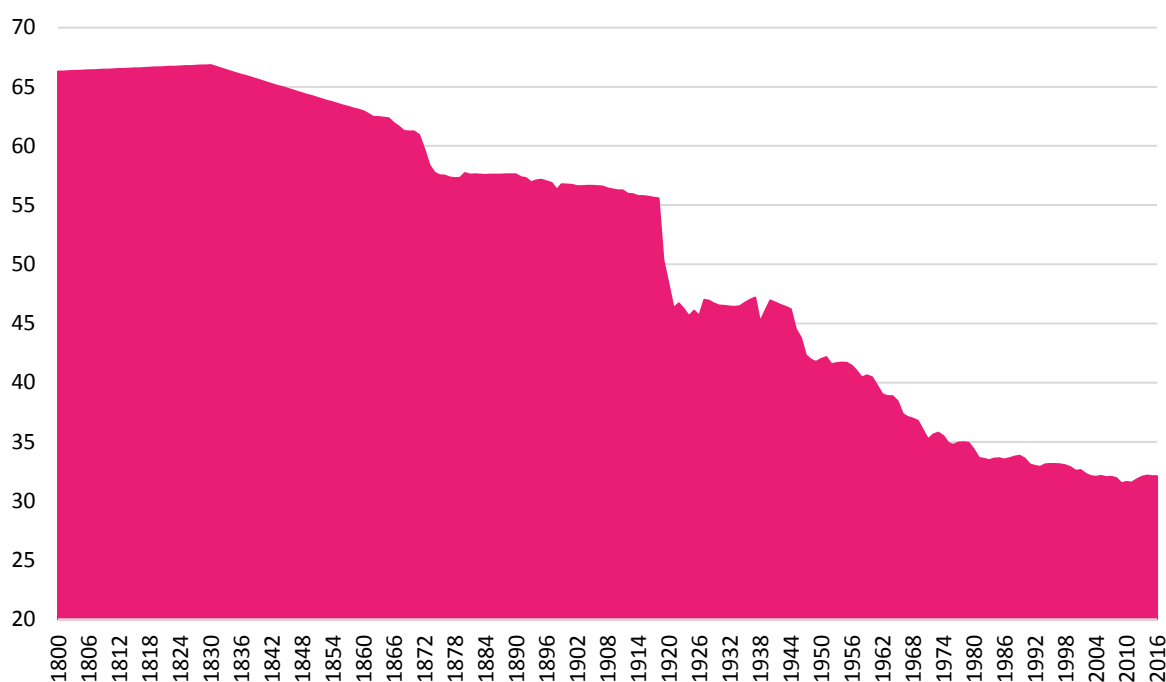
As we argued in the previous chapter, the use of 4IR technologies – robotics, big data, connected devices and autonomous vehicles – provides significant opportunities to improve productivity levels in the workforce. This could help drive the UK out of the lost decade of wage growth and back into a world where living standards start to show sustained improvements again. Having said that, as we discuss in the next chapter of the report, this is contingent on UK workers sharing fairly in the gains from productivity growth – something that is by no means guaranteed.

Leisure time – the four day week

In addition to higher wages, 4IR opens up the possibility for individuals to spend more time enjoying leisure rather than working and commuting. As the Figure below shows, while the average working week has declined significantly over the past century, recent years have seen relatively little change.

Through the automation of tasks, and higher levels of productivity, use of 4IR can enable the UK to produce more goods and services while at the same time working fewer hours than at present. Increasingly, people could be able to spend less time at work and more time with families and engaging in leisurely pursuits. Conceivably, a four or three day working week could become the norm over the coming decades.

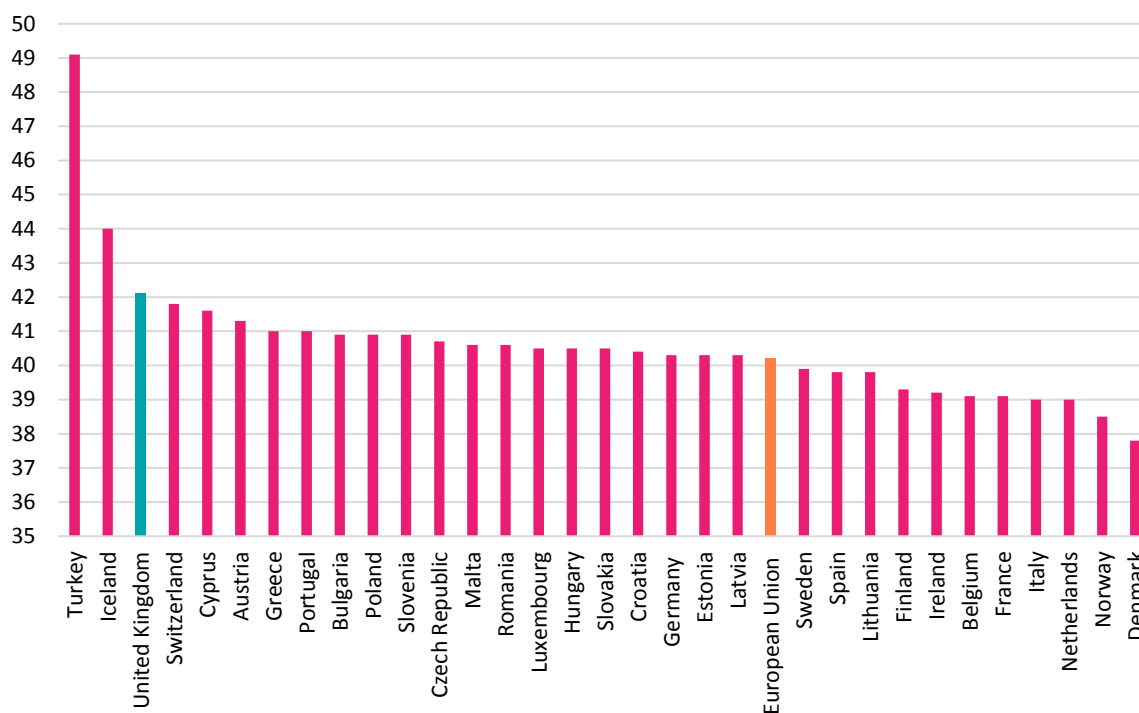
Figure 9: Average weekly hours worked



Source: Bank of England, "A Millennium of Macroeconomic Data"

At present, UK employees work some of the longest hours in Europe (see graph below) – in part driven by relatively low levels of productivity in the economy which mean UK employees have to work longer hours to produce the same amount of goods and services as their counterparts in France and Germany. By embracing technological change and the associated productivity benefits, the UK will be better placed offer an improved work-life balance for employees.

Figure 10: Usual weekly hours in the main job for full-time employees, average, 2017

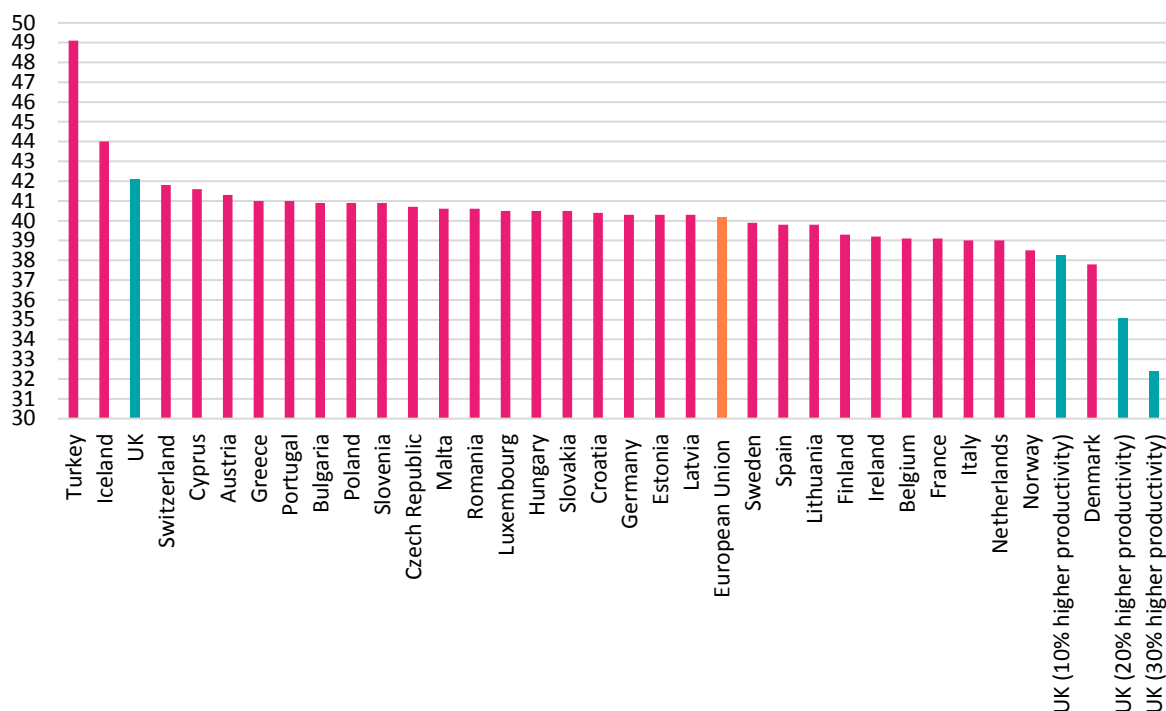


Source: Eurostat

To put the leisure time gains that could be realised from increased productivity into context, the chart below shows the extent to which hours worked in the UK could be reduced, while keeping economic output and incomes the same, if productivity were to increase. If workforce productivity increased by 10%, it would be possible to maintain current incomes while reducing the typical working week of full-time employees from 42 hours to 38 hours. A 30% productivity gain would allow the working week to be reduced to 32 hours – essentially ushering in the four day working week.

Of course, some (or even most) workers might prefer to work longer hours than that, and be paid accordingly. But these illustrative examples highlight the leisure gains that could be realised by those that place a higher value on having more free time than on additional earnings.

Figure 11: Usual weekly hours in the main job for full-time employees, average, 2017. Graph also includes hypothetical scenarios where UK workforce productivity is higher and this is entirely translated into reduced working hours rather than higher incomes.



Source: Eurostat

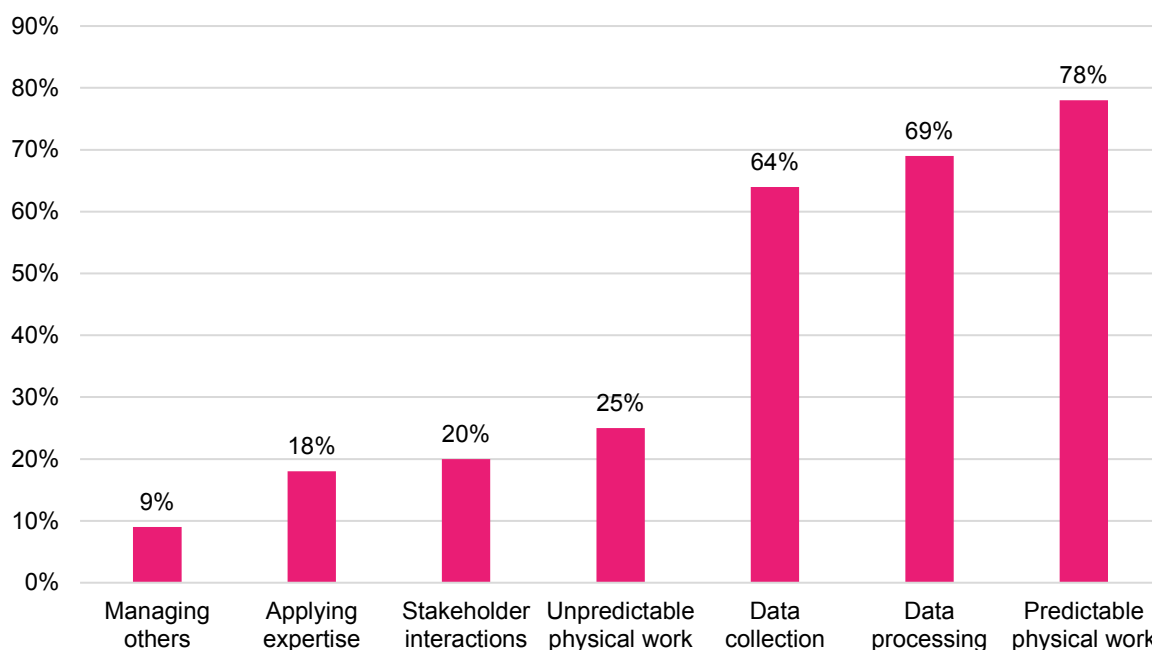
In addition to leisure gains realised through greater workplace productivity, we expect technological developments to drive an increase in the number of individuals that are able to work from home – either on a full-time or a part-time basis. For example, continued improvements in video conferencing quality and online collaboration tools should make it easier for individuals to work remotely as part of a team. Increased home-working in turn increases leisure time by reducing the need of individuals to commute to and from work.

The end of tedium – more fulfilling work

As well as boosting incomes and leisure time, 4IR has the potential to make the hours that we do spend working more enjoyable; less dominated by monotonous tasks. By automating routine and tedious tasks, employees would be freed up to spend time on more creative, challenging and enjoyable work – such as devising new products, developing strategies and (in the case of manufacturing) producing more artisanal manufactured products that are hard to automate.

Analysis by McKinsey and Company in the US estimates that 78% of predictable physical work can be automated by adapting currently demonstrated technology, as can about two thirds of data processing (69%) and data collection (64%) jobs. In contrast, just 9% of managing jobs can be automated, and 25% of jobs involving unpredictable physical work.

Figure 12: % of time spent on activities that can be automated by adapting currently demonstrated technology



Source: McKinsey and Company analysis for the US

The workforce of the future will see many monotonous, tedious jobs become a thing of the past. While this could support wellbeing by increasing fulfilment and enjoyment in the workplace, it raises questions around potential job losses for those doing tasks that can be automated, and the risk of sustained unemployment. Unemployment is a particularly large risk for those lacking the skills to undertake work in areas that are hard to automate – such as management and creative tasks. The precise impact of this change is largely beyond the scope of this paper -- our focus here is on the *workplace* as distinct from the *labour market* -- but it should be noted that estimates for that impact vary quite significantly, as will be discussed in the next chapter.

Supporting family life and eroding pay gaps

By enabling people to work more fewer hours, more flexibly, 4IR can help ensure that family life flourishes in the 21st Century – allowing individuals to spend more time with their relatives and friends.

There might be particularly strong benefits for those that need to care for others – whether that be a parent looking after children, or an individual looking after a spouse or elderly relative with care needs. Being able to work from home, and work more flexible hours, can increase the ability of these individuals to remain in the labour market and gain income and skills from work. Recent SMF research has highlighted the negative impact that being a family carer can have on labour market outcomes; family carers who care for 20 or more hours a week are 22% less likely to be in paid work than non-carers⁶.

Flexible working, supported by new technologies, can go some way towards narrowing the gender pay gap that exists in the UK, where women on average earn less than men. A

⁶ SMF (2018), Caring for Carers

significant part of this pay gap arises from the fact that women are more likely to leave the labour market to look after children or other relatives – thus disrupting their paths of career progression⁷. Recent SMF research showed that while a large majority (94%) of women on maternity leave report intending to return to work in the future, 20% of these did not return to work within a year. Further, the research showed that women dramatically reduce their working hours after becoming parents. In contrast, the average weekly hours worked by men tends to increase after the birth of a child⁸.

Being able to work from home while caring for family could keep more women tied to the labour market while also supporting their families – helping eliminate the current pay gaps that exist in the UK.

Another potential benefit of 4IR is through making it easier for older individuals to remain in the workplace, if they wish. The increasing ability to work from home, and more flexibly, can allow more older individuals to supplement their pension income with wages from employment – which could dramatically improve living standards for those that have been unable to build up a large enough retirement pot to live well on pension income alone.

A safer and healthier workplace

The use of robotics and connected devices has significant potential to make the workplace safer. Robots will increasingly undertake relatively dangerous manual tasks, such as lifting and moving heavy objects. In an office environment, the use of connected devices can help ensure workers take appropriate rest breaks from computer screens to avoid eye strain, and to inform staff to move away from the desk to get some physical exercise.

ONS statistics show that just under a fifth (19%) of sickness-related workplace absence in the UK is due to musculoskeletal problems⁹ – some of which can be prevented through creating more physically active workplaces and encouraging employees to adopt better posture.

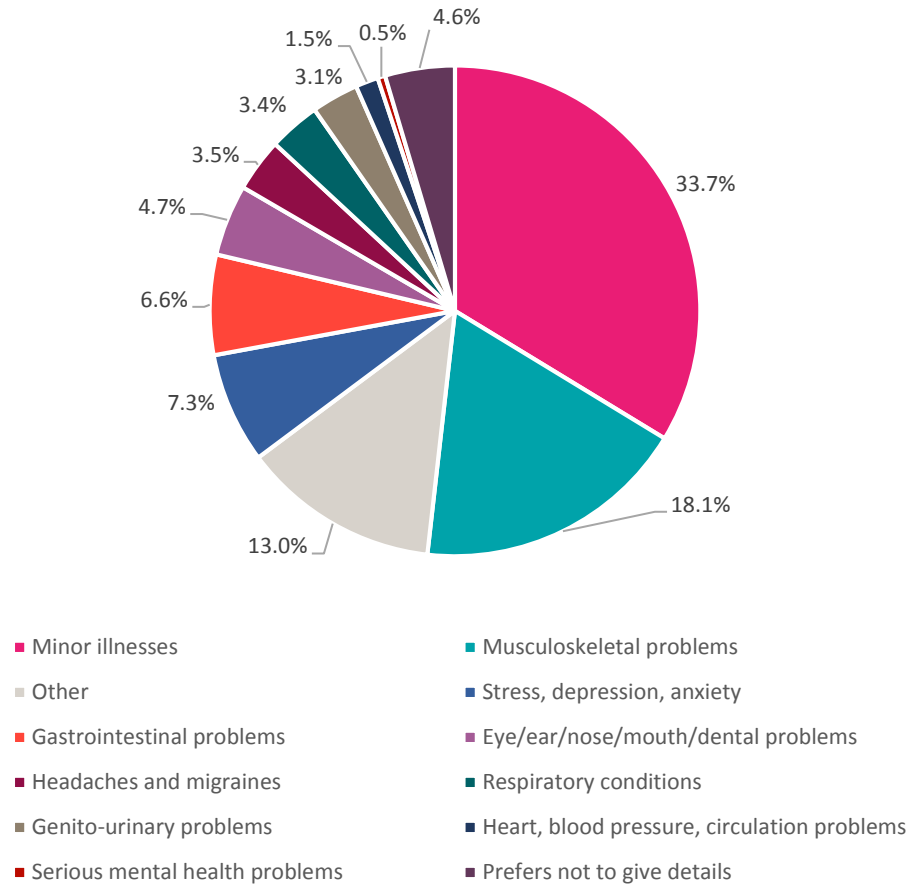
Some 8% of sickness absence is due to stress, depression and anxiety. There is scope for artificial intelligence, data analytics and connected devices to help improve mental health at work – for example through checking if some employees are working excessive hours or not taking a lunch break.

⁷ See, for example, <https://www.ifs.org.uk/publications/12888>

⁸ SMF (2018). Back on Track, Making the Most of Parents' Working Lives

⁹ Musculoskeletal problems' includes back pain, neck and upper limb problems and other musculoskeletal problems

Figure 13: Reasons for workplace absence, UK, 2016



Source: ONS. 'Other' includes the total number of days lost to diabetes as well as days lost to accidents, poisonings, infectious diseases, skin disorders and anything else not covered.

CHAPTER 4: THE CHALLENGES FOR EMPLOYERS AND EMPLOYEES

While 4IR brings with it a wide range of opportunities for both employers and employees, realising these benefits is not without its challenges. Critically, addressing some of these challenges will require intervention from policymakers, or at least continued monitoring from policymakers to ensure that 4IR in the workplace is benefiting, rather than harming, employers, employees and wider society.

Infrastructure barriers

One key barrier to realising the benefits of 4IR in the workplace is lack of supporting infrastructure for businesses. Unless business has access to high quality, high speed broadband, mobile connectivity and a road network that is equipped for a new age of autonomous and electric vehicles, UK firms risk falling behind those in other countries.

One area where the UK lag Britain lags other European countries is in the race to deliver full-fibre networks that generate speeds of 1 gigabits per second, with only 4 percent of UK premises connected, compared with 71 percent in Spain and 89 percent in Portugal¹⁰. A report released in July 2018 suggests that average broadband speeds in the UK are lower than in most EU member states, as well as being lower than in Hong Kong, Singapore, Taiwan and even Madagascar. The UK had the 35th highest average broadband speeds across the world in 2018, slipping down from having the 31st highest speeds in 2017¹¹. With the UK falling behind competitor economies, there is a strong need for policy intervention to ensure further improvements in digital infrastructure.

Skills barriers and the need for reskilling

In addition to having sufficient infrastructure in place, to realise the benefits of 4IR the UK also needs a workforce with the right skills to take advantage of 4IR as the economy restructures itself in light of technological change. Businesses will not be able to realise the productivity gains from innovations such as robotics and big data, without the technicians, data scientists and programmers to support their implementation and use. And workers will not be able to take advantage of emerging jobs if they are not appropriately skilled to do so.

Increased use of robotics and AI is set to dramatically shake up the nature of the labour force. Some jobs will disappear as they are rendered redundant by automation. At the same time, there will be increased demand for jobs in other areas such as engineering, computer programming and creative industries which are difficult to automate.

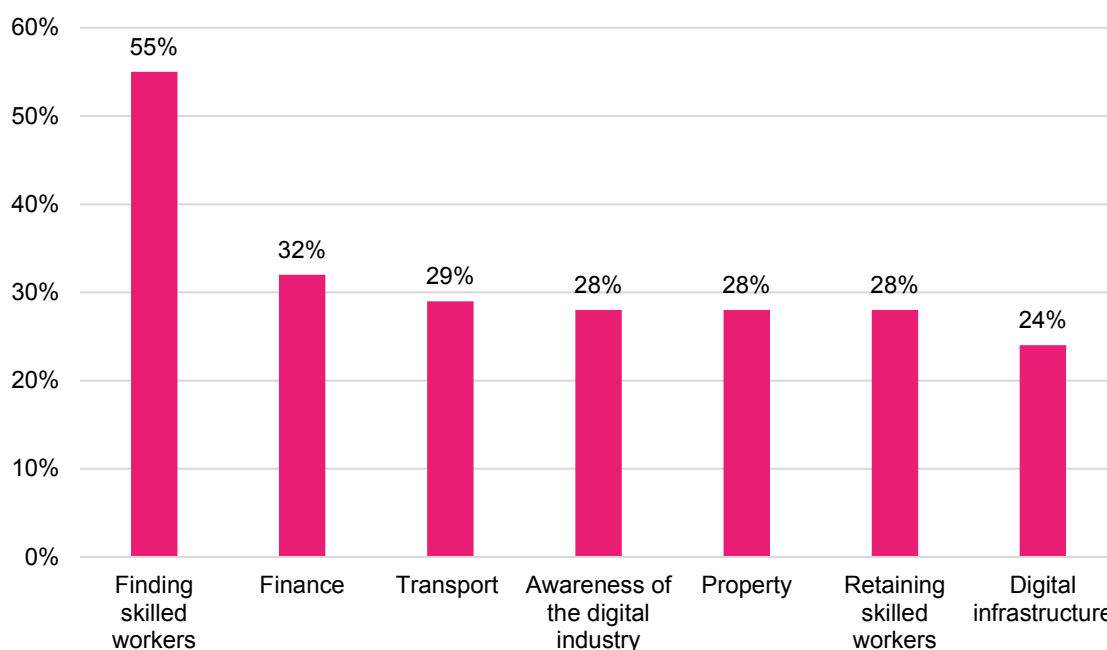
At present, digital skill shortages risk undermining the rollout of 4IR in the UK. Surveys suggest that skills shortages are currently a major barrier to growth in the tech sector. Over half of businesses surveyed by Tech City UK in its Tech Nation 2017 survey stated

¹⁰ <https://uk.reuters.com/article/us-britain-broadband/uk-sets-out-full-fiber-network-plan-to-catch-up-with-european-rivals-idUKKBN1KD0PF>

¹¹ <https://www.theguardian.com/technology/2018/jul/10/uk-slips-to-35th-in-global-table-of-broadband-speeds>

that access to skilled workers was a challenge for their business – the most commonly cited challenge.

Figure 14: % of digital tech businesses reporting issue as a challenge



Source: Tech Nation 2017 survey, Tech City UK

Potential changes to the UK's immigration regime following Brexit could further undermine the ability of UK businesses to access the tech professionals that they need to grow and flourish in a world of 4IR. According to research by Tech City UK and Nesta¹², some 13% of jobs in the digital tech sector in the UK were filled by international workers in 2017. London's digital tech economy is even more dependent on international workers - EU workers hold 11% of jobs in London and non-EU nationals fill a higher proportion still at 20%.

The ability of UK businesses to take advantage of 4IR could also be impacted by a shortage of home grown talent. As the Office for National Statistics noted in an article in 2017, the number of individuals studying Computing for GCSE is low relative to the growing number of jobs and skill requirements in the tech sector¹³. Furthermore, getting more females to study computing remains a challenge; In 2016 just 20% of those taking a Computing exam at GCSE level were female.

Thinking beyond the tech skill requirements associated with 4IR, the rise of automation is going to require a wide range of individuals to adopt new skills, both IT and non-IT related, in order to remain employable. Traditional career paths within companies are likely to be disrupted, as middle management roles and routine entry-level roles are increasingly automated. Having solid "soft skills", such as the ability to communicate ideas well, will

¹² <https://technation.techcityuk.com/digital-skills-jobs/digital-skills-shortage/>

¹³

<https://www.ons.gov.uk/businessindustryandtrade/itandinternetindustry/articles/arewetrainingenoughpeopletobecomeprogrammers/2017-06-19>

become increasingly important even at an entry level within a company, as routine roles are eliminated.

The notion of a job for life, or even a career for life, is rapidly fading and employees in the future are going to need to be flexible in terms of adjusting their skillsets for new job roles. Lifelong adult learning will become increasingly essential.

Despite this, the UK's education system is not fit for the future. We still have a system of learning which revolves around acquiring qualifications in younger age and then abandoning formal education in one's late teens or early twenties. That needs to change, particularly as we enter an era in which the reskilling of older individuals becomes increasingly important – something we discuss in the next chapter of this report.

4IR and employment – are we at risk of large scale unemployment?

One of the most widely-discussed issues related to 4IR is the potential job losses that could arise as robots and AI is increasingly rolled out. A range of high profile economic commentators have raised concerns about large-scale unemployment arising from 4IR, including the Bank of England's Chief Economist, Andy Haldane. There is a growing public policy debate around whether some kind of Universal Basic Income (cash handouts for all in the population) will be needed in the future, to support those that cannot find work.

Yet, despite all of the debate, it is extremely difficult to have a solid understanding of what the impact of 4IR on unemployment will be. Past technological changes – increased use of machinery, electronic devices, the internet and computers – have not translated into widespread unemployment. Critically, because these technologies have increased productivity in the workforce, they have also boosted profits and pay packets, driving up spending power in the economy and creating new jobs elsewhere to replace those lost by automation. New technologies require new kinds of worker to service and utilise them – such as technicians and computer programmers.

Conceivably, 4IR could result in very different outcomes to past technological change, but it is highly likely that much of the current public debate is overstating the negative impacts of automation on employment while understating potential levels of job creation elsewhere in the economy. There is a risk that, like the Luddites of the 19th Century, many are engaging in a one-sided discussion of automation which paints an overly bleak picture.

Estimates of the likely scale of job losses vary substantially. While estimates from Carl Frey and Michael Osborne at the University of Oxford suggest that 47% of US jobs are at risk of “computerisation”, the OECD has estimated that a smaller proportion of jobs are highly automatable. In a recently published paper, they estimate that just 14% of jobs in OECD countries are “highly automatable”, given the challenges associated with automating many aspects of jobs – such as the ability to negotiate complex social relationships, creativity, complex reasoning or the ability to carry out physical tasks in an unstructured work environment.

Furthermore, the OECD estimated that jobs in English-speaking countries, Scandinavian countries and the Netherlands were less likely to be automated than in

Germany, Japan and Southern and Eastern Europe. The UK's relatively smaller manufacturing sector, and larger services sector, than countries such as Germany leaves fewer jobs at risk of automation.

The need to ensure SMEs benefit

One risk is that the benefits of 4IR will not be realised across all firms. If the use of big data, robotics, AI and other technologies is predominantly among larger firms, small and medium-sized enterprises (SMEs) risk falling behind and losing market share. This could see the UK economy becoming one increasingly dominated by a small number of very large companies. As the Social Market Foundation has argued in past research, even at present many markets in the UK are highly concentrated in the hands of large firms, and in several markets this can be shown to have a negative impact on consumers in terms of higher prices and poorer customer service¹⁴.

Poor outcomes for consumers – higher prices and worse customer service – are particularly likely to arise if the market power of large companies acts in a way to undermine competition, making it harder for other firms to enter a market and compete effectively. This is because, in the absence of genuine competitive pressures, incentives to cut prices and improve service quality are relatively limited.

4IR could exacerbate competition concerns in a number of ways. The growing importance of big data and data analytics could give a substantial competitive advantage to larger firms, with their vast pools of customer data which they can use to optimise their products and pricing in a way that maximises profits. Smaller firms, lacking such data, may find it hard to compete and gain market share – raising questions about whether policymakers should be using the tools at their disposal to move us to a world of open, shared data, where smaller companies can more easily benefit from insights gleaned from large datasets.

Another consideration is the potential for *bundling* and *network* effects to grow in importance as the Fourth Industrial Revolution gathers pace. As companies such as Amazon, Google and Apple enter new markets, such as groceries and automobiles, we could see an increasing number of firms offering “lifestyle” subscription packages – where individuals purchase their technology, cars, music and groceries from a single provider. While such bundles could offer a range of consumer benefits, such as lower prices from efficiency savings, bundling may make it increasingly difficult for smaller firms to compete with larger ones. Network effects, whereby individuals benefit from using the same provider as others, are also growing in importance and making it more challenging for small firms to enter and compete in markets – examples at present include computer and smartphone operating systems, and social networking platforms.

In addition to potential competition issues, we note that another challenge among smaller businesses is that so many are not even taking advantage of established technologies, let alone new ones such as AI and big data analytics. Some 2.6 million SMEs across the

¹⁴ SMF (2017), “Concentration, not Competition: the State of UK Consumer Markets”

UK are still not accepting card payments, for example¹⁵. Unless smaller businesses in the UK adopt established technologies such as card payments and online sales platforms, they will fall even further behind as the Fourth Industrial Revolution takes place. Already, as the Figure below shows, smaller companies in the UK are behind larger ones in terms of the amount of turnover generated per employee – one gauge of relative productivity. SMEs need to become more willing to embrace new technologies, in order to compete more effectively and bolster their productivity and profitability.

Figure 15: Turnover per worker, by size of workforce, UK private enterprises, 2017



Source: SMF analysis of BEIS Business Population Estimates

Question marks over the extent to which employees will get a “fair” share of the benefits

Over the past two decades, labour productivity growth in most OECD countries has decoupled from employee wage growth, implying that raising productivity is no longer sufficient to raise real wages for the typical worker. Interestingly, the UK has been something of an exception here - with wage growth relatively closely tied to productivity growth to date¹⁶.

There are concerns, however, that new technologies could see a wage-productivity decoupling occurring in the UK, as has already occurred in countries such as the US.

One way that this could occur is if new technologies erode employee bargaining power in wage negotiations. If job security is perceived to be much lower in a world of rapidly

¹⁵ <https://www.globalbankingandfinance.com/why-are-so-many-smes-across-the-uk-not-accepting-credit-card-payments/>

¹⁶ <https://www.oecd.org/eco/Decoupling-of-wages-from-productivity-Macro-level-facts.pdf>

advancing automation, and if workers see others made redundant as a result of automation, employees may become more reluctant to request a pay rise.

Use of data analytics to drive more optimal resource allocation could see a growing proportion of the workforce on zero hours contracts rather than fixed hour employment – with companies increasingly varying employee hours each week according to anticipated demand for labour. Such a move by companies could see employee wages squeezed and productivity gains concentrated in the hands of company owners.

Ensuring employees are beneficiaries of technological change, in addition to employers, will be crucial for 4IR to gain widespread support among the electorate. As we discuss in the next chapter, there may be a role for policymakers in ensuring this happens.

Zero hours and zero privacy – worse work for some?

As we discussed in the previous chapter of the report, 4IR can greatly improve our working lives – increasing our pay, cutting our working hours and making work more enjoyable. However, there is also a risk of new technologies leading to worse work for some.

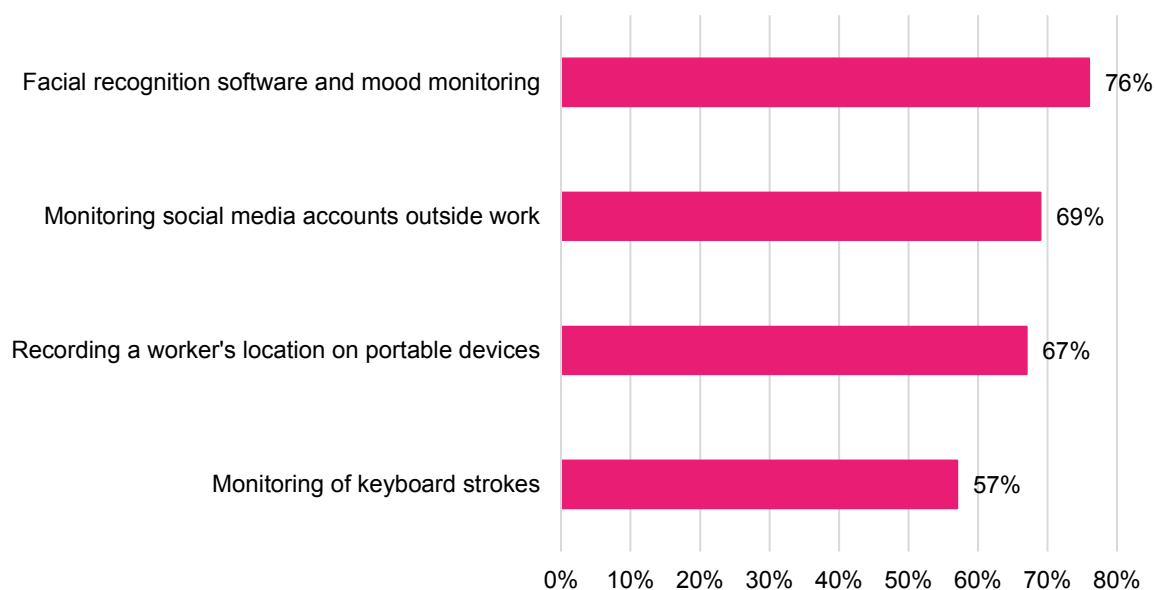
While connected devices can be used to improve employee health – for example telling those that have been sitting for a long time to take a break – these devices can also be used to place a high degree of pressure on workers. Each and every move of workers could be monitored in order to minimise idle time while at work. Monitoring technology is used by many large employers, but Amazon has come to stand as a symbol of excessive workplace monitoring undertaken by some companies, with the company coming under fire for timing toilet breaks and imposing tough targets on its warehouse workers¹⁷.

A recent study by the Trade Unions Congress¹⁸ (TUC) found that two thirds of workers (66%) were concerned that workplace surveillance could be used in a discriminatory way if left regulated. Concerns identified in the research included the timing of toilet breaks and companies viewing employees' social media profiles, and using this to pass judgement on their suitability for a job role.

Under two fifths (38%) of employees surveyed felt that they were able to challenge forms of surveillance they felt uncomfortable with.

¹⁷ See, for example, <https://www.mirror.co.uk/news/uk-news/timed-toilet-breaks-impossible-targets-11587888>

¹⁸ TUC (2018), “I’ll be watching you”

Figure 16: Forms of workplace surveillance least acceptable to employees (% against)

Source: TUC research

As home life and working life are increasingly blurred – for example with a growing proportion of employees working from home at least part of the time – there is a risk of leisure time increasingly being impinged by workplace demands. This is already an issue for some workers, who feel obliged to respond to work-related communications out of office hours – prompting some to consider whether this requires policy intervention. Since 2017, workers in France have a legal “right to disconnect” and avoid checking or responding to emails out of office hours¹⁹. Some businesses are taking measures to curb out-of-office communication in a bid to improve employee wellbeing; German vehicle-maker Daimler implemented a system that gave workers the option of having emails received during holidays automatically deleted²⁰ – reducing the risk of employee stress during the holiday or upon return when dealing with a mountain of unread communication.

In addition to increased monitoring and intrusion out of work hours, as mentioned earlier, technological change could see more workers on zero hours contracts, exposing them to more volatile and uncertain incomes. Some have expressed concern that zero hours contracts may lead to more individuals coming into work even when they are ill, out of fear of having their working hours reduced in the future²¹.

One plausible scenario is a situation where higher income professionals see their working lives improved by 4IR, while those on lower incomes see a deterioration in their quality of work. While professionals may increasingly benefit from home working and flexible working, those on low incomes in relatively routine occupations could see themselves subject to intrusive levels of monitoring, driven by new technologies. At the same time,

¹⁹ <https://www.theguardian.com/money/2016/dec/31/french-workers-win-legal-right-to-avoid-checking-work-email-out-of-hours>

²⁰ <https://www.bbc.co.uk/news/magazine-28786117>

²¹ <https://www.theguardian.com/commentisfree/2018/aug/01/fewer-sick-days-more-exploitation-zero-hours-scared-unwell>

low income workers with limited savings may find themselves struggling to cope with increased levels of income volatility as they are moved onto zero hours contracts.

Figure 17: Different experiences of 4IR – homeworking and improved collaboration for some, excessive monitoring and zero hours contracts for others



Negative impacts of 4IR on employee outcomes could potentially be exacerbated by declining labour bargaining power over issues such as worker pay and conditions. A shift towards increased homeworking and gig economy employment is likely to leave the UK workforce more fragmented than in the past – potentially limiting the (already declining) ability of trade unions to have an impact on workplace conditions. Another factor likely to erode trade union influence is that job roles in the future could be more varied than in the past – as routine, similar jobs are automated. With workers having less common experience as a result, it might be increasingly hard for an organisation such as a trade union to argue in the interests of a large number of workers. Only 13.5% of workers employed in the private sector belong to trade unions, and 4IR could cause that proportion to fall further still. Ultimately, trade unions will have to change dramatically to regain relevance and bargaining power in the 4IR economy. or alternative institutions step in to ensure that employees have an appropriate level of bargaining power.

The use of 4IR in the workplace has to be ethical and rolled out in a way that enhances the experience of work. If 4IR is used in a degrading or undignified way, and a way that makes employees more financially vulnerable, the political backlash from the electorate could be immense – particularly at a time when there already seems to be a growing focus on inequalities in the economy.

CHAPTER 5: THE ROLE OF POLICYMAKERS – GETTING TO A PLACE WHERE 4IR BENEFITS EMPLOYERS AND EMPLOYEES

The previous chapters have explored the potential benefits and challenges associated with rolling out 4IR in the workplace, from the perspective of employers and employees. Realising these benefits, and overcoming some of the challenges is mission critical for the UK economy. On some measures the UK has gone through the most parlous decade of economic performance on in recent history – with wage and productivity growth at their lowest levels since the early 1800s. To return to an age of rising wages, and to ensure that UK businesses can continue to compete effectively with other countries, drastic change is required.

4IR offers scope to turbocharge business performance while improving employees' working lives – driving up wages and increasing leisure time. At the same time, 4IR poses a number of challenges. Large portions of the workforce will need to be re-skilled in order to remain in employment. Many small businesses are unprepared for the scale of technological change set to take place. And use of new technologies raises a number of important ethical questions – particularly related to the monitoring of employees and increasingly uncertain incomes and job security.

Below are a number of practical policy recommendations that we believe will help ensure the successful roll out of 4IR technologies in the workplace in a way that benefits small and large businesses, and employees.

Developing a cross-government 4IR working group

As the SMF stated in our report on 4IR in the home²², we recommend the establishment of a cross-government working group to develop and push forward new policies that would help support 4IR and ensure the UK becomes a world leader in this space. The working group should develop a strategy and clear action plan to ensure these ambitions are realised.

We propose that it is chaired by the Secretary of State for Digital, Culture, Media and Sport (Currently Jeremy Wright). The working group should operate with a number of sub-committees each chaired by a Government Minister. These should include:

- **Infrastructure** – Margot James MP, Minister for Digital and the Creative Industries
- **Homes** – James Brokenshire MP, Secretary of State for Housing, Communities and Local Government
- **Business environment** – Greg Clark MP, Secretary of State for Business, Energy and Industrial Strategy
- **Health and social care** – Matt Hancock MP, Secretary of State for Health and Social Care

We expect the working group and its sub-committees to feature senior officials, industry representatives and, where appropriate, individuals from organisations that represent

²² SMF (May 2018), “4IR in the Home: Maximising the Benefits”

consumer and business interests – such as Citizens Advice, Age UK, Carers UK, the Confederation of British Industry, Tech UK and the Federation of Small Businesses.

Recommendation 1: Develop a pan-government 4IR working group to develop a clear action plan for driving forward the Fourth Industrial Revolution in the UK.

Ensuring businesses have access to the right infrastructure to benefit from 4IR

The infrastructure sub-committee of our proposed 4IR working group would have a key role to play in ensuring the full benefits of 4IR in the workplace come to fruition. This includes, but is not restricted to, the underlying telecommunications infrastructure driving 4IR.

Telecommunications infrastructure

The uptake of 4IR technologies in the workplace, and elsewhere, will depend heavily on whether the supporting telecommunications infrastructure for these technologies is available. The Government has already announced a number of plans to improve connectivity in the UK, which should support more widespread adoption of technologies such as connected devices in the workplace. For example, the 2018 Spring Statement saw the Chancellor making the first allocations of the £190 million local full fibre broadband challenge fund announced at the Autumn Budget as well as confirming £25 million for 5G mobile connectivity testbeds.

Furthermore, recent years have seen a significant improvement in some aspects of the UK's telecommunications infrastructure. For example, a recent report from Ofcom showed a 28% increase in average household fixed broadband download speeds over the year to November 2017²³.

However, despite these recent announcements and developments, there is still a long way to go in improving connectivity in the UK, as we highlighted in the previous chapter of the report. For example, despite improving broadband speeds, the UK is still falling down global internet speed league tables as other countries also improve the quality of their broadband infrastructure.

Action plans and cost-benefit analyses should be developed by government to explore the best and most cost-effective ways of rolling out better broadband and mobile connectivity across the country. This includes the rollout of full fibre-to-the-premises (FTTP) broadband to a wider audience. These action plans should be informed by expert insights in the telecommunications industry, as well as the views of end users of telecommunications infrastructure – households, businesses and government.

The infrastructure sub-committee of the 4IR working group should explore relatively affordable “quick wins” that could be adopted rapidly by the government to support 4IR – for example, via the installation of mobile antennae on public sector buildings to boost coverage. “Small cells” which boost mobile capacity could be installed on public

²³ Ofcom (May 2018), “UK Home Broadband Performance”

infrastructure such as street lighting – something that will be increasingly important with the mass rollout of connected cars requiring access to a mobile signal.

Thinking beyond the obvious – roads and urban planning

While improving broadband and mobile connectivity is crucial it is only part of the infrastructure requirements needed to make all of the benefits of 4IR a reality. It is essential that the government does not lose sight of the broader requirements needed to achieve widespread adoption of 4IR technologies – from the way our roads are designed to how our towns are planned.

While the 2017 Budget saw the Chancellor announcing regulatory reforms allowing the testing of self-driving vehicles on UK roads, there has been very little discussion by policymakers on the need to ensure that the UK is developing a *road network* that is well-suited to autonomous vehicles. Worryingly, this suggests that much-needed thinking about the broader requirements of 4IR is not taking place. This needs to change.

The autonomous vehicle revolution will fail to take off without careful consideration of our road infrastructure. Policymakers should be exploring ways of optimising and future-proofing the road network for driverless vehicles, which take account of their potential strengths and weaknesses. For example, autonomous vehicles, in the near-term at least, may struggle to interpret the hand gestures of construction workers telling a car where to go or whether to stop – requiring a rethinking of how we go about road maintenance. If autonomous vehicle cameras struggle to “see” traffic light signals under certain lighting conditions, this may require a rethink of lights and how they communicate with vehicles. Autonomous vehicles may perform better under a simplified grid road network rather than a convoluted and complex one – with implications for town planning.

Recommendation 2: Develop a broad 4IR infrastructure strategy that takes account of all relevant aspects of infrastructure – such as telecommunications, roads, vehicle design (such as requirements for telematic boxes), public transport, energy infrastructure and planning requirements.

Ensuring employees benefit from 4IR

Ensuring that 4IR works for an overwhelming majority of employees is crucial if it is to gain popular support. If the electorate perceives 4IR as a threat to livelihoods, stability and job quality, then they may use their political power to prevent such technologies being rolled out. For example, policies such as a punitive “robot tax”, to prevent robots replacing jobs, might gain considerable appeal among the electorate.

Given this, it will be crucial that policymakers curb the excesses of businesses that might opt to use 4IR in a way that undermines dignity and income stability in the workplace.

Ethical and transparent use of technology

Employees are entitled to understand how they are being monitored at work²⁴ – for example, the extent to which a company is using technology to time restroom breaks, monitor internet usage and track the speed with which some tasks are undertaken.

²⁴ <http://www.acas.org.uk/index.aspx?articleid=5721>

Transparency is crucial if employees are to trust the usage of new technologies in the workplace – and it is crucial that existing legislation here is enforced as 4IR is rolled out.

In addition to transparency, there are significant ethical questions around *what* employers should be allowed to monitor. Company owners and managers have a right to check that employees are “doing their job”, but as a society we should also question whether excessive micromanagement and “micro-monitoring” of employees is permissible – such as the timing of toilet breaks and tracking of each and every activity undertaken. Such heavy-handed monitoring not only imposes stress on employees, but it also undermines the dignity of work. Getting the right balance here is crucial.

One way of ensuring that an appropriate balance is struck is through government use of employee panels, which examine the way that workers are being impacted by new technologies. Feedback from employee panels should play a key role in discussions by our proposed 4IR Working Group – used to identify instances where technology is being used in a detrimental way from the perspective of employees, and considering the case for appropriate policy interventions – such as changes to employment laws. We need an active conversation among business owners, employees and policymakers about what “dignity in the workplace” entails and what the rights of employees should be in terms of, for example, having some privacy and not being excessively monitored while at work.

Recommendation 3: Require employers to consult with employees on the use of new forms of workplace surveillance and monitoring. **In addition, government should** create a series of employee panels to examine how use of new technology is impacting the quality of work in the UK – for example, monitoring the extent to which technology is being used to shift individuals onto zero hours contracts, impose new heavy-handed forms of employee monitoring, or to interrupt “out of hours” time such as evenings, weekends and holidays.

Ensuring workers share in the proceeds of technological change

As discussed in the previous chapter, it is no guarantee that employees will get a “fair” share of the proceeds of technological change. There is a risk that the UK, like the US in recent decades, could start to see wage growth and productivity in the economy decoupling – with workers failing to see productivity gains translate into higher wages.

One risk of 4IR is that it undermines employee bargaining power. For example, more uncertain working hours and increased job insecurity could deter employees from asking for a pay rise – something that could see wage growth falling behind productivity growth as 4IR is rolled out.

Given this, there may be a need for policymakers to use the tools at their disposal to increase employee bargaining power and also place pressure on businesses to give workers a reasonable share of the proceeds of productivity gains.

Requiring large firms to report on the extent to which productivity and profit gains are feeding through into higher wages could place additional social pressure on businesses to show that employees are benefiting from improvements in company performance – something we think should be explored. One such metric that could be reported is the average profit or turnover per employee, and how this is changing over time relative to wages.

Another possibility is offering corporation tax cuts for firms that increase wages by a certain amount – a policy tool currently being explored in Japan to bolster pay growth²⁵. Linking tax cuts to better employee outcomes might become increasingly important in a world of 4IR, to ensure that workers benefit in addition to company owners.

Recommendation 4: Require large companies in the UK to report on the extent to which profit and productivity gains are translating into higher employee wages. Also examine the case for making future cuts to corporation tax contingent on good employee outcomes, such as wage rises and limited rather than widespread use of zero hours contracts.

Reskilling - an education system fit for the future

The education system in the UK needs to change dramatically over the coming years. A system focused on learning in younger years is not fit for purpose in an age where a growing proportion of older adults will need to reskill.

Policymakers need to start getting serious on this. While the Government's Industrial Strategy saw the announcement of a new National Retraining Scheme that supports people to re-skill, its ambitions are relatively limited at present focusing on digital and construction training²⁶.

While it is important that we train people for these industries, adults also need to be better able to retrain for a wide range of careers in other parts of the economy, and it is crucial that over time the National Retraining Scheme is sufficiently broad in scope.

The current education system is currently poorly equipped to support those in these age groups, many of whom need to be able to fit reskilling and education around existing work and family life. For a large portion of the population, reducing working hours to undertake education is not an option – not least due to the financial hit that this entails. Increasingly, we need more low cost online education options, as well as evening and weekend courses which individuals can slot in around work and family commitments. Given this, it is welcome that the Industrial Strategy saw government pledging to invest £30m to test the use of AI and innovative education technology (edtech) in online digital skills courses. Edtech offers many opportunities to dramatically reduce the cost of providing education and training in the UK.

Policymakers also need to get better at incentivising older individuals to learn work-related skills of their own volition, rather than through their current employer – especially as we enter an era where a growing proportion of individuals might need to move across industry sectors in order to remain in work (for example as jobs are increasingly automated in some industries). One way of doing this is through making self-funded work-related training income tax deductible – something the Government is currently exploring the

²⁵<https://www.japantimes.co.jp/news/2017/12/12/business/japans-corporate-tax-slashed-20-wage-boosting-firms/>

²⁶

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/730043/industrial-strategy-white-paper-print-ready-a4-version.pdf

case for²⁷. Current rules mean that employees who fund their own training cannot generally claim tax relief on those costs; an estimated 860,000 employees self-funded training in 2016. Meanwhile, the self-employed can deduct the costs of training incurred “wholly and exclusively” for their business where it maintains or updates existing skills but not when it introduces new skills. Both are unjustifiable: policy should incentivise the acquisition of new skills workers will need to thrive in the 4IR age, not penalise it.

At present the UK is behind many other countries on this; an OECD study published in April 2017 found that 21 of 30 countries examined provided tax relief for training through deductions from taxable income²⁸.

Recommendation 5: Ensure that the National Retraining Scheme broadens out from its current remit, to offer a wide range of retraining opportunities across the whole economy – including through the widespread provision of online, evening and weekend learning solutions.

Recommendation 6: Make costs associated with self-funded work-related training income tax deductible, to encourage more individuals to reskill and prepare for the changing job market as 4IR is rolled out.

Ensuring SMEs rise to the challenge

We need to ensure that SMEs, as well as large businesses, benefit from 4IR. As we have argued, at present too many small businesses are failing to adopt even long-standing technologies such as card payments. Many businesses seem inadequately prepared for the implications of 4IR, which could make it increasingly difficult for smaller firms with outdated modes of doing business to compete effectively.

One way that government can encourage uptake of new technologies in the business community is through the rollout of more co-working spaces across the country – spaces where small businesses can gain shared access to technologies such as high quality video conferencing facilities and highspeed broadband. Collaboration and discussion among small businesses in co-working spaces can also bolster productivity and uptake of new technologies by smaller businesses – for example, as firms work together on projects and witness how other companies are adopting and benefiting from new technologies.

As well as granting planning permission for co-living developments, there may be a role for government to play in offering some of its own property space for use by businesses – a potential revenue stream for government as well as a benefit to the local business community

Government also needs to provide a competition regime fit for the future, which ensures that smaller companies have a fair shot in being able to gain market share. As discussed, one risk of 4IR is the ability of dominant companies to entrench their market position

²⁷ <https://www.gov.uk/government/consultations/taxation-of-self-funded-work-related-training>

²⁸ OECD Tax Policy Studies: Taxation and Skills, OECD, April 2017, www.oecd.org/ctp/taxation-and-skills-9789264269385-en.htm

through, for example, substantial data advantages and network effects. It is crucial that the Competition and Markets Authority (CMA) is prepared to tackle increasingly complex competition issues as data and network effects become increasingly important determinants of market power.

Recommendation 7: Work with town planners and local government to explore the role that co-working spaces can play in improving SME access to and use of new technologies such as high quality videoconferencing facilities. This includes through exploring the role that the government can play in turning some of its own buildings into co-working spaces.

Recommendation 8: Ensure the CMA has sufficient resource and remit to deal with the emerging competition challenges posed by new technologies.