FUTUREOFWORKHUB

A LEWIS SILKIN INITIATIVE

The future of work in 2050

too few jobs or too few workers?

A REPORT BY JAMES DAVIES

"Debate continues as to whether the drivers of change will result in a net increase or decrease in jobs. The skills shortage, which has become increasingly pronounced over the last year throughout the world, has reinforced the view that finding enough people to do the available jobs will be a critical and long-term issue. However, pessimists continue to point to technological advances replacing human work in the long-term and, in the shorter-term, economic consequences of extended periods of low growth and recessions fuelling a rise in unemployment."

James Davies, Partner at Lewis Silkin LLP

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EXECUTIVE SUMMARY

Since the world emerged from the Covid pandemic, economies in richer nations such as the UK have faced skills shortages. A range of converging factors have resulted in many sectors experiencing too few workers for the available jobs. This report considers whether this situation is likely to improve in the longer-term. Looking ahead to 2050, the report explores whether a world of work with too few jobs or too few workers is likely to emerge.

Although this report concludes that there are too many uncertainties to be too confident about the future shape of the labour market, it suggests that there is a real possibility that, by 2050, economies such as the UK will face a labour market with too few jobs for the available workers.

This potential future is driven by the pace and scale of change. Rapid advances in technology will continue, propelled by pivotal developments in AI. However, it is not just technology which is driving and accelerating change. Other interconnected drivers of change – demographic changes, shifts in migration patterns and the geo-political landscape, globalisation, climate change and social trends - are, together, significantly impacting the world of work.

Historically, industrial transformations have always eventually led to a net increase in jobs created by changing demands driven by new ways of working, newly available goods and services, and increased consumer demand from improved productivity.

This report looks at the broadly optimistic views of commentators that current and future disruption will generate similar results but sounds a degree of caution that the scale and speed of change could easily have a different outcome this time.

Delving down into the work and occupations of today, this report considers the factors which could increase or decrease jobs in different sectors over the next quarter of a century. Analysing predictions made in a range of other reports and commentaries, it foresees growth in jobs requiring caring or social interaction skills, particularly in the health and caring sectors. In other sectors, the report predicts jobs will remain but potentially will be fewer, or change significantly, as humans and machines increasingly collaborate and work alongside each other.

The report concludes with a "Manifesto for tomorrow's work" - outlining a set of actions for policymakers, employers and individuals in order to prepare now for the future world of work. As a priority, it calls for increased investment in the new and evolving skills required in the years ahead – a necessary investment regardless of whether there are too few jobs or workers.

Profound and extensive disruption to jobs over the next quarter of a century is inevitable and this disruption will not at times be predictable. The impact of this transformation on the world of work will depend on decisions made, and actions taken, over the next few years. This report identifies the decisions and actions which will need to be addressed and brings together insights from a variety of sources to offer a glimpse of that future.

INTRODUCTION

The debate over the likely impact of AI and other technological advances on jobs has been raging for years. In my 2022 report, Eight Drivers of Change – 2022 and beyond, I explored a number of converging drivers transforming the world of work at an unprecedented pace and scale and reflected on whether or not these changes would result in a world with too few jobs or too few workers, particularly in the richer nations of the G7 countries.

Advances in technology and the rate of its adoption will play a significant part in determining the balance between jobs and workers in the years ahead. However, other drivers of change will also heavily influence the size and shape of the labour market over the second quarter of this century, especially the ever more pressing steps required to address the climate emergency and demographic shifts leading to an ageing, and potentially shrinking, population in some countries.

A shortage of jobs rather than workers may seem unlikely as the UK and many other countries experience an era of record levels of job vacancies, high levels of employment and forecasts of persisting shortages of workers.

However, since the public release of ChatGPT in November 2022, the media has featured debate and warnings on the potential impact of AI on the world as a whole, and particularly on the world of work, almost on a daily basis.

Notwithstanding that much reporting has focussed on an apocalyptic vision of a world without jobs, optimists continue to argue that automation will create enough new jobs and boost productivity.

> *"Is this the start of the AI jobs bloodbath?"*
>
> Daily Mail headline (May 2023)

Commentators point to:

- persistent skills shortages
- demographic trends which only seem likely to increase pressure on the labour market
- past industrial transformations which have always resulted in a net increase in jobs.

If these optimists are right, a rosy future for job seekers awaits.

However...

What if... these optimists are proved wrong, and they are seriously under-estimating the pace and scale by which automation will replace and change the jobs of today in the second quarter of the 21st Century?

What if... the insipid productivity growth of the last quarter of the century continues?

What if... too few workers will have the skills needed for the occupations of tomorrow?

Crystal-ball gazing at the workplace in 2050 is notoriously difficult and the future is uncertain. The world today looks very different from the expectations and predictions of merely four years ago, before the pandemic swept across the world and Russia's tanks swept into Ukraine.

AI-led transformation will, no doubt, make many jobs redundant, create new ones and fundamentally change many more. But will the world of work in the decades ahead be one of too few jobs or too few workers? What might the world of work look like in 2050? And, if we consider the possibility of a world with too few jobs, what should policymakers, businesses and individuals be doing to prepare?

This report explores these questions. The first part of the report considers past transformations in the industrial landscape which led to employment in some sectors temporarily declining and asks whether the creation of the new jobs that ultimately emerged is likely to happen again this time. The second part of the report considers today's job market in the context of skills shortages, low levels of unemployment and historically high levels of employment that dominate the UK labour market. The third part of the report looks ahead to 2050 and considers the combined impact of technology and other interconnected

drivers of change on jobs, reflecting on the sectors and occupations most and least at risk from change, and what new jobs might be created. The report concludes by setting out a "Manifesto for tomorrow's work", suggesting a number of steps policymakers, businesses and individuals should be taking now to prepare for an increasingly automated world of work.

Over the last decade, many expert commentators have published detailed reports considering these issues. This report aims to bring this thinking and analysis together to better see ahead and imagine the landscape of tomorrow's world of work.

This report is primarily focused on the UK labour market, but many of the observations and thoughts apply equally to many other countries.

James Davies, Partner, Lewis Silkin LLP

September 2023

> *"There will be an impact on jobs. We try to be very clear about that."*
>
> Sam Altman, CEO, OpenAI.

1. LOOKING BACK... WHAT CAN WE LEARN?

Transformations in the industrial landscape over past centuries have historically resulted in temporary periods of increased unemployment and disruption, but lost jobs were always eventually replaced by the creation of even more new jobs. However, while the past can be a helpful guide to the future, just because it happened before does not mean it will necessarily happen again.

Historical impact of past industrial revolutions

The **First Industrial Revolution,** from around 1765, saw mechanised production from water and steam power and the mechanisation of the textile industry. This originated in the UK and over the next century expanded across Europe.

The **Second Industrial Revolution** occurred between 1870 and 1914 through advances in the use of steel, electricity, gas and oil, resulting in mass production and the internal combustion engine.

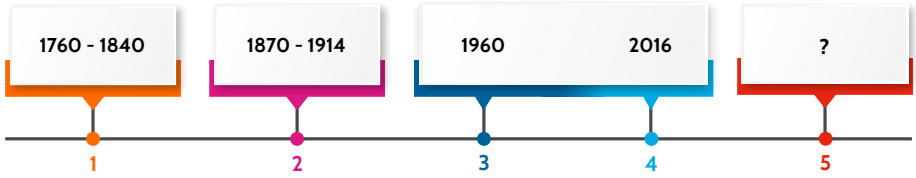
From the 1960s, the **Third Industrial Revolution** witnessed computerisation and increased automation, embracing concepts such as robotics (the automation of repetitive tasks), digitisation (converting analogue data to a digital form), and digitalisation (using technology to transform business activity).

Each of these industrial revolutions has been characterised by labour markets transformed by industrial or technological developments and employment in some sectors declining. However, in each case, these industrial revolutions also saw enough new jobs created to compensate for those lost.

Society is currently experiencing the **Fourth Industrial Revolution,** which has seen the emergence of smart technology, including AI and greater interconnectivity. In 2016, Klaus Schwab, founder of the World Economic Forum, referred to the Fourth Industrial Revolution as a fusion of technologies that is blurring the lines between the physical, digital and biological spheres.

McKinsey refers to the Fourth Industrial Revolution as the next phase in the digitization of the manufacturing sector, driven by disruptive trends including the rise of data and connectivity, analytics, human-machine interaction, and improvements in robotics.

Some commentators even suggest the significance of AI means that society has seamlessly entered the **Fifth Industrial Revolution, the AI Revolution or Industry 5.0**, as any gap between industrial revolutions diminishes or disappears entirely.



How work has evolved?

Over the last 250 years, paid work has changed beyond recognition. In 1750, nearly half of all workers in the UK were employed in agriculture and mining and nearly as many in manufacturing and construction. The service sector accounted for less than 15% of workers. By 2016 the numbers employed in the agriculture and mining sector barely registered at 1%. The numbers employed in manufacturing and construction had declined but less rapidly, though steeply over the last half century, to account for 15% of the workforce (having peaked at 40% in 1966). By 2016 the service sector accounted for most jobs and had swelled to 84% of the workforce.

Over this period machines have replaced people doing physical work – initially routine and repetitive manual work and more latterly skilled manual trades. This automation has enabled tasks to be done more quickly, more efficiently, more cheaply and often to a higher standard. This has resulted in significant increases in productivity which has translated into economic growth, higher wages and greater demand for goods and services. Although advances in technology have created major shifts in work in the past, these advances have helped drive the resulting net increase in jobs with each industrial revolution.

Optimists predict that the numbers of jobs lost to the technological advances which are expected in the years and decades ahead will be more than replaced by new jobs created. They point out that sceptics were always proved wrong in the past. In 1930, the celebrated economist, John Maynard Keynes predicted that increases in productivity would lead to widespread technological unemployment and his grandchildren working 15-hour working weeks, but this has not happened.

McKinsey highlights five lessons to take from history on AI automation and employment:

- employment in some sectors can decline sharply, but new jobs created elsewhere compensate for those that have been displaced
- employment shifts can be painful
- technology creates more jobs than it destroys, including some that can't be imagined at the outset
- technology raises productivity growth, which in turn boosts demand and creates jobs
- most people will work less and play more thanks to technology.

Whether the future in the UK and similar countries will be characterised by more jobs than workers or more workers than jobs will depend on whether these lessons apply again this time around.

Will John Maynard Keynes be proved right, albeit a generation premature, in his prediction?

See Looking back... what can we learn? which covers in more detail the historical impact of past industrial revolutions on productivity, economic growth, and jobs.

2. JOBS OF TODAY... WHAT CAN WE SEE?

As the Fourth or even, as some argue, the **Fifth Industrial Revolution** takes hold, society has emerged from the Covid pandemic to challenging economic times. Today's economic conditions feature high levels of inflation, a cost of living crisis and negligible, or even negative, growth, in the UK and in many other countries. Profound skill shortages, low levels of unemployment and historically high levels of employment are the dominant characteristics of the UK labour market in mid-2023. From this vantage point, a shortage of jobs might seem a distant worry for employers and policymakers.

Compared to past decades, the UK labour market of the 2020s is characterised by an increase in women and the over 60s in work; those in work working fewer hours per week; and acute labour shortages, with more adults of working age economically inactive due to long-term ill-health.

Key characteristics of the current UK labour market

Sluggish economic growth

The first quarter of the 21st Century has seen low improvements in productivity, slow economic growth, and little rise in real wages across many industrialised economies notwithstanding the potential efficiencies from increased automation. The UK economy has been characterised by sluggish productivity and economic growth since the 2008/9 recession and markedly lower productivity levels than the US, Germany and France. Real wages are no higher than fifteen years ago.

High employment rates and low unemployment

Data from July 2023 indicates that UK employment levels are high compared with historic norms, and unemployment is low. Unemployment remains comparatively low elsewhere too, for example, in the US and EU data from September 2023. The stagnant economy and cost of living crisis is, however, beginning to impact the jobs market with job vacancies decreasing significantly in the UK by over 20% from the record levels of a year earlier Vacancies and jobs in the UK - Office for National Statistics (ons.gov.uk). The position is similar in the US and the EU.

Widespread labour shortages

Data from summer 2023 from across the richer world shows consistent labour shortages are restricting economic growth.

About one in five of the working age population in the UK is economically inactive (i.e. not in work or seeking work). This principally comprises full-time students, carers, the long-term sick and the early retired. While numbers have remained reasonably consistent over recent years, the amount of those not working on account of caring responsibilities has fallen as more women return to work, and the numbers of long-term sick has increased.

Health and social care, followed by retail, education and professional, scientific and technical jobs, represent the biggest sectors in the country. All these sectors are characterised by acute job shortages.

The effects of Brexit

The UK job market has been significantly impacted by the UK's departure from the EU which resulted in the end of the free movement of workers in 2020. While work-related migration visas are up greatly, it is difficult to compare this with pre-Brexit numbers because no official records were kept for EEA nationals coming to the country for work purposes. In any event, migration remains an important source of workers for British employers, particularly in the health and care sectors, and will continue to do so for many years.

The end of free movement of workers from the EEA has shifted work migration to nationals of other countries particularly the old Commonwealth countries of India, Nigeria and Zimbabwe as well as the Philippines - many of which enter with Skilled Worker health and care visas.

Changing demographics

The UK workforce is becoming less male dominated and, reflecting the wider population, is ageing.

The gender gap in employment has come down. Today 57% of women over 16 are economically active (72.3% of women between 16 and 64). This has increased from 52.7% at the beginning of 2000, whereas the proportion of economically active men has gone down from 67% (79% of men between 16 and 64) to 65.7%. Fifty years ago, of those aged between 16 and 64, 91% of men were in work against 53.3% of women. In addition, more women are being employed in senior positions around the world. For example, the share of seats on boards

of publicly listed companies held by women in the UK has increased from 18.8% to 40.9% over the last ten years.

The number of economically active over 65s has increased from 5.3% at the beginning of the 21st Century to 12.2% today. The bulge in the UK population (consisting of the younger Baby Boomers and older Generation X), largely born in the 1960s where fertility rates peaked (2.93 children per woman in 1964), is reaching retirement age. In 2021, UK fertility rates stood at 1.61 children per woman, a slight increase on the year before after eight successive years of decline The fertility rate has not hit the population replacement rate needed to maintain a population's size – all other factors being equal – since 1972.

Falling unionisation levels

The UK workforce is also becoming less unionised. Between 1995 and 2022, the proportion of trade union members declined from 32.4% to 22.3%, primarily accounted for by a fall in private sector union membership. Unions have struggled to adapt to broad trends including deindustrialisation, the shift towards individual employment rights, and the increasingly fragmented nature of workplaces. Unions are also competing with a much wider array of ways in which employees can have a voice at work and in society in general.

The balance of employed vs self-employed

Over the first quarter of this century, the ratio of employed to self-employed workers has remained relatively stable with the proportion of self-employed to total workers (employed and self-employed) having increased slightly from 12.1% to 13.2%. The top sectors engaging the self-employed are: construction; and professional, scientific and technical activities.

Declining working hours

Average weekly hours of full-time employees have continued the long-term trend of coming down. Since 2000 they have declined from 38.2 to 36.7 hours per week. The proportion of the UK workforce working part-time has increased very marginally from 25.3% to 25.6% with far more women than men working part-time (37.9% against 14.4%). Of those working part-time, however, average weekly hours have increased (15.3 hours per week in 2000 to 16.8 in 2023). Overall, looking at all those in work, whether full-time or part-time, average working hours per week have come down between 2000 and 2023 from 32.4 hours per week to 31.6 hours per week.

The evolution of the employment relationship

The last decade has seen the beginnings of some seismic shifts in the "employment" relationship. The traditional full-time, one employer, 9-to-5 job has come under threat from arrangements which increase flexibility for "employers", workers or both. New ways of working including portfolio careers, platform working and side hustles have emerged. The distinction between employee and self-employed has become blurred and resulted in much litigation and uncertainty. This breakdown in the traditional employment model has been driven, in part, by the regulation and taxation of work suited to a world of work which is fast declining.

THE WORLD OF WORK IN 2050

Any prediction of the world of work in 2050 will certainly be wide of the mark, but there is no doubt that the world in 2050 will be very different from today. The backdrop to these changes will be advances in technology, but combating global warming, ageing societies and, in some instances shrinking populations, will greatly influence the world of work in 2050.

Twenty-seven years ago, today's world of work would have seemed unbelievable. In 1996, email was in its infancy and was clunky, slow, and unreliable. Faxes, now largely redundant, represented the preferred method of communication. Google launched that year on the Stanford University network. The iPhone was more than a decade away. Twenty-seven years from now, the world of work in 2050 will, no doubt, seem as unbelievable.

In the words of former US Secretary of Defence, Donald Rumsfeld, there are **known knowns**; **known unknowns**; and **unknown unknowns** which can provide a context to consider the evolving world of work.

Know knowns about the next quarter of a century include:

- **Scientific and technological progress** – AI and robotics will assume a bigger and bigger role in daily life, alongside leaps forward in sustainable energy. Medical breakthroughs will greatly improve the prevention and treatment of conditions such as cancer, Alzheimer's and malaria.
- **Demographics** – declining populations in some richer nations (e.g. Japan, Korea, Italy and Germany) and rapidly increasing populations in other less industrialised nations particularly in sub-Saharan Africa will have profound implications for the world of work across the world.
- **Climate change** – greater urgency and attention on combatting global warming and the climate emergency will create jobs and change what work is done where.

Know unknowns about the next quarter of a century include:

- **Geo-political tensions** — a Chinese invasion of Taiwan; an escalation of the Russia/Ukraine war possibly involving Russian use of battlefield nuclear weapons and the involvement of NATO powers; right-wing populist parties assuming power in key European countries; and a Trump presidency in the US introducing populist and isolationist policies. These could all have catastrophic implications for many parts of the world, the global economy and the world of work.
- **The pace of automation** — will, for example, driverless vehicles be commonplace by 2050?
- **Increased productivity** — will technological advances at long last result in increased productivity and will any such increased wealth be shared equitably?
- **Energy** – looking further ahead, limitless possibilities of free clean energy beckon from wind, tide, sun, nuclear fusion and "white hydrogen" among other sources. The extent and timing of such exciting developments is, as yet, unknown.

Unknown unknowns:

- "**Black swans**" — events such as Covid and Russia's invasion of Ukraine and, earlier in the 21st Century the September 11 attacks in the US, overhauled plans and expectations. Unexpected world events could deliver future shocks and disruption. Another pandemic? Wars erupting elsewhere? Global water shortages?

3. LOOKING AHEAD... WHAT CAN WE PREDICT?

Technology and other interconnected drivers of change are affecting the world at an unprecedented scale and pace and signal significant structural and societal shifts which will deeply impact the labour market and the workplace over the next quarter of a century. In 2050 the world and the world of work, in particular in the UK, will be very different from today.

AI, robotics and new technologies are key drivers of change in the world of work, elevating the focus on, and concern about, technology's impact on jobs and tasks traditionally performed by people. As anxiety about the potential of AI to replace human jobs dominates the headlines, it is important to note that technology is but one driver of change which will have a significant impact on jobs and define the world of work over the next quarter of a century.

The impact of interconnected drivers of change

Alongside technology, the impact of the pandemic has converged with changes driven by sustainability, demographics, globalisation, the role of the state, migration, and social trends to bring about significant changes to the where, when and how of work. The impact of these drivers of change are covered extensively in this report for the Future of Work Hub Eight Drivers of Change – 2022 and beyond.

In its 2023 Future of Jobs report, the World Economic Forum similarly identified the following drivers of labour market transformation as generating demand for new jobs: the green transformation (sustainability); technological change; supply-chain transformations (globalisation); and changing consumer expectations (social trends). It identified growing geoeconomic tensions (role of the state) and a cost of living crisis as offsetting these positive drivers.

This collection of drivers of change can be divided into supply-side drivers, which will govern the numbers of people available to do the available jobs, and demand-side drivers, which dictate the numbers of available jobs.

Supply-side drivers include: **demographics, migration, covid/ health**, and **social trends.**

Demand-side drivers include: **technology, the role of the state, globalisation,** and **sustainability.**

Making predictions about the future is challenging given the inter-connected nature of these drivers. Nonetheless, they signal how the world of work may evolve over the next quarter of a century.

Technology will be a significant driver of change over the second quarter of the 21st Century. However, other drivers promise to influence profoundly the world of work over this period. Major demographic changes will unfold - populations will age and, in some richer nations shrink. Other countries will see populations increase greatly.

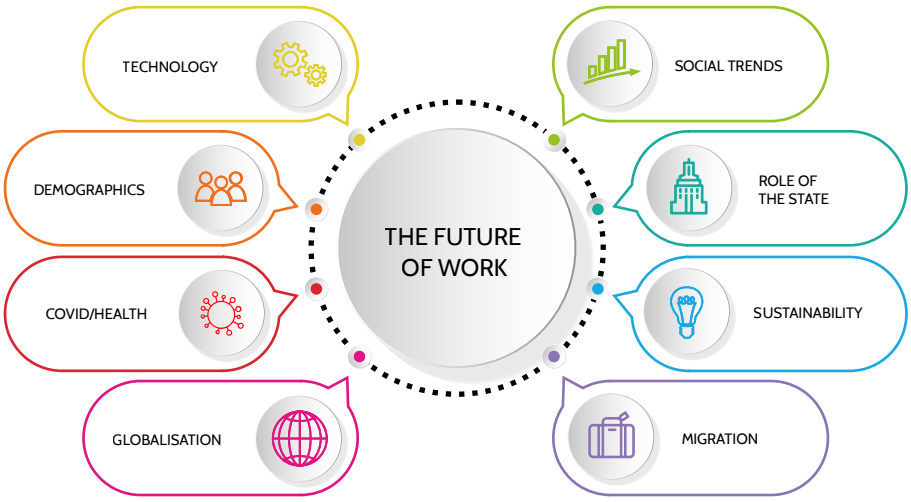
Migration and globalisation will see countervailing pressures. Richer countries will see increased pressure from migrants fleeing poverty, repression, war, and climate change while competing for in-demand skills and experience. Manufacturing will move back closer to the consumer while knowledge jobs will become increasingly globalised.

Climate change will more and more influence the where, when, and how of work. In countries such as the UK, high levels of economic inactivity caused by long Covid and other long-term health issues will come under greater scrutiny.

Social trends and domestic politics will influence the world of work but, arguably, less predictably. Will the more left-wing politics of Millennials and Generation Z (and in five years' time, the next generation, Generation Alpha who will reach the age of 18 and be able to vote) come to the fore or will right-wing populism become even more influential in challenging economic times?

The Spotlight on... technology considers the impact of technology in particular on jobs.

See Looking ahead...what can we predict? which covers in more detail the collective drivers of change and their impact on jobs of the future.



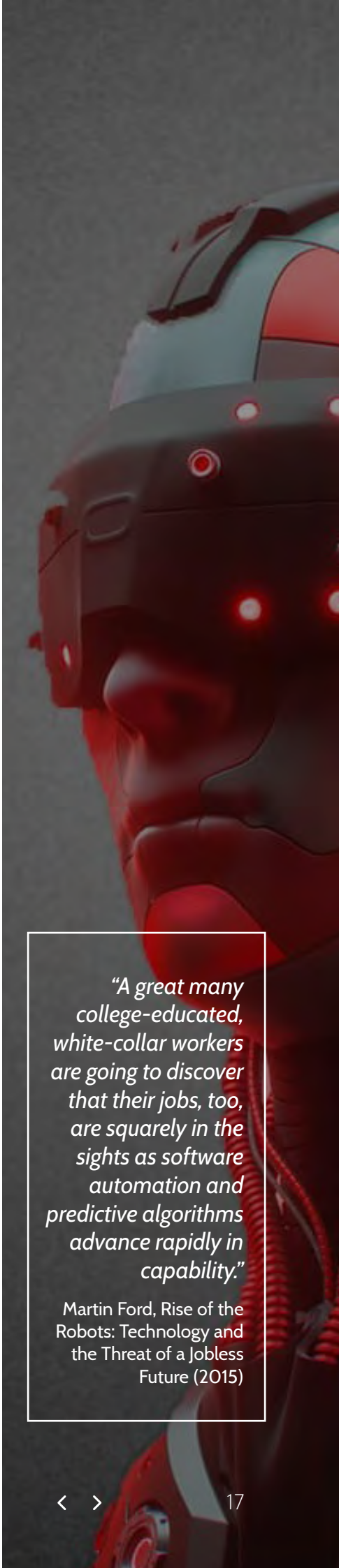
Which jobs will be disrupted and where will new jobs come from?

Predicting what work and which occupations will be most disrupted will be important in preparing for an increasingly automated world of work.

Which jobs are most at risk?

Most occupations fall into one of five categories: routine work; skilled manual work; knowledge work; creative work and caring/ social interaction work, with some occupations falling into more than one category.

Routine and skilled manual work have, to date, been the categories most disrupted by technology. The next 25 years will see further automation and disruption to this work. Manufacturing jobs are likely to become scarcer with increased automation. For example, many driving jobs will eventually be replaced by driverless vehicles and increasing use of drones. How far into the future this might happen remains less clear.



"A great many college-educated, white-collar workers are going to discover that their jobs, too, are squarely in the sights as software automation and predictive algorithms advance rapidly in capability."

Martin Ford, Rise of the Robots: Technology and the Threat of a Jobless Future (2015)

Knowledge work will come under threat with advances in AI and, in particular, the ability of generative AI to generate content. There will still be lawyers, architects, accountants and managers; just fewer of them as AI complements their work. Caring work will be under the least threat, at least for the time-being. Automating this type of work and those jobs where social interaction is important seems further away even though Japan's experiments with robots in the care sector have been much publicised.

Where will the new jobs come from?

Looking ahead 25 years there is likely to be a greater proportion of the workforce employed in the health, caring and education sectors. Increased leisure time may well see the creation of jobs. People with more time on their hands will create work, for example in hospitality and for those employed in coaching people in new skills. Work requiring STEM skills (science, technology, engineering, and mathematics) will be in demand but susceptible to global competition as the work can often be done from anywhere, and even this work will be increasingly vulnerable to automation.

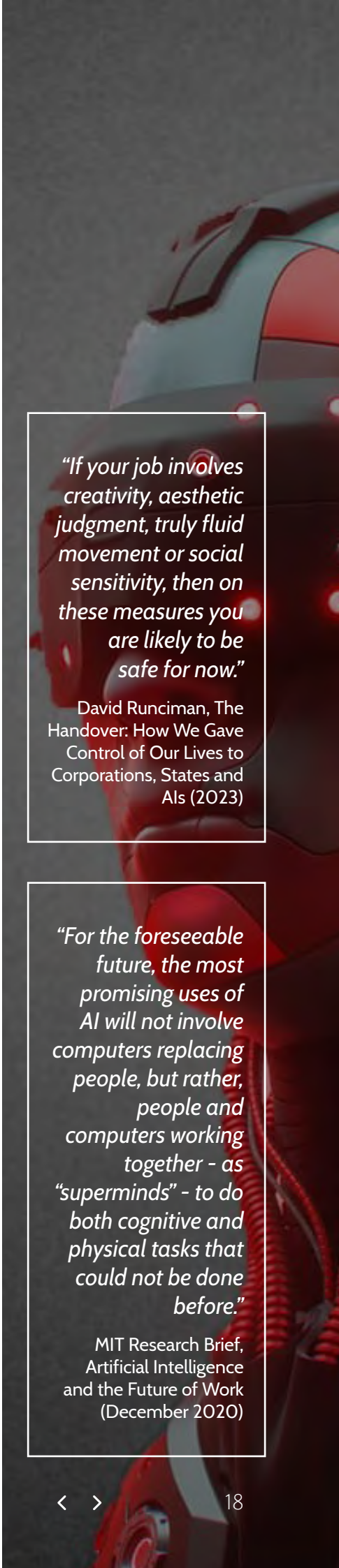
Collaboration or competition?

AI can do tasks quicker, cheaper, more efficiently and, often, better than people. Its capabilities and competitive advantages over humans will only grow. Interviewed by Harvard Business Review, Karim Lakhani, a professor at Harvard Business School, argued that AI won't replace humans but humans with AI will replace humans without AI. IBM's 2023 report on Augmented work for an automated, AI-driven world also concluded that AI would not replace people – but people who use AI will replace those who don't.

Organisations which will thrive in this new world are the ones which will restructure work so that humans and machines work together doing what each does best. The concern is an ever-decreasing number of jobs where humans have the advantage over machines.

A rocky road ahead

The march of automation seems inevitable but its scale and speed less certain. The net impact on the jobs market will depend not only on the pace and scale of this transformation but the extent to which increased prosperity and demand for goods and services occur with a resultant increase in jobs. Even among the optimists, some foresee a turbulent period before any net increase in jobs is seen.



> *"If your job involves creativity, aesthetic judgment, truly fluid movement or social sensitivity, then on these measures you are likely to be safe for now."*
>
> David Runciman, The Handover: How We Gave Control of Our Lives to Corporations, States and AIs (2023)

> *"For the foreseeable future, the most promising uses of AI will not involve computers replacing people, but rather, people and computers working together - as "superminds" - to do both cognitive and physical tasks that could not be done before."*
>
> MIT Research Brief, Artificial Intelligence and the Future of Work (December 2020)

A report by the ILO in 2023 highlights the potentially discriminatory impact of job displacement globally with more than twice the proportion of women potentially affected by automation than men as many more women than men are employed in the clerical roles which the report considers most at risk.

Too few jobs or too few workers?

Longer-term, the key question remains: in countries like the UK, will the world of work feature too few jobs or too few workers? History suggests that after an initial period of disruption, the industrial transformation will result in a net increase in jobs. The current Fourth/Fifth Industrial Revolution may, like previous industrial revolutions, create enough new jobs to replace the ones lost. AI may complement workers rather than displace them, and where jobs are displaced, sufficient others may be created working with the technology.

Resultant increases in productivity may benefit the many and not the few. Demand for goods and services may grow and more jobs may be created. Increased productivity may also mean a shorter work week with increased leisure time boosting the economy. New jobs and the benefits arising from increased productivity may mean that the current shortages of workers might even persist in the long-term, notwithstanding technology's displacement of many jobs currently carried out by people. An ageing and, possibly even, further ahead, a shrinking population might add to a future with too few workers in 2050 where automation is embraced not only for the benefits it brings but to address persistent labour market shortages Optimists may well be proved right.

There is, however, reason to be fearful that it might not be the same this time. While new technology has typically meant new jobs replace the redundant ones during historic periods of disruption, the pace and scale of change is greater this time. Just because past industrial revolutions resulted in a net increase in employment does not mean it will happen in the future.

See Which jobs will be disrupted and where will new jobs come from? for more detail on which jobs will be disrupted and where new jobs will come from.

"Technological change provides long-term benefits, but the transitions can be rocky".

MIT Research Brief, Artificial Intelligence and the Future of Work (December 2020)

"Labour supply may continue to be constrained, given that one in four Americans will be of retirement age or older by 2030. Without higher participation rates, increased immigration, or meaningful productivity growth, labour shortages could be a lasting issue as the economy and the population grow. This remains an open question confronting markets, economists, and employers."

McKinsey Global Institute, Generative AI and the future of work in America (2023)

SPOTLIGHT ON... TECHNOLOGY

With the launch of **generative AI**, AI has reached a tipping point and the implications will be profound. Advances in technology will create new jobs, even if the numbers are uncertain, and change the skills needed in many others. These advances will also displace workers from certain jobs and in other cases augment workers who, enhanced by automation, will become more productive.

The adoption of AI in the workplace will create jobs such as AI researchers, robotics scientists, machine learning engineers, robotics engineers and data scientists as well as less technical jobs, for example, designing user experiences and in data analytics and cyber security. The most visible new emerging roles are for those with coding and development skills to build, adapt, train and prompt AI models, alongside AI content editors.

New jobs will be created in business, HR and legal teams to manage the variety of new challenges and issues that arise in the context of AI and machine learning in the workplace. KPMG has estimated that half of the jobs displaced by AI will be replaced by jobs managing the technology in those organisations. Whether or not these new jobs are enough to replace those lost in these fields due to automation remains to be seem and is probably unlikely. Developments in technology are not, however, just about AI. Advances in robotics, quantum computing and other fields will extend profoundly the capabilities of machines and promise to create many more jobs. Responding to the climate emergency will result in work with wind turbines, insulation, heat pumps, solar power, new nuclear sites and much else. Exciting advances in genetics, medicine and life sciences will also generate employment.

> *"The only thing I am sure of is that there is no way of knowing how many jobs will be replaced by generative AI."*
>
> Carl Benedikt Frey, Future of Work Director, Oxford University's Oxford Martin School

Artificial Intelligence: impact on jobs

AI is not new. Its birthplace is often considered to be a summer workshop at Dartmouth College, New Hampshire in 1956 attended by leading scientists of the time researching "thinking" machines. However, today's fear of mass job losses has been spurred by awareness of the enormous potential of AI unleashed by the public release of ChatGPT in November 2022. Suddenly, free of charge, anyone with access to a laptop or smart phone could experience for themselves the abilities of AI and foresee its potential, and its potential disruption to the world of work.

ChatGPT is an example of "generative AI". GPT stands for "generative pre-trained transformer". These models learn from vast amounts of "training data" which can then generate new text in response to questions. As OpenAI, the company behind Chat GPT, claim, Chat GPT interacts in a conversational way. The dialogue format makes it possible for ChatGPT to follow up questions, admit its mistakes, challenge incorrect premises, and reject inappropriate requests. Others have quickly followed OpenAI with, for example, Google launching its own generative AI model, Bard. Products such as ChatGPT or Bard use large language models (LLMs) which are algorithms using deep learning techniques and vast data sets to understand, summarise and generate content in response to questions.

> *"AI – the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings."*
>
> Encyclopaedia Britannica

As the editors of Harvard Business Review explain, generative AI changes everything. It can displace many tasks people currently perform but at superhuman speeds and, potentially, at much lower cost.

Notwithstanding the implications of current technological advances on the labour market, technology will continue to advance, and the scale and speed of technological innovation is only likely to accelerate.

Artificial general intelligence (AGI) is the next target for computer scientists. AGI would represent a significant next step where AI would match or exceed human cognitive abilities. Computer scientists disagree about how imminent AGI might be, but, as consultants McKinsey explain, businesses should not be ignoring its potential transformative effects.

In 2022, Charles Simon, founder and CEO of Future AI, looked at the potential impact of AGI on jobs and argued that its arrival within the next decade, where robots will be able to replicate the contextual understanding of humans, will further transform the labour market.

Even before the emergence of ChatGPT, employers were adopting AI in the workforce. IBM reported in 2022 that 35% of companies reported using AI in their business, and an additional 42% reported they are exploring AI.

Counter-intuitively, Stanford University's respected Global AI Index 2023 reported that in 2022, for the first time in a decade, private investment in AI had declined. However, this reported a time before generative AI's potential was widely understood and next year's index is likely to show a big rise again.

Other technological advances: impact on jobs

> *"The tectonic plates of technology are shifting - not just in AI, but in quantum, synthetic biology, semiconductors, and much more."*
>
> *Rishi Sunak, British Prime Minister (June 2023)*

Advances in technology beyond AI also promise to displace jobs and create new ones. In 2021, the World Economic Forum published McKinsey's top 10 tech trends for the next decade. As well as applied AI, these included: next-level process automation and virtualisation; far faster digital connectivity; next generation quantum computing; and the growth of trust architectures.

In 2023, the World Economic Forum published a fresh report setting out its top emerging technologies of 2023 which included: flexible batteries; general AI; sustainable aviation fuel; wearable plant sensors; flexible neural electronics; and AI-facilitated healthcare, all of which promise new jobs.

Deloitte in April 2023 identified what it described as "x-Tech" as the next frontier comprising: SpaceTech; BioTech; NeuroTech; ClimateTech; EnergyTech; and RobotTech.

As well as new technological developments and advances, job disruption will result from the increased use of existing technology. The UK, among others, has much scope to catch up with its international competitors in embracing the potential of existing technology. For example, data from the International Federation of Robotics illustrates the adoption of industrial robots has been increasing year on year and there is the potential for further adoption. It also shows how adoption varies from country to country. The UK has been relatively slow to embrace robotics and, with 101 industrial robots per 1,000 employees, lags way behind all other G7 nations and has merely a tenth of the industrial robots per employee of the leading nation, Korea.

Goldman Sachs predict humanoid robots capable of doing many more tasks than people could become economically viable in factory settings between 2025 and 2028 and in consumer environments between 2030 and 2035, their adoption being spurred on by the current worker shortages.

Finally, many expect the Metaverse to gain momentum, with organisations increasingly envisaging it as a virtual future forum for many of their activities.

Barriers to and accelerators of automation

In predicting the likely actual impact of automation on the labour market, it is not the potential capability to automate which will be determinative. It is the adoption in practice by employers of this technology which will drive the change. In its Future of Jobs 2023 report, the World Economic Forum noted that businesses were automating more slowly than previously anticipated. Various barriers to automation and conversely, various accelerators of automation, often within the control of policymakers and employers, are having an effect on the pace of adoption and the impact on the labour market.

> *"Whether [such] technologies will be forthcoming depends not just on our innovation capabilities but also on the supply of different skills, demographic changes, labour market institutions, government policies including taxes and research and development spending, market competition, corporate strategies, and the ecosystem of innovative clusters".*
>
> *MIT and Boston University, Journal of Economic Perspectives, Automation and new tasks: How technology displaces and reinstates labour (2019)*

Barriers to automation

Costs of automation

The price of robots is coming down quickly and the relative cost of automation compared to the cost of human workers will influence the pace at which machines replace humans in the workforce. The tax treatment of investments in automation will also be relevant to the costs equation.

Regulation of AI

Fierce debate continues about the extent to which AI should be regulated. Issues around intellectual property ownership rights in the training data used by generative AI platforms are emerging. Countries veer between collaborating to set common standards and competing to attract innovators. Protectionist governments may seek to delay the disruption to workers' jobs. How these debates are resolved will impact the pace and scale of AI's impact on jobs over the next decades.

Accelerators of automation

Government incentives

Incentives to invest in innovative technology will drive automation. Countries will compete to attract innovative businesses. The OECD assesses countries' support for research and development and innovation and found that the UK has an implied tax subsidy rate on research and development expenditure of 0.27 compared to 0.36 for France and 0.19 for Germany.

Unlocking unmet potential to automate

As mentioned above, the extent to which countries automate will not only depend on the advances which are capable of being exploited. The current unmet potential to automate

could enable some nations to catch up with those which have exploited technology best so far. The UK, for example, has automated manufacturing far less than many other similar countries.

Barriers to employing people

Factors which will act as a barrier to job creation are likely to accelerate automation. These include:

- Costs of employing the people to do the work who might potentially be replaced by automation
- Regulation of work
- Availability of workers with necessary skills and experience
- Other obstacles or costs to employing people.

It is also the case that economic downturns have historically spurred the automation of routine jobs. Using history as a guide, further automation of routine jobs can be expected as a result of the current turbulent period of disruption, low growth and elevated interest rates.

4. WHAT IS TO BE DONE?

Analyses of the impact of technology and other drivers of change on jobs in years ahead consistently emphasise that the future of jobs will depend significantly on decisions of policymakers and businesses. What can be done to mitigate the downsides of future disruptions and prepare for the transformation ahead?

What if the optimists are not right? **What if** automation displaces more jobs than it creates in the long-term as well as the short-term? **What if** we face a world with too few jobs and too many workers?

Work can and should be a positive. Good work can be important for an individual's wellbeing as well as supporting them with a decent standard of living. It can deliver a sense of purpose, belonging and self-esteem, and provide a collegiate and supportive environment.

Work has always evolved. The tasks undertaken in different occupations have always changed. A production line worker at a car manufacturer nowadays is more likely to operate a robot than physically fix a body panel to a chassis. A doctor will now spend much of their time examining and interpreting data. Other occupations have all but vanished while new ones have been created as a result of our changing society. The future will be no different to the past in this regard. It is the pace and scale of change which may well pose greater challenges in the years ahead than in the past. Failing to overcome these challenges risks the potential of a world with too few jobs, coupled with a labour force without the skills for the jobs which remain.

Predicting confidently the shape of the workforce in 2050 is not possible. Nonetheless, the combined impact of the drivers of change gives an indication of the direction of travel and the steps needed to prepare for the future.

Reaping equitably the benefits of AI and automation more generally will be critical in the years ahead and investment, reform, management and support are necessary. Increased productivity and a growing economy will be central to mitigating significant job losses and a possible world with less work for people to do.

> *"The real impact of automation depends on how we manage the transition ... We see a significant need for governments and other parts of society to help smooth this transition, especially for the individuals whose old jobs are disrupted and who cannot easily find new ones"*
>
> MIT and Boston University study 2020, Artificial Intelligence and the Future of Work

Eight areas of priority action emerge as necessary steps to ensure policymakers, employers, and individuals are in the best possible position to prepare for and manage forthcoming disruptions.

Manifesto for tomorrow's work

This report recommends the following "Manifesto for tomorrow's work" addressing these priority areas.

See What is to be done...? A manifesto for tomorrow's work for more details.

SPOTLIGHT... ON SKILLS

Government, businesses and individuals all have a role to play in equipping the workforce with the skills needed for tomorrow.

What are future skills challenges?

Both Rishi Sunak and Keir Starmer, the UK prime minister and leader of the opposition respectively, have spoken of the need for a skills revolution. Although an ambitious skills strategy is required, embarking on this strategy does not seem to be happening at anywhere close to the rate and urgency required. The UK's Learning and Work Institute published a report in 2022 which showed the paucity of investment in skills by UK employers. It reported that expenditure per employee had declined by 28% since 2005 and was half the EU average, indicating a difficult future where the workforce is ill-equipped for the jobs of tomorrow. Management consultants, BCG, reported in January 2023 that improving workers' skills was still not a top priority among leading companies.

In 2017, the World Economic Forum commented that although the job opportunities available today are 21st Century jobs, the way most people perform them is still stuck in the previous century, as is the way society is training and educating people. It also noted that the half-life of a job skill is about five years (with other commentators since noting how this period is coming down further).

In 2023, the World Economic Forum's Future of Jobs report found that:

- six in 10 workers will require training before 2027, but only half of workers are seen to have access to adequate training opportunities today
- the skills that companies report to be increasing in importance the fastest are not always reflected in corporate upskilling strategies
- employers estimate that 44% of workers' skills will be disrupted in the next five years.

Responding to these challenges, a three year study by The Millennium Project recommended a number of actions to prepare for work in 2050, including several to address future skills requirements:

- government, business, and the labour unions need to cooperate to create lifelong learning models including forecasts of future skills requirements and training programs

> *"In the coming decades millions of workers may need to be entirely reskilled — a fundamental and profoundly complex societal challenge that will require workers not only to acquire new skills but to use them to change occupations."*
>
> Harvard Business School and Boston Consulting Group, Reskilling in the Age of AI, Harvard Business Review (2023)

- in parallel to STEM education, a hybrid system is needed of self-paced inquiry-based learning for self-actualisation, creativity, critical thinking, and human relations using new AI tools
- education/learning systems need to shift more toward mastering skills than mastering a profession.

Further, writing in the Harvard Business Review in 2023, Harvard Business School and Boston Consulting Group identified five paradigm shifts that are emerging in reskilling in the age of AI:

- reskilling as a strategic imperative
- reskilling as the responsibility of every leader and manager
- reskilling as a change-management initiative
- persuading employees to embark on reskilling programmes
- reskilling taking place in an ecosystem in which government and industry have roles to play.

As well as developing the skills for the future, the UK will need a strategy to attract and retain the workers with the in-demand skills and experience amidst global competition.

Which skills will be in-demand?

Assuming predictions are correct, the in-demand skills for the years ahead will be STEM skills (science, technology, engineering, and mathematics) and caring/social skills. IBM's 2023 report showed STEM skills dropping in importance since 2016 among surveyed business leaders with people skills such as time management and an ability to prioritise; and an ability to work effectively in teams, heading the 2023 poll. The report noted that *as technology becomes more user-friendly, employees are able to do more with less advanced technical skills*.

In many jobs people will work with AI. An understanding of this technology and its capabilities will be necessary for many people's careers to thrive. Managerial skills needed going forward will also change with AI being as integral to management jobs as accounting is today. With the pace and scale of change, change management skills will be a priority.

A World Economic Forum report in 2016 showed that the jobs which had grown as a percentage of the US workforce between 1980 and 2012 were the ones which required high levels of social skills, whereas the ones which fell as a proportion were often the ones which required limited social skills.

This shift to technical, caring and social skills is supported by McKinsey's conclusions from its 2021 report. Soft skills such as empathy, co-operation, leadership, communication, kindness and emotional intelligence will be increasingly valued.

Technology may not just compete with humans for work but help humans maintain a competitive advantage in areas in which people outperform machines. AI has a role to play in helping humans do human work better by improving our emotional intelligence, soft skills and interpersonal communications skills.

Lessons need to be learnt from the past. For example, the failure of any effective industrial strategy to retrain and re-skill redundant workforces at the time of the mass closure of British coalmines led to social strife and hardship across many regions.

How can in-demand skills be developed?

Education

Arguably, schools in the UK concentrate too much on acquiring knowledge and too little on acquiring life skills. Today a Google search or a question asked to Alexa can provide a wealth of information almost instantaneously. No doubt, accessing information will become even easier in the future.

Lessons can be learned from the oft-quoted success of Estonia's education system. Their Minister for Education and Research is quoted in the Times as explaining that the curriculum was moving away from knowledge and understanding towards implementation, analysis, synthesis and assessment, with more collaboration across subjects. The article reported that there is an emphasis on problem-solving, critical thinking, values, citizenship, entrepreneurship and digital competence - the qualities that employers say they want.

Scientific, technical and mathematical knowledge and skills will be needed as jobs are created working alongside technology. In addition, the future growth in the percentage of work from the caring economy, including highly skilled jobs where inter-personal skills comprise a key part of the role (e.g. schoolteachers, vocational instructors, doctors, nurses), will necessitate the school curriculum paying greater attention to the development of soft skills.

Universities

Tertiary education faces a similar transformation to the workplace. Universities and colleges will need to adapt in a globally competitive environment and will need to equip students for the skills and work of tomorrow not today.

In 2019, Duc Pham, Professor of Engineering at Birmingham University, predicted that in 2050, at least 90% of the student population will be pursuing online degree programmes, and that education will be truly democratised and globalised, with students unhindered by age, social, geographical or national boundaries.

Vocational training

With demand from the health and care sectors set to increase, government policy is only now beginning to recognise the need to train more doctors and nurses. The UK has the lowest number of hospital beds per capita among G7 nations with less than half of the number in France, less than a third of the number in Germany and less than a fifth of the number of Japan. Adequate vocational training means not only investing in more training places but having enough skilled professionals who can deliver the training. It also means adequate financial support to enable the students to afford the training. Inadequate funding for student nurses, for example, only exaggerates the shortfall in skilled nursing professionals. An ambitious strategy focused on ensuring we have the skilled professionals we will need includes adequately funded vocational training.

Apprenticeships

Apprenticeships are an important pathway to acquiring the needed skills and experience. The UK government introduced an apprenticeship levy under David Cameron's Conservative Government in 2015. Medium-sized and large employers pay 0.5% of their annual wage bill by way of an additional tax to help fund apprenticeships in their organisation.

Apprenticeship starts have, however, generally been declining since 2015 though increased slightly in 2021/22 over the previous year. This decline will need to be reversed as apprenticeships need to form a key element in equipping people with relevant skills and experience.

Employer training

Businesses need to be encouraged to train and develop their workers. Employers will derive a secondary benefit from increased investment in training and developing their workers. Professional and personal development is often cited as a key factor among workers in deciding which job to accept. A strong training and development programme should improve staff attraction and retention.

There are obvious potential positive consequences from greater investment in training and education if the supply of work decreases. The combined impact of more 16- to 18-year-olds in education; more adults in tertiary education; and more workers reducing their working hours to develop skills, reduces any surplus from the labour market. More investment in education and training also creates more jobs in that sector.

Employers will need to respond to reskill in the age of AI by developing new ways to learn – in a systematic, rigorous, experimental, and long-term way – to adapt to the rapidly accelerating pace of technological change.

Respondents to IBM's 2023 survey report estimated that 40% of their workforces would need to reskill due to AI and automation over the next three years.

Labour market activation strategies

As well as employers, the state has a role to play in reskilling workers. The OECD has long advocated active labour market policies as effective in improving labour market participation. In a rapidly changing world, such strategies become more important.

Harvard University's *Epicenter* has highlighted how the US came very near the bottom of an international table of public expenditure on labour market activation expenditure.

Effective government intervention by way of skills training is seen by businesses as the most important potential intervention, ahead of more flexible hiring and firing practices, tax incentives to improve wages and relaxing laws on work visas.

Policymakers should also consider reforms to the tax system so that training in new skills becomes tax deductible and review redundancy consultation laws so that they contain a specific requirement to consider training in new skills as part of the redundancy process.

Attracting and retaining skilled workers

In a competitive world, to attract and retain workers with the key skills and experience, employers will need to create working environments to meet the priorities of the workforce of tomorrow. The UK government and organisations such as the CIPD and TUC have in recent years been paying more attention to the importance of modern working practices and there will be even more of a focus on "Good Work" in the years ahead.

The 2022 Eight Drivers of Change report predicted the growth of PREFAB jobs – ones which provide: **Purpose**; **Remunerate** fairly; **Engage** with the workforce; offer **Flexibility** and **Autonomy**; and confer a sense of **Belonging**.

A successful economy will need to compete internationally for workers with the required skills. This strategy will entail attracting skilled workers from overseas and retaining domestic skills. Just as a country such as the UK will want to attract those with in-demand skills and experience, other countries will be seeking to attract those who have developed their skills here.

Not only will this mean creating attractive working environments, but competing successfully internationally will necessitate an enlightened approach to skilled migration. The costs and barriers to bringing in skilled workers will need to be low.

The country will need to be an attractive home. This will mean an environment which is not hostile to migrants and a country where the infrastructure and services work effectively. Arguably, it also has implications for a competitive tax policy. The consequences of failing to retain skilled workers is illustrated today with media attention on Australia's wooing of burnt out disenchanted NHS doctors.

Assuming that the UK can retain its skilled workers, the economy will also need the skilled workers to work. Reasons for economic inactivity include workers electing not to work (i.e. retiring early), caring responsibilities and, increasingly, long-term ill health.

Automation has the potential to de-skill, where the need for skilled labour within an industry is diminished by the introduction of technologies operated by semi-skilled or un-skilled workers. This deskilling can bring substantial efficiency and cost saving, but it can also lead to irreparable loss of important skills.

5. CONCLUSION

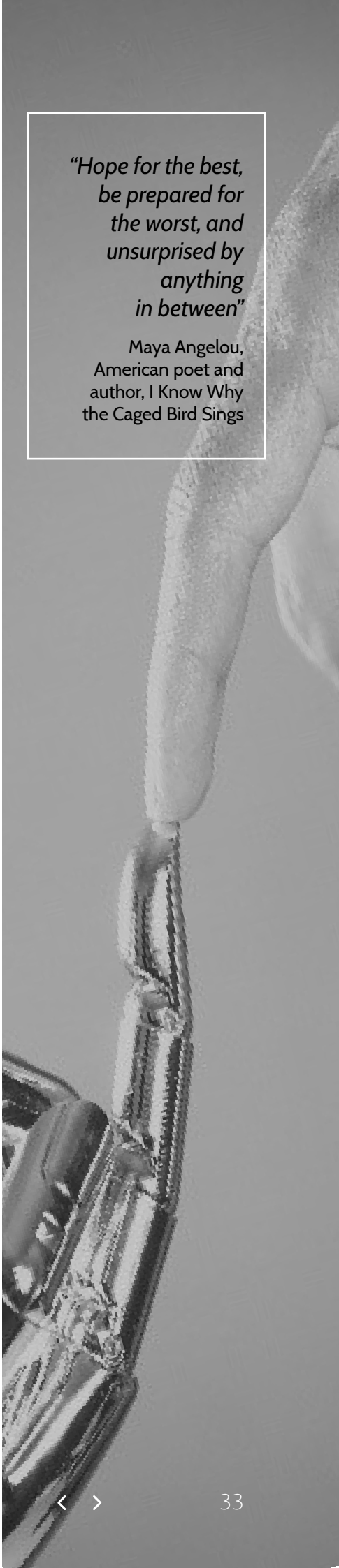
In today's uncertain world, crystal ball gazing to the year 2050 with confidence is impossible. However, there is every reason to believe that the changes to the world of work by then will be profound. Policymakers and business leaders need to make the best predictions possible to ensure steps are taken to prepare before it is too late.

The impact on the workforce of AI and other advances in technology will be colossal. Many jobs will be replaced by automation. Some will be complemented by technology and others will decline in number. Demand for some jobs will increase and new occupations will be created even if it is not yet certain what these will be.

However, just because the world of work experienced net increases in employment in past industrial revolutions does not necessarily mean that it will do so this time. The pace and scale of disruption promises to be quicker and greater this time and any increases in productivity may not translate into more jobs in the future.

The ability of the workforce to fill the jobs of tomorrow will depend on whether education systems and training investment by businesses and government can equip individuals with the necessary skills for future jobs.

The climate emergency will increasingly affect everything we do. Global and domestic politics; economic growth; and a fairer sharing of the fruits of productivity increases will be major factors influencing the job market in the years ahead.



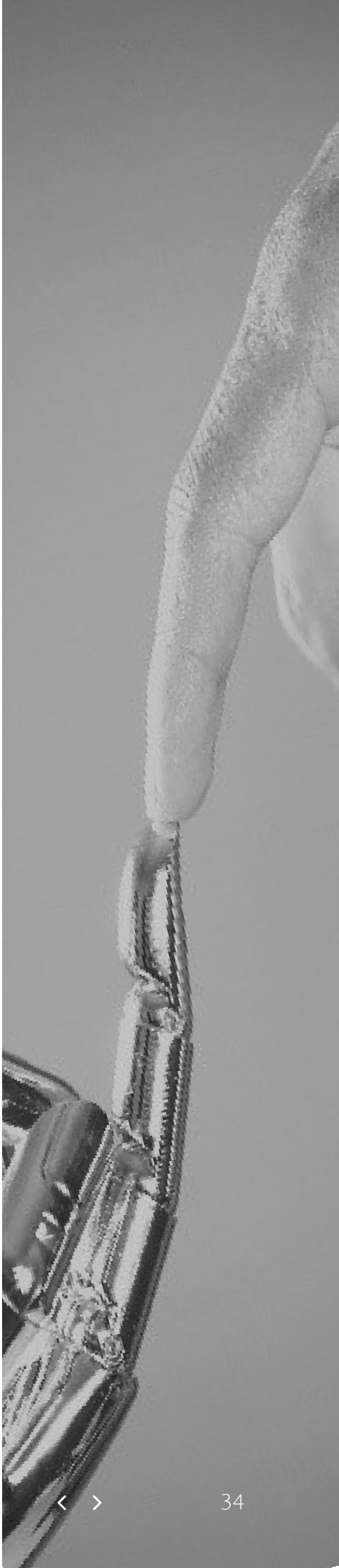
"Hope for the best, be prepared for the worst, and unsurprised by anything in between"

Maya Angelou, American poet and author, I Know Why the Caged Bird Sings

A foreseeable vision of the world of work in 2050 is of a world where there will be fewer jobs than workers with new jobs not having been created fast enough to replace those which have been displaced. Action is needed now to mitigate the potential destabilising and disruptive transitions ahead.

Key features of the UK labour market of 2050 could include:

- More employment in the health and care sectors
- More people working in education – primary, secondary, and tertiary education and life-long learning
- The number of scientific and technical jobs increasing with the relevant STEM skills in great demand and global competition for these workers, notwithstanding the automation of many of these roles
- Workers still employed in management, law, accountancy, finance, business consultancy and similar professions, but fewer than today as AI complements their work
- Routine and repetitive work being replaced even further by automation
- People working longer into older age as the population and the workforce age
- Average working hours decreasing with more part-time work and career breaks
- Both unemployment and skills shortages increasingly being a feature of the labour market

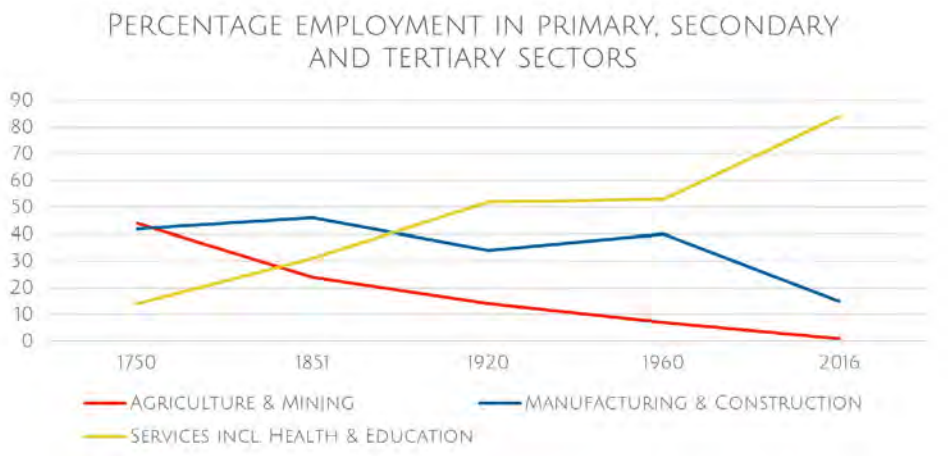


LOOKING BACK... WHAT CAN WE LEARN?

The past is not necessarily an accurate predictor of what will happen in the future. Nonetheless, the impact of past industrial revolutions on jobs and historic links between automation, productivity, economic growth and job creation provide useful pointers to the years ahead.

Over time, employment has changed beyond recognition. Back in 1750, nearly half of all workers in the UK were employed in agriculture and mining (primary industries) and nearly as many in manufacturing and construction (secondary industries). A suggestion in those days that agricultural workers would become negligible as a percentage of the workforce and that less than one in five workers would be employed in the secondary industries in the future would no doubt have been met with great scepticism, and many of the jobs of today met with incomprehension and disbelief.

Centuries from now, jobs will emerge that are beyond what can be imagined today.



Data source: University Cambridge Research and Office of National Statistics

Past industrial revolutions – how jobs have evolved?

At the start of the First Industrial Revolution in the middle of the 18th Century, it is estimated that 44% of the working population was employed in the primary sector (primarily agriculture and mining); 42% in the secondary sector (manufacturing and construction); and 14% in the tertiary sector (services including health and education).

By the time of the Second Industrial Revolution a century later, the proportions had shifted to 24% in primary industries; 46% in secondary industries; and 31% in tertiary industries. By the end of the Second Industrial Revolution in 1920, these had changed to 14% in primary industries; 34% in secondary industries; and 52% in tertiary industries. By the beginning of the Third Industrial Revolution in around 1960, the primary sector had continued to decline, and the tertiary sector had remained stable. However, this point marked the post Second World War peak in manufacturing and construction with 40% of the workforce employed in the secondary sector.

Turning to the beginning of the Fourth Industrial Revolution, by 2016 the employment numbers changed dramatically to just over 1% employed in the primary sector, 15% in the secondary sector and 84% in the service sector.

In a report in 2015, Deloitte calculated that, during the 140 years between 1871 and 2011 in the UK, "caring" jobs increased from 1.1% of the workforce to 12.2%. Over the same period, Deloitte calculated that "muscle power" jobs had decreased from 23.7% to 8.3%, highlighting the impact of mechanisation on routine manual work and human's competitive advantage (at least to date) with work requiring interpersonal skills.

In the period between 1992 and 2014, Deloitte considered UK Labour Force Data and determined that the occupations which had grown the most over that period were "caring roles": nursing auxiliaries and assistants (+909%); teaching and educational support assistants (+580%); welfare, housing youth and community workers (+183%); and care workers and home carers (+168%). On the other hand, the occupations which had declined the most were skilled trades: footwear and leatherwork trades (-82%); weavers and knitters (-79%); metal making and treating processes (-70%).

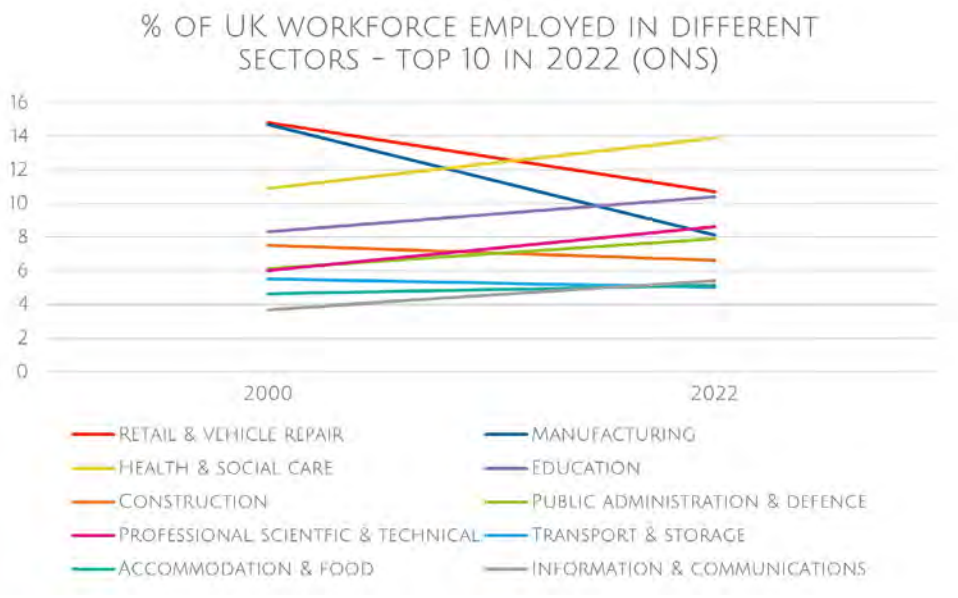
Deloitte's data also highlighted the impact of technology on occupations. The fourth largest increase was among information technology managers (+195%), whereas the fourth largest decline was among typists and related keyboard occupations (-57%).

That the biggest rise in occupations was among nursing and teaching assistants highlights a trend to disaggregating jobs to enable better qualified and experienced staff to focus on work which necessitates those qualifications and skills.

Even over the first quarter of the 21st Century, the types of jobs people do have changed. Using the Standard Industry Classification job categorisation, over the first quarter of the 21st Century (2000 to 2022), the major shifts in employment in the UK have been:

- growth in health and social care (10.9% to 13.9% of the working population); education (8.3% to 10.3% of the working population); and professional, scientific and technical jobs (6% to 8.6% of the working population); and
- contraction of wholesale, retail and vehicle repair (14.8% to 10.7% of the working population) and manufacturing (14.7% to 8.1% of the working population).

The other sectors comprising 5% or more of the British workforce are: public administration, defence and social security (7.9%); construction (6.6%); information and communication (5.4%); accommodation and food services (5.1%); and transport and storage (5%).



Data source: University Cambridge Research and Office of National Statistics

Past industrial revolutions – productivity, economic growth and wages

In 2017, McKinsey set out five lessons to take from history on AI, automation and employment. One of those lessons related to the role that technology has had in raising productivity to create jobs.

However, the first quarter of the 21st Century has been notable for low improvements in productivity, slow economic growth and little rise in real wages across many industrialised economies notwithstanding the potential efficiencies from increased automation.

Productivity

Productivity increases where each hour of work (labour productivity) or each pound of investment (capital productivity) results in increased output. Technological advances spur improvements in productivity as goods and service can be provided more cheaply and more efficiently – and often of a higher quality.

Productivity increases, in fact, can drive job numbers up or down. On the one hand, increases in productivity should mean that less people are needed to produce the same amount of goods or deliver the same services. On the other hand, increases in productivity are one of the principal drivers of economic growth (real – after inflation – growth in per capita GDP), the others being increased hours worked and increased capital investment. Economic growth has historically been a major driver in job creation.

Increases in productivity in the UK averaged around 2% per year in both 19th and 20th Centuries rising after the Second World War to a peak of over 4% around 1970 before falling back to historically very low levels by early this century. Between 2012 and 2019 UK annual productivity rises were well below historical trends (increased output per hour worked averaged 0.8%). Post pandemic trends are uncertain but low rates of productivity growth appear to be continuing.

The last few years have shown that rapid technological advances do not necessarily translate into increased productivity and economic growth (or, at least, take some time to show through). This sluggish growth has been referred to as a "productivity paradox". In 2020 a US study for MIT explored various explanations for this paradox and considered the most compelling that new technologies take time to diffuse, to be implemented and to reach their full economic potential. If this is right, the benefits of these advances may only emerge in the future.

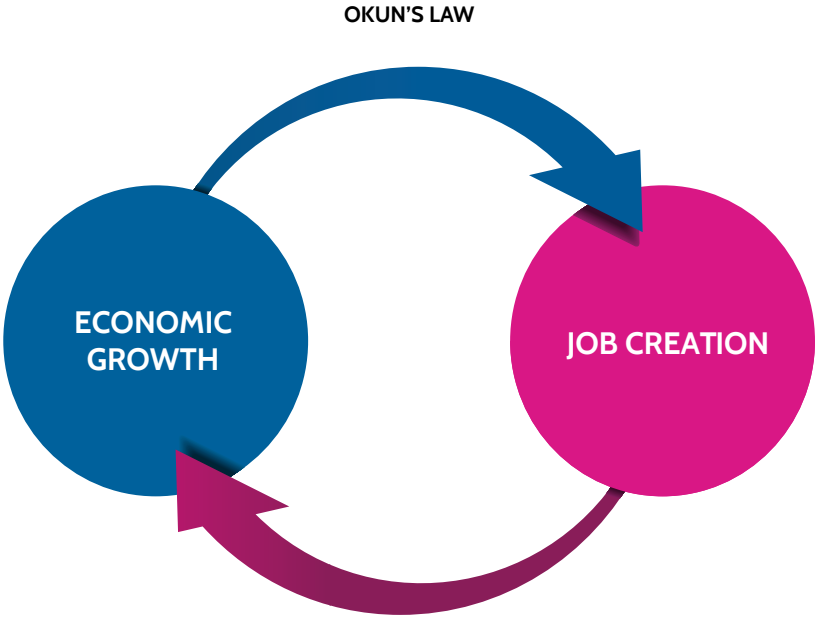
McKinsey analysed the factors contributing to low productivity growth over the last fifteen years. They highlighted as key factors: weak demand since the 2008 financial crash; and short-termism and risk aversion resulting in failure to reap the benefits of digitalisation (at least, to date). McKinsey also expressed concern that growing inequality has resulted in broad-based income growth diverging from productivity growth, because declining labour share of income and rising inequality are eroding median wage growth, and the rapidly rising costs of housing and education exert a dampening effect on consumer purchasing power.

The UK has relatively low levels of productivity (GDP per hour worker) among G7 nations with a need for improved productivity to match Canada, Italy, Germany, France or the US. Commentators looking at the UK which fared worse than other comparable nations since 2008, consider country-specific factors have been at play. Academics at the London School of Economics pointed to poor training and insufficient public expenditure as more likely causes of this productivity puzzle. PwC pointed to a more labour-intensive business model relying on low paid employees in some sectors as well as a need for higher investment levels, a stronger education and skills strategy and improved adoption of existing technologies.

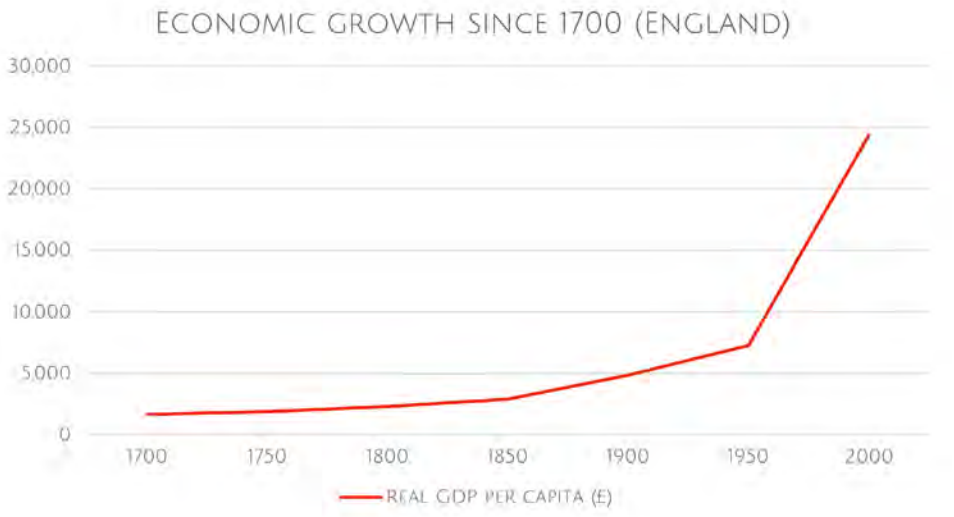
"AI [will] disrupt the way we work - but we should focus too on the potential living-standards gains from higher-productivity work and cheaper-to-run services, as well as the risk of falling behind if other firms and economies better adapt to technological change."

Torsten Bell, Chief Executive, Resolution Foundation (2022)

Economic growth

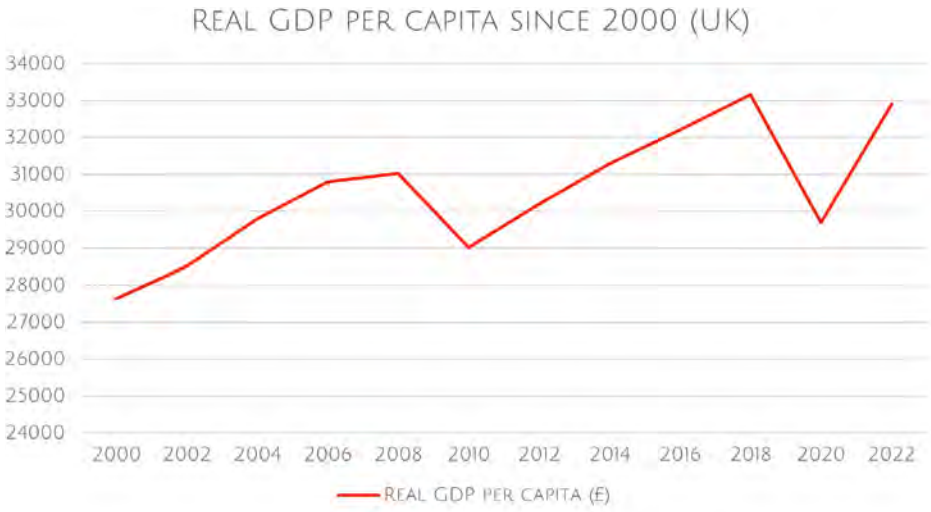


Economic growth creates jobs and job creation, in turn, generates economic growth. Economists refer to this as Okun's Law.



Data source: Our World in Data

Real GDP per capita - after taking account of inflation - had changed little in the centuries leading up to First Industrial Revolution but has increased more quickly since an initial surge after the Second World War.



Data source: Statista

From 2008, however, economic growth stagnated in the years up to the jolts to the global economy of Covid and Russia's invasion of Ukraine and beyond.

Real wages and increasing inequality

Raised productivity also means more profitable businesses can increase wages. Increased wages can pull in two different directions as far as job creation is concerned.

On the one hand, increased wages mean that workers should have more disposable income which should increase demand for goods and services which, in turn, should result in the creation of more jobs. Increased wages should also mean more jobs as people pay for tasks to be done by others that they would once have performed themselves. On the other hand, however, increased wages can make employing people less competitive and accelerate automation. Increased wages can also spur inflation which is more of a concern today than it has been for some time. Monetary policy to control inflation will often then be to raise interest rates to stifle demand by reducing workers' disposable income which would be expected to lead to reduced levels of employment.

For increased productivity to create jobs, the benefits need to be spread widely. The correlation between inequality and lower growth has been explored by various academics and organisations. The rapid growth in inequality seen in the UK and across many countries threatens the translation of economic growth to wage growth to job creation in the years ahead.

In the decade after the 2008 financial crash, labour productivity and wage growth in the UK have diverged. Real wages have flatlined since 2008 whereas productivity has grown even if such growth has been at slower rates than previously.

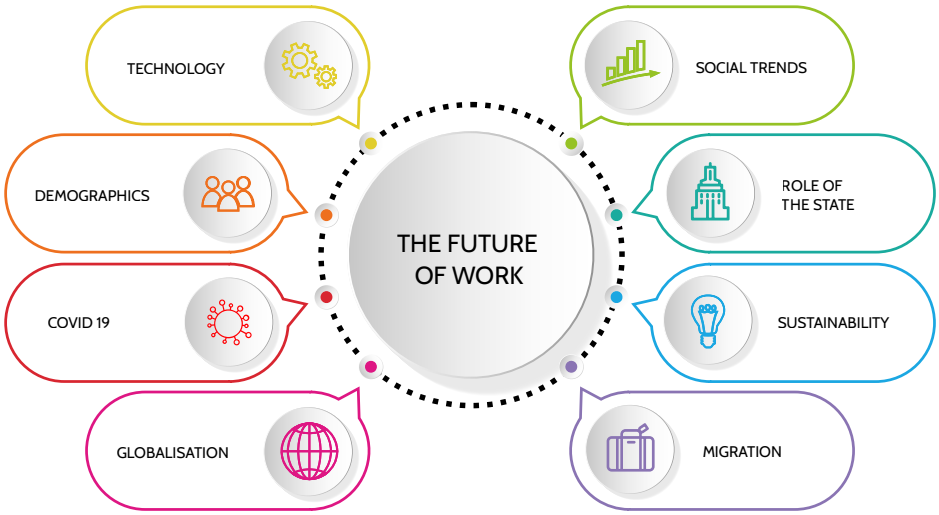
LOOKING AHEAD... WHAT CAN WE PREDICT

The balance between jobs and workers in future years and the nature of work of tomorrow will depend not only on the advance of AI and further developments in technology but also on the combined impact of other interconnected drivers of change.

Alongside technology, the effects of the pandemic have converged with other drivers of change, namely sustainability, demographics, globalisation, the role of the state, migration and social trends, to bring about significant changes to the **where**, **when** and how of work.

Drivers of change

The various drivers of change are explored in more detail in a report by James Davies, partner at Lewis Silkin LLP Eight Drivers of Change – 2022 & beyond. That report explored how these eight drivers are shaping the world of work and makes recommendations on how employers can prepare and navigate future uncertainty as these changes gather pace.



Technology

Advances in technology promise fundamental disruption to most jobs. Robotics has led to machines replacing people throughout much of the manufacturing sector. AI, and now generative AI, threatens to do the same to many knowledge jobs. Recent concerns about a future with too few jobs have been fuelled by the frightening capabilities of generative AI. Sustainable energy, genomics, quantum computing and battery technology will drive further changes in the labour market.

Technology clearly has the potential to result in massive job displacement. However, it also has the potential to accelerate economic growth and create jobs.

Read more about the impact of technology in our Spotlight on...technology.

> *"The long-term impact of AI is highly uncertain...all firm predictions [about the long-term impact of AI] should be taken with a very large pinch of salt."*
>
> Torsten Bell, Chief Executive, Resolution Foundation (2023)

Demographics

Demographic change caused by an ageing population, a result of low fertility rates and increasing life expectancy, has the potential to tighten the labour market and pull in the opposite direction to automation.

In the US, the Bureau of Labor Statistics is predicting the skills shortage to become more pronounced in the years ahead with the Baby Boomer generation reaching retirement age.

Today, the ageing population is seen as a potential obstacle to addressing current labour market shortages. However, a shrinking number of people of "working age" could be seen as an answer to a shrinking number of jobs. If productivity increases as predicted, resulting in higher wages, a smaller labour market could be seen as an alternative to many people of "working age" without jobs. Indeed, some actively promote a future of "de-growth".

Some countries' populations are already in decline and there will be a global turning point towards the end of the century when the world's population starts to decline. Populations in some countries like China, Japan, Korea, Russia, Germany, Italy and Spain are projected to contract materially by 2050. Last year Japan's population declined by more than half a million, the twelfth consecutive year of decline. With a fertility rate of 1.26 children per woman, there are enough children to turn around a declining and ageing population. In South Korea the issue is even more serious with a fertility rate of only 0.78 and

> *"Today's business leaders and policymakers face countless sources of uncertainty — but when it comes to demographics, the future is clear. The reality of our globally aging population is evident now, as once a population's fertility rate goes below replacement levels (an average of two children per woman), it stays there. Barring massive immigration from places that still have young and growing populations, such as Ethiopia or Nigeria, that most likely means a less-populated future for the majority of countries on our planet."*
>
> Jennifer D. Sciubba, Harvard Business Review (2022)

the population has begun to decline. South Korea and Japan are among countries seeking to address low fertility rates by encouraging more births.

Unlike some Western European nations, the UK, with a fertility rate of 1.6 children per woman, is projected to grow from 67.7 million to 71.7 million, by 2050. However, this is predicated on positive net migration numbers being maintained.

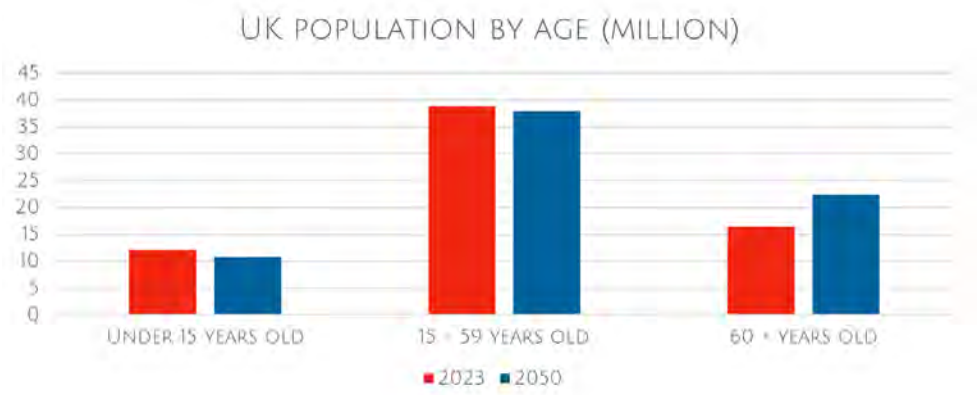
The declining population projected for some richer nations can be contrasted with other parts of the world and sub-Saharan Africa in particular. Nigeria's population, for example, is projected to grow by over 150 million people and overtake the US in around 2050 to become the world's third most populous nation.

This changing face of the world's population promises to have profound implications for the world of work in the UK. These growing nations will become more important as potential customers for richer nations' goods and services. Significant population increases in some places will shift the focus for low-cost manufacturing and, with knowledge work being ever more easily portable, low-cost knowledge jobs.

Combined with geo-political conflict and climate change, surges in population in parts of the world and chiefly in sub-Saharan Africa will create refugee crises around the world.

Covid aside, life expectancy is increasing in countries like the UK, though more slowly than in past decades. In the US, life expectancy even declined in the five years to 2020. However, while cures for cancer and dementia may emerge in the third quarter of the century, medical advances in the meantime could well see people living longer and exaggerate further the ageing population in the decades ahead.

As mentioned above, the UK population is projected to grow to 2050. This growth will be primarily from the over 60s who are projected to increase in number from 16.4 million to 22.3 million. The number of children under 15 will decline from 12 million to 10.7 million. 15- to 59-year-olds will decline in number slightly from 38.8 million to 37.9 million.



Data source: Statista

An ageing population results in an altered demand for goods and services, as older people's needs and priorities will differ from those of younger generations. As a consequence, more jobs will be created in the health and social care sectors.

Retirement ages can also control numbers in employment. Shifting the retirement age later in life increases the available workforce and amplifies the effect of a reduction in jobs. An ageing population increases the dependency ratio (the numbers above and below normal working ages which need financial support from those of working age) putting further strain on public funds. However, the violent reaction of the French people to President Macron's increase in retirement ages from 62 to 64 highlighted the difficulties in bringing the electorate along with such change.

Sustainability

The record temperatures and fires of summer 2023 have reinforced that addressing the climate emergency will become even more urgent in the years ahead. This will have implications for labour markets and create work across a number of sectors, including renewable energy.

The World Economic Forum 2023 report found that, according to business leaders questioned for their report, three of the four drivers considered most likely to create net positive growth jobs over the following four years were: investments to facilitate the green transformation of business; broader application of ESG standards; and climate-change induced investments into adapting operations. Increased adaption of new and frontier technologies only came sixth. However, the position of new technologies disguises that this driver was put forward by some business leaders as the biggest driver of new jobs but offset by others who saw it as reducing jobs in their organisation.

The US Bureau of Labor Statistics predicted in 2021 that the biggest percentage increases in jobs over the following decade would be, along with nurses, wind turbine engineers.

New jobs responding to climate change will emerge. Sustainability managers are now commonplace in companies and will no doubt grow in number. Both the US and EU are investing huge sums in an industrial strategy which will create many new jobs tackling the climate emergency. Climate change will mean that optimal conditions for agricultural products will shift creating new jobs in places and disrupting others elsewhere.

> *"Businesses predict the strongest net job-creation effect to be driven by investments that facilitate the green transition of businesses, the broader application of ESG standards and supply chains becoming more localized, albeit with job growth offset by partial job displacement in each case."*
>
> World Economic Forum Future of Jobs report (2023)

Migration

Migration has often been a valve used by nations to address skills shortages. While releasing this valve can alleviate skills shortages, effective use of migration to address skills shortages can be politically contentious. Concern about levels of migration was the most common reason given by those who voted to leave the EU. The current UK Conservative government opposes migration as a lever to combat shortages while at the same time accepting high numbers of migrants to meet immediate needs, particularly in the health and care sectors.

This restrictive approach to migration has been cited as a contributing factor to the UK's economic woes, and a more

> *"We can only get the problem of an ageing workforce under control with a modern immigration policy... We have to reach the mark of 400,000 skilled workers from abroad as quickly as possible."*
>
> Christian Duerr, German politician (2021)

relaxed approach as a contributor to growth. Huw Pill, Chief Economist to the Bank of England, in evidence to the UK Parliament's Treasury Committee was quoted as saying net positive levels of immigration led to an increase in the level of GDP of about two tenths of a percentage point by the end of 2025 relative to its previous forecast.

ONS data suggests that the UK population will grow by 1.8 million between 2020 and 2030 and then by a further 2.25 million to 2050. Population growth in the first half of the next quarter of a century is predicated, however, on estimated net migration of 205,000 per year. That the population does not shrink from 2030 depends on migration levels consistently reaching at least this level. Some levels of migration will, therefore, need to be maintained merely to maintain levels of population in the UK. However, in 2022 net migration far exceeded this projection at just over 600,000.

Other factors favouring encouraging skilled migration will be competition among nations for those with the in-demand skills of a rapidly changing workforce. Germany, for example, is easing its requirements to attract the best workers. Others are following suit. Canada, which has always been at the forefront in seeking skilled migrants has recently launched a new pathway for STEM professionals to enter that country. According to the OECD, in 2023 New Zealand, Australia, Sweden and Switzerland represent the most attractive destinations for highly qualified workers.

Negativity towards migration is abating and, with hostility greatest among the older generations, this trend will probably continue. It seems increasingly likely that the UK's Brexit woes will result in the UK re-joining the Single Market (or some very similar relationship) long before 2050, resurrecting EEA free movement rights.

Workforce numbers will also be influenced by increasing pressure from migrants escaping poverty, oppression, or war. As of August 2023, 237,000 visas have been granted permitting Ukrainians to enter the UK under the Ukraine Family and Sponsorship visa schemes. A combination of the global climate crisis, geo-political tensions and rapid population growth will only put more pressure on the richer nations to find a global solution to a growing migrant-emergency.

Ultimately, however, a world of work with too few jobs may place the Spotlight back on immigration numbers.

Covid and ill-health

Ill-health potentially restricts the number of available workers. In the UK, much attention has recently been given to the high levels of the economically inactive – those of working age who are neither in work, nor seeking work. These include students, those with caring responsibilities, those who have retired early and the long-term sick.

While the number of students and early retirees has not changed greatly in the UK in recent years, the numbers economically inactive due to long-term ill health have grown appreciably. Covid continues to affect the UK labour market even after its most serious threats have declined through the long-term debilitating effects of long Covid. In 2022, the Brookings Institute estimated that between two and four million American workers were off work due to long Covid.

McKinsey highlight the significant contribution good health generally plays towards productivity reporting that economists estimate that about one-third of economic growth in advanced economies in the past century could be attributed to improvements in the health of global populations, with research focused on more recent years finding that health contributed almost as much to income growth as education.

Advances in health and medical interventions also promise an increasingly ageing population and the creation of more jobs in the health and care sectors.

"Coronavirus has completely changed how people think about where or how you should work."

Eric Yuan, CEO Zoom, (2020)

Social trends

Attitudes and priorities can also increase or reduce labour supply, and impact which occupations grow and which decline. Younger generations today have markedly different values, attitudes and priorities to older generations, and this promises profound implications on the world of work. These changing priorities will impact on the workplace in the years and decades ahead. Increased flexibility is one such priority.

As well as those electing not to work voluntarily, such as those who retire early, an increase in numbers working part-time reduces labour supply. Average working hours have declined over recent years.

"Millennials have developed different values to previous generations, shaped by experiences unique to them."

John Burn-Murdoch, Financial Times (2023)

Consumer behaviour is also ever evolving and advances in technology is one driver of these changes. During the pandemic, online shopping and food deliveries surged and this trend has continued. Such changes in behaviour influence the number and type of jobs, McKinsey, in its report on the future of work after Covid-19, concluded that Covid-19 triggered new consumer and business behaviours that may have additional effects on labour demand in the years ahead and may result in greater displacement of workers in some occupations while also increasing job growth in others. The future is likely to see fewer sales assistants and more delivery riders and drivers (at least until driverless vehicles and delivery drones replace their jobs) in the years ahead.

Globalisation

The number of jobs is also influenced by globalisation or de-globalisation and the extent to which jobs are transferred into or out of the country. The highly skilled knowledge jobs of the future are likely to be easily transferred across frontiers putting increased pressure on countries to develop, attract and retain the best people with the most in-demand capabilities. Globotics, the tele-migration of service jobs, is likely to be an increased trend over the second quarter of this century.

Sustainability, the reduced importance of labour cost as machines replace humans, a shift from neo-liberalism to more interventionist politics in many countries, and geo-political uncertainty may result in manufacturing jobs passing in the opposite direction and the supply chain moving closer to the consumer –a growth in on-shoring and friend-shoring. And, of course, any geo-political turmoil will damage the global economy with adverse consequences for job creation.

Increased protectionism threatens economic growth and any retrenchment from globalised trade will affect jobs.

"Our focus [on trade] has shifted from liberalization and the pursuit of efficiency and low costs - at any cost - to raising standards, building resiliency, driving sustainability, and fostering more inclusive prosperity at home and abroad."

Ambassador Katherine Tai, US Trade Representative (2023)

The role of the state

The importance of politics in the number and types of jobs available often receives little attention. It is, however, a key driver. A country's tax policies, investment strategy and industrial policy can result in job-creation. Recently, governments have taken significant steps to intervene to create jobs, arguably driven, in some countries, by voters' expectations following governmental support during the pandemic. The UK,

"There will be an impact on jobs, and I think it will require partnership between the industry and government, but mostly action by government."

Sam Altman, CEO OpenAI (2023)

however, looks to be out of step with other major economies in relying on laissez-fare free market strategies which deter state intervention to drive forward the economy, as most other nations consider that the days of such ideology are past.

Joe Biden's government in the US has pushed through various laws aimed at driving growth, with government support totalling $1.7 trillion for building chip manufacturing plants, energy efficiency and infrastructure investment. The EU has announced steps to invest in climate neutrality and digital leadership.

One area where social trends, demographics and the role of the state converge is the leftward political shift of the younger generations. John Burn-Murdoch writing in the Financial Times at the end of 2022 illustrated clearly how Millennials, unlike previous generations, were not (yet) shifting rightward in their politics as they get older, at least in the UK and US.

This move left in politics, if maintained, promises profound implications for the world of work in the years ahead in which more interventionist pro-job politics can be expected.

The role of the state extends to regulating the evolving world of work. It is likely that the next decades will see measures to adapt the regulation of work to the plethora of flexible working relationships which advances in technology have enabled. The regulation and taxation of work needs to adapt and evolve from yesterday's world of work to meet the needs of today and tomorrow. The debate will continue about security and flexibility and the appropriate balance of economic risk between employer and employee in the employment relationship. Political decisions about the regulation of AI will have profound implications for the scale and speed of AI-driven job disruption.

In 2016, the Guardian newspaper interviewed various experts about their predictions for the world of work in 2050. They predicted seismic changes, including a move away from the traditional employment model to one of task-based self-employment and a consensus emerged that changes in the labour market risked increasingly creating a two-tier society. Governments will need to react to these tectonic shifts.

WHICH JOBS WILL BE DISRUPTED AND WHERE WILL NEW JOBS COME FROM?

Automation will disrupt work and jobs. However, predicting what work and which occupations and sectors will be most disrupted will be important in preparing for a more-automated world of work.

Since the First Industrial Revolution 250 years ago, manual work has borne the brunt of displacement by machines – firstly agricultural work and then manufacturing came under threat, and then, as the capabilities of machines increased, skilled trades. These were replaced by jobs in the burgeoning service sector along with knowledge and caring jobs where machines could not compete. With ongoing advances in AI, machines promise the potential to replace thinking and communicating tasks and, therefore, to compete across the occupations depending on such skills.

Some commentators have predicted that increased use of AI in work will continue to impact most on routine and repetitive jobs. However, over the last decade, more and more comment has focused on the potential implications for more highly skilled knowledge jobs. Indeed, it is difficult to think of many jobs which could not potentially be affected by AI.

Some occupations will have a finite shelf life. For others, automation and AI, in particular, will increase efficiency so that the same output can be achieved with far fewer workers. New jobs will be created in new areas with the potential for increased productivity to result in increased prosperity, increased demand and an increased number of jobs. But will the number of new jobs be anywhere near enough to replace redundant occupations?

KPMG estimate in their 2023 report that generative AI will increase UK productivity by 1.2% and note that other researchers, looking at technological advances more broadly, estimate productivity increases ranging from 7%.

Economists refer to the correlation between economic growth and job creation as Okun's Law. Following this approach, even a 7% increase in global GDP would result in only around a 3% increase in global employment. With around 3.3 billion jobs globally at present that would create 100 million jobs, only a third of those Goldman Sachs consider could be lost.

The views of a range of commentators on which jobs will be disrupted and which jobs will grow is set out in more detail in the review of leading commentary and reports section.

Looking at the jobs most at risk and those most secure from automation, it is possible to break down work by the nature of the tasks involved (routine; skilled manual; knowledge; creative; and caring and communicating) and by the sector of the economy in which the occupation sits.

Looking ahead – by nature of work

Though jobs can be broken down by the nature of the tasks involved, many jobs include more than one type of work. Nurses' work involves, for example, skilled manual work, knowledge work and caring/communicating work. Architects' work, by way of another example, includes knowledge work and creative work.

Routine jobs

Routine work has been impacted most by industrial transformation over the years. Until recently it was routine and repetitive jobs that continued to be seen as most at risk from automation. Back in 2013, Frey and Osborne warned that it would be the low-skill low-wage jobs most at threat of automation.

This seemed to be the consensus of commentators over much of the following decade and some still predict that these remain most at risk.

Skilled manual jobs

As Frey and Osborne pointed out in their 2013 report, many skilled manual jobs were an early casualty of automation as mechanisation was able to simplify tasks and perform them more quickly, more efficiently, more cheaply and, often, better. More recently, as the capabilities of automation increased, more skilled manual jobs were displaced. A Deloitte study in 2015 showed that the occupations most displaced proportionately by technology between 1992 and 2014 were: footwear and leatherwork trades; weavers and knitters; and those working in metal making and treating processes.

As machines' capabilities increase yet further, skilled manual work will be further displaced. Many skilled construction jobs, for example, will be under threat as the potential of automated robots grows. Disruption of other skilled manual occupations may be further away, particularly those requiring manual dexterity or mobility such as electricians and plumbers. No doubt, to the extent that they are not already able, robots will acquire the necessary dexterity to accompany their diagnostic abilities to displace plumbers or electricians. Even with jobs requiring mobile skilled manual work, it is likely that humans and machines will collaborate more and more.

Knowledge jobs

Many commentators argue that highly skilled "knowledge jobs" are now under threat.

Martin Ford, the author of **Rule of the Robots: How Artificial Intelligence Will Transform Everything**, argues that the disruption from automation will move from mundane and repetitive to "white collar" jobs. Mitch Downey argued in his 2021 article in Labour Economics that automation threatened middle-income jobs which risked being replaced by lower skilled jobs operating the displacing technology. Asked recently in a CBS interview what jobs would be disrupted by AI, Sundar Pichai, the Google Chief Executive said "Knowledge workers", including accountants, architects, and software engineers.

In most cases, these knowledge occupations will not disappear, but AI will take over certain tasks and also enable knowledge workers to complete other tasks much more quickly and efficiently. The skills required for the knowledge jobs of tomorrow will not be the same as today. As with skilled manual workers, knowledge workers will need to learn to work alongside and collaborate with technology. Knowledge jobs requiring expertise and qualifications in the STEM subjects will continue to be in demand, but technology will advance to displace even many of these in time. AI is already able, for example, to write computer code and its capabilities will only increase.

KPMG in a 2023 report focusing particularly on generative AI, on the other hand, suggested that its impact may not be as significant as some suggest. It identified only 2.5% of tasks which it determined could be performed by AI and concluded that the tasks most at risk from generative AI are those: classifying and summarising large volumes of documents, text and data; drafting technical documents; and image and long form creation.

Indeed, evidence of occupations of highest growth over the last twenty years (e.g. nursing and teaching assistants; paralegals in law firms) shows that employers have been looking to disaggregate certain knowledge jobs so that tasks previously integral to the knowledge professional's work are transferred to colleagues with lesser or different qualifications at lower cost. AI promises to accelerate this trend of disaggregation.

Technology not only means that these jobs are changed and displaced by technology but that they can now, as seen during the pandemic, often be done from anywhere, increasing global competition for what will be highly prized skills regardless of a world of too few jobs or too few workers.

Creative jobs

Many occupations contain an element of creativity whether it is generating creative ideas or producing creative visual imagery. No doubt, AI will be used soon, if it is not already being used, to support strategic thinking.

Generative AI has demonstrated the huge potential of creative automation. AI can already compose music and create images driven by user prompts. OpenAI, the company behind ChatGPT, has launched DALL.E2 which generates artwork. AI will soon, if it does not already, have the capability to generate ideas. However, artificial general intelligence is needed before AI is capable genuine original thought.

Despite AI's capabilities, it may be difficult to imagine actors, musicians, artists and entertainers being replaced by automated alternatives however capable. McKinsey included among the occupations it considered least at risk of automation "creatives, a small but growing category of artists, performers, and entertainers who will be in demand as rising incomes create more demand for leisure and recreation.

Nonetheless, there are real fears that actors and entertainers will be displaced by AI. In the US, actors are striking about fears to their livelihoods from AI-generated versions of themselves. Google and Universal Music are reportedly in discussions to licence artists' voices for AI-generated songs. In Brazil, a furore erupted at the AI-generated appearance of a long since deceased and venerated singer in the latest Volkswagen advert.

On-going debates about intellectual property rights in the training data used by AI will influence its impact on creative work.

Caring jobs and those based on social interaction

Caring jobs and those involving a high degree of social interaction such as care workers, nurses and primary schoolteachers seem least at risk from automation. These occupations seem less vulnerable to automation for the time-being even though Japan's use of robots in the care sector my well show their long-term potential.

Commentators predict that customer-facing roles are at particular risk from the march of technology. The drive by providers of goods and services for increased efficiency through automation will no doubt continue despite customers' frustrations continuing to rise at the challenges of not being able to speak to a human. A backlash may result, with some providers seeing a competitive advantage with human customer relations roles.

The negative reaction to the UK's Rail Delivery Group's proposal to close staffed ticket offices at most stations is an example of potential resistance to automation and highlights the possible implications for those less able to manage the technology, such as the elderly and some people with disabilities.

However, in the long-term, chatbots will only improve and the future almost certainly will be one of automated customer relations.

In an increasingly automated world, consumers may well show an increased willingness to pay for social interaction. Gartner highlighted the value of retail sales associates in enhancing customer experience saying that retailers will find it difficult to eliminate traditional sales advisers. The rapid growth of dating apps illustrates that people will be prepared to pay for opportunities which historically (arguably) came for free.

In his 2023 Guardian article, David Runciman reviewed the likely future impact of automation on jobs and emphasised the durability of jobs for people who deal with people.

Further, some skilled manual occupations will focus more on the added value of the social interaction which customers prize rather than the skilled output from the labour of the worker-beauticians and hairdressers are possible examples.

Looking ahead – by sector and occupation

Following the pattern of previous industrial revolutions, automation, along with the other drivers of change, will impact different sectors and different occupations in different ways.

Over the first quarter of the 21st Century the trend has been an increase in jobs in the health and social care, education and professional scientific and technical sectors with significant decreases in the manufacturing and wholesale, retail and vehicle repair sectors.

The sectors employing the largest numbers in the UK today are:

- Health and social care – 4,378k
- Retail and motor repair – 3,646k
- Education – 3,435k
- Professional, scientific and technical – 2,942k
- Public administration and defence – 2,747k

Data source: Office for National Statistics

In the UK, the health, retail and education sectors are all marked by high levels of unsatisfied demand. Last year, the House of Lords estimated that there were about 300,000 current vacancies in health and social care sectors and the House of Commons Health and Social Care Committee reported that nearly a million more jobs would be needed in these sectors over the next decade. The Institute of Fiscal Studies review of NHS England's workforce plans published in June 2023 concluded that by 2036 -2037, the NHS would be employing another 800,000 to 900,000 workers and would by then employ 9% of all workers in England (up from 6% of all English workers in 2021-2022) and 49% of all public sector workers (up from 38% of all public sector workers in 2021-2022).

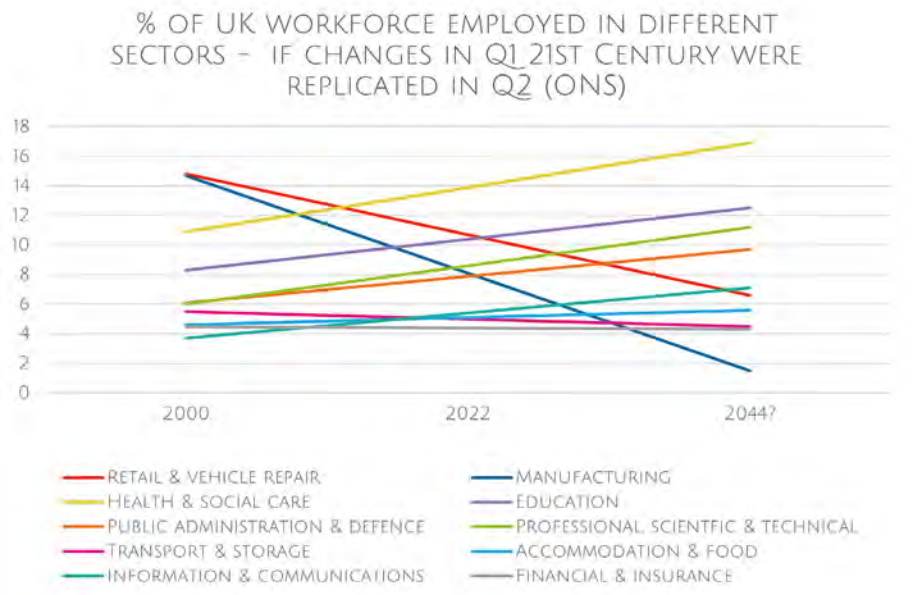
In September 2022, the British Retail Consortium reported 100,000 job vacancies in retail. Retail, like hospitality, has been badly impacted by Brexit and the end of free movement of workers as work visas are generally unavailable to workers in this sector.

ONS data shows that teaching vacancies rose significantly in 2021 and 2022, peaking at approximately 80,000 in autumn last year before coming down to around 70,000 in spring 2023. Nonetheless, the pressures on schools remain, with the Guardian reporting in June on "English schools' recruitment crisis".

Looking ahead to the end of the second quarter of this century, it is impossible to assess with any certainty how sectoral employment will change. There are too many unknowns. However, it is still possible to paint a picture of how the sectoral spread may be most likely to shift.

If, for example, the trends from the first quarter of the 21st Century were to continue in the second quarter of the century, the workforce would look quite different to today with nearly one in three workers employed in the health, care and education sectors. There is good reason to believe that these trends will become more pronounced over the next couple of decades than over the previous two.

Sectors which include many jobs which depend on routine and manual work are likely to decline most. Sectors which include mostly knowledge jobs are under more threat than before whereas those incorporating the bulk of the caring jobs are well-placed to grow.



Data source: Office for National Statistics

In the short to medium term, predictions are relatively consistent that the biggest growth will be in technology jobs and those in the medical and care sectors, with automation impacting routine and repetitive work the hardest.

At times, though, the views of commentators are contradictory. In 2019, the ONS rated waiting staff as being most at risk of automation. On the other hand, when interviewed by the Guardian newspaper earlier this year, Anu Madgavkar, who leads labour market research at the McKinsey Global Institute said that while new technologies might be able to take customer orders, that didn't mean that many robots were going to be bringing food to the tables.

Looking further ahead and beyond the time frames generally considered by these reports, it is reasonable to foresee even greater changes in work types over the next 20 years than foreseen in these reports.

Some jobs in every sector require skills and experience which are transferable to other sectors. Workers in managerial roles, those in finance, marketing, HR and IT as well as administrative

posts will have the skills and experience to transfer to other sectors. However, for others, the disruption will require re-skilling for the work in the growing sectors.

Looking globally, McKinsey predicts that the marketisation of previously unpaid domestic work in advanced economies could be significant in creating jobs, for example in the care and education sectors. Rising female workforce participation worldwide could accelerate the trend and McKinsey estimated that this could create 50 million to 90 million jobs globally, mainly in occupations such as childcare, early-childhood education, cleaning, cooking, and gardening.

Taking the top ten sectors by employment numbers in the UK, in every sector there are drivers which might increase and drivers which might decrease demand for workers. How these drivers play out will determine whether, by 2050, there will be too few jobs or too few workers.

The views of other commentators on which jobs will grow in numbers and which will decline are set out in more detail in the Further Reading section.

1. Health and social care (2022 – 13.9% of UK jobs)

- Health and social care is experiencing the most profound skills shortages and unmet demand of all sectors. Meeting this existing unmet demand will increase the number of jobs in this sector. The unmet demand is colossal. Recent NHS data for England shows 133,446 vacancies representing nearly 10% of all jobs including 47,496 nursing vacancies (11.6% of all NHS nursing jobs) and 9,053 medical vacancies (6.2% of all NHS medical jobs). Though not as high as the UK, health and social care vacancies are among the highest of any sector in the US at 8.5% (seasonally adjusted). The UK has relatively few doctors and nurses per capita compared to comparable economies.
- The ageing population will increase demand for both health and social care.
- Some predict that the numbers in the UK living with major illnesses will rise steeply with the effects of obesity more than compensating for gains made by by less smoking and lower cholesterol levels

AI will create jobs for less highly qualified workers who will be supported by that technology. Charles Simon, for example, predicts that the healthcare industry will benefit most from AI with a "tremendous upward surge" in AI-assisted healthcare assistants.

AI could help much reduce health professionals' administrative work releasing them to concentrate on their professional work.

Technology will transform health care – AI will mean more effective health monitoring, better and quicker diagnoses, better and quicker development of new drugs and treatments; robotic surgery and virtual nursing assistants to monitor patients reducing healthcare demand.

Among the doom of 2023, three news items stood out as beacons of light – potential breakthroughs in the treatment of dementia, cancer and malaria. It is quite plausible that these and other advances will result in improved healthcare with fewer patients in need of care for serious ill-health conditions.

2. Retail and vehicle repair (2022 – 10.7% of UK jobs)

A backlash against an impersonal retail experience and a move to more local shopping could, at the very least, slow the reduction in jobs.

Growth in the economy would result in increased retail expenditure.

Sales assistants are being replaced by automated check outs. AI will create personalised retail experiences further reducing the need for support and guidance in-store. The metaverse may emerge as a significant retail environment.

The pandemic saw a surge in online shopping replacing in-store shopping and while "bricks" are fighting back against "clicks", the trend to consume online will grow.

This sector includes vehicle repair jobs. The decline in numbers employed in the motor industry will accelerate. Purchasing experience is continuing to change, with the emergence of online retailers

such as Cazoo and the computerised maintenance of electric vehicles which will lead to many more redundancies in the vehicle repair sector.

3. Education (2022 – 10.4% of UK jobs)

↑ Benefits of smaller class sizes will result in more teachers particularly for primary and early-years teaching.

↑ Numbers accessing tertiary education should increase with an increased focus on in-demand skills and more time away from work.

↑ Lifelong and personalised learning and the acquisition of new skills will require more educators.

↑ Increased leisure time may result in increased demand for instructors.

↓ AI could help much reduce teachers' administrative work releasing them to concentrate on their professional work.

↓ Early years teaching jobs will decrease as declining fertility rates mean fewer babies are born.

↓ Secondary and tertiary learning classroom teaching will be replaced by more personalised online methods of education. There will be no need to sit in classrooms or lecture theatres to consume information.

4. Professional, scientific and technical (2022 – 7.9% of UK jobs)

↑ Increased adoption of AI and automation will result in increased employment in the technology sector. Highlighting the demand for technology jobs, in 2020 the World Economic Forum identified the top five jobs for increase by 2025 were:

- data analysts and scientists
- AI and machine learning specialists
- "Big data" specialists
- digital marketing and strategy specialists
- process automation specialists.

↑ Many more technical and scientific jobs will be created tackling the climate emergency and in life sciences.

↑ More jobs of the future will involve working with AI to support highly skilled and qualified professionals. The rapid growth in teaching and nursing assistants over the first quarter of the 21st Century is perhaps a precursor to this disaggregation of highly skilled roles with less-qualified workers assuming some of the tasks of their more highly qualified colleagues.

↓ The ability of AI to code will mean that even technology jobs are at risk of being displaced.

↓ Knowledge jobs in professional sectors such as law and accountancy will be at risk of being displaced by technology. Workers will still be employed in management, law, accountancy, finance, business consultancy and similar professions, but fewer than today as AI complements their work.

↓ Technology will make knowledge jobs more geographically portable and professional, scientific and technical jobs risk migrating to lower cost jurisdictions or those jurisdictions where in-demand skills are more readily available. As manufacturing jobs revert home, knowledge jobs look likely to pass in the opposite direction – a new globalisation.

5. Manufacturing (2022 – 8.1% of jobs)

↑ Off-shored supply chains will come under scrutiny as a result of geopolitical uncertainty and sustainability concerns.

↑ Low labour-costs will become less relevant as automation replaces human labour in the manufacturing process and manufacturing returns from lower cost countries.

↓ Robotics will gradually make the need for human labour in many manufacturing sites largely redundant.

↓ Down: The rise of additive manufacturing will further diminish the need for human labour in manufacturing.

6. Public administration, defence and social security (2022 – 7.9% of jobs)

- ↑ Geo-political tensions are likely to result in increased defence expenditure.
- ↑ Cuts in central and local government expenditure may be reversed with political change and an increased recognition of the need to remedy the harm done to public services from the last decade or so of austerity.
- ↓ The armed forces will rely increasingly on automation and less on military personnel.
- ↓ Public expenditure may come under greater scrutiny in challenging economic times.
- ↓ Advances in AI mean fewer public administration jobs are required.

7. Construction (2022 – 6.6% of jobs)

- ↑ Increased expenditure on infrastructure would create construction jobs.
- ↑ A resurgent economy would create more construction jobs.
- ↑ A long overdue house building programme to address acute shortages would result in more jobs.
- ↓ Increased use of robotics in construction will reduce construction jobs.

8. Information and communication (2022 – 5.4% of jobs)

- ↑ Social media and an addiction to instant communication will create more work. Over the last decade social media influencers, a job unforeseen at the beginning of the 21st Century, has grown globally to a US$ 21 billion industry.
- ↓ The value of knowledge has greatly diminished over the last decades with information being freely and readily available particularly through the internet. Today, virtual assistants such as Siri or Alexa are an increasing source of information and generative AI promises to disrupt even more information jobs.
- ↓ Virtual influencers will replace real people.

9. Accommodation and food services (2022 -5.1% of jobs)

- ↑ Growth in the economy will result in increased expenditure in the hospitality sector.
- ↑ A backlash against automation with customers wanting a personal service experience in the hospitality sector will slow the decline in employment in the sector.
- ↑ Global warming could represent a boon for the UK tourism sector.
- ↓ QR codes and even robotic waiters will replace waiting staff.
- ↓ Online home delivery services will erode restaurant jobs.

10. Transport and storage (2022 – 5% of jobs)

- ↑ The continued shift from "bricks" to "clicks" from the High Street to online retail will increase further driving jobs.
- ↓ Self-driving vehicles remain some years away but will potentially decimate driving jobs well before the middle of the century.

WHAT IS TO BE DONE...? MANIFESTO FOR TOMORROW'S WORK

Disruption to the world of work is inevitable, but the pace of change promises to be unlike anything seen before. Policymakers, employers, and individuals need to prepare for the forthcoming transformation in the job market and implement a strategy to preserve work as an integral part of our lives.

This report's 'Manifesto for tomorrow's work' sets out eight priority areas to prepare for the world of work in 2050.

> *"The changes are so profound that, from the perspective of human history, there has never been a time of greater promise or potential peril."*
>
> Klaus Schwab, founder of the World Economic Forum, The Fourth Industrial Revolution (2017)

Invest in skills for the world of work of tomorrow

Whether or not fears of a world of work with too few jobs will prove justified, the jobs of tomorrow will require many different skills from the jobs of today and an absence of those skills from the available workforce will only exaggerate the obstacles facing society. Of all the steps to be taken in preparing for the world of work in 2050, investing in skills should be top of the list.

This is explored further in the Spotlight on...skills section in the main report.

Grow the economy

For a country such as the UK to thrive, it will need a growing economy. Past industrial revolutions have relied on increased productivity to grow the economy and create more jobs than were lost, even if the time lag before the net increase in jobs was seen caused increased unemployment.

Politicians across the political spectrum recognise the need to grow the economy even if they do not agree on the steps to achieve this. The steps needed to grow an economy should not be controversial. The government has some control over a growth strategy, but some major factors are largely outside of its control. For example, global economic growth remains at serious risk of disruption from geo-political forces largely outside the control of national governments.

The Eight drivers of change report in 2022 identified eight drivers of growth:

Investment

Investment, public and private, is necessary to grow the economy. The US and the EU are adopting industrial strategies with massive public investment in green technology and job creation. The UK will need to follow suit quickly if it is not to be left behind.

As well as an industrial strategy and public investment, the strategy will need to encourage domestic and overseas private investment. The UK is seeking to establish itself as a global hub for AI businesses which is clearly a step in the right direction with a sector where the UK ranks fourth, behind the US, China and Singapore globally.

Equally, the UK should be well-placed to invest in and nurture a world-leading life sciences industry. Governments will need to tread carefully not to undermine investment with proposed rises to the NHS Voluntary Scheme for Branded Medicines Pricing and Access threatening industry investment.

The taxation regime needs to encourage investment and overcome short-termism which has been blamed for low productivity growth in recent years. This is explored in more detail in the sub-section on tax reform below.

Innovation

According to the European Central Bank, innovation is an essential driver of economic progress. Spending on research and development, education and a business environment conducive to encouraging start-ups are all ingredients of a strategy to nurture innovation.

According to the House of Commons Library, based on 2019 data UK gross expenditure on research and development at 1.8% of GDP was below the EU average and only ahead of Canada and Italy among G7 nations. Israel led the way with 4.9% of GDP spent on research and development.

Innovation in advancing technological developments will augment productivity rises and grow the economy.

Skills

Growing the economy by attracting and retaining business depends on a competitive skilled workforce. The Spotlight on... skills sets out in detail key considerations for any growth strategy.

Labour supply

A corollary of access to skills is access to labour. A world with too few jobs looks a long way off with skills shortages affecting many sectors and being held by many as responsible for holding back economic growth.

In the short to medium term, where the market faces a shortage of workers not jobs, steps to increase the labour supply are necessary, potentially through a more relaxed approach to work migration, reducing numbers of economically inactive and increasing retirement ages.

Market access

A growing economy needs access to global markets. Access is, at least in part, outside of the UK's control. A major threat to growth would be an increasingly protectionist world with the possible election of Donald Trump at the 2024 US presidential election a real threat to the global economy.

The most effective boost to the UK economy would be to re-establish links with the EU along the lines of the Single Market and it would be a surprise if this has not taken place over the next couple of decades.

Increased productivity

Transformations in the industrial landscape over past centuries have historically resulted in temporary periods of increased unemployment, followed by the creation of even more jobs and increased productivity driven by technological advances. The first quarter of the 21st Century has featured low productivity and growth, notwithstanding dramatic developments in technology. One possibility put forward by some commentators is that the labour market is merely experiencing a time lag before the fruits of new technologies will drive upwards productivity.

Commentators project that AI, and generative AI in particular, will accelerate significantly economic growth. McKinsey have estimated that generative AI could add trillions of dollars in value to the global economy.

Political stability

Political stability and predictable economic policies are crucial to investment and growth. Liz Truss' short-lived premiership in the UK damaged business confidence. The risks from domestic instability are evident today in Israel from the reported disinvestment in response to that country's political turmoil.

Benign economic environment

Most developed economies are struggling with inflation and interest rates at historically high levels, a result, primarily, of disruption to global trade from Russia's invasion of Ukraine. Return to more benign economic times will encourage economic growth.

Reform tax

A strategy for the world of work of tomorrow needs to include a debate about tax.

The current tax system in the UK has evolved during a very different world where employers had fewer alternatives to human labour. Employing people is taxed through employer's National Insurance Contributions and employment income is taxed more heavily than increases in wealth from other sources.

UK tax rate as a proportion of GDP has not changed significantly over the last two decades and generally correlates closely to OECD averages. It is projected to increase over the next few years but nonetheless remain middling by international standards.

With jobs under threat from automation, it becomes important to invest in skills and an active industrial policy. With technology key to solving the productivity puzzle, public as well as private investment will be necessary.

An ageing population and medical advances means more needs to be spent on a growing health and care sector and a rising dependency ratio means that those of working age need to contribute more to fund those beyond working age. If there are fewer jobs, tax revenue will decline and unemployment will rise with state support needing to grow in address (before we even consider universal basic income – see below).

A fundamental review of what is taxed, at what rates and who bears what tax is long overdue. The Institute for Fiscal Studies agrees. The current political environment does not, however, lend itself to an informed discussion at present. Economically

illiterate calls to reduce taxes in an era of high inflation emanate from the right and the left seems too timid to propose meaningful changes to taxes.

Whatever the pros and cons of raising interest rates to stifle demand to bring down inflation, having fiscal and monetary policy pulling in different directions would be folly. Interest rates would only rise more in order further to dampen demand.

In any event, the evidence that tax cuts, especially on the rich, are an effective driver of economic growth is weak. Government funds are much better spent on supporting investment, skills and innovation and addressing inequalities in society. For economic growth to translate into an increase in real wages, the benefits of growth must not be unequally distributed.

Any reforms need to tackle increasing income and wealth inequalities in the UK. Reforms must also take account that internationally uncompetitive tax rates could deter international investment and migration of skilled workers in a competitive global recruitment environment.

To prepare for the future will require: investment in skills; promoting innovation; meeting the health and care needs of the ageing population; improving public services; reforming the education system to meet the needs of tomorrow; addressing growing inequality; tackling the climate emergency; and, in all likelihood, supporting a greater number of underemployment and unemployment, Economic growth is unlikely to generate the funds to achieve this. At least some, therefore, will have to pay more tax. Options to consider include:

- tax incentives to encourage investment in skills and research and development
- reducing tax avoidance
- increasing investment in tax enforcement
- equating rates of income tax and rates of tax on other forms of increased wealth
- integrating the regressive employee National Insurance Contributions into income tax
- reducing and ultimately abolishing employers' National Insurance Contributions
- introducing a temporary or permanent wealth tax
- taxing non-resident UK citizens (as the US does).

And even, as a last resort, taxing robots though encouraging automation will be necessary for increased productivity and a competitive economy.

Another suggestion is to consider renaming "taxes" as "social contributions". This shift in perspective would reinforce the importance of adequate tax revenues to drive a growing economy and a fair society in a turbulent and uncertain world.

Overcoming unnecessary barriers to jobs

Creating more jobs will involve removing unnecessary barriers to job creation and unnecessary barriers to people taking the available jobs.

Cost of employing workers

The higher the cost of employing people, the greater the incentive to automate. These costs include the wage costs of the workers and the employer's social security costs.

Recent years have seen pressures to increase wages driven by various factors:

- inflation and the cost of living crisis putting pressure on pay with heightened levels of industrial action to secure higher pay awards
- the skills shortage increasing employee leverage in negotiating higher pay
- a renewed focus on equity and low pay.

If salaries increase at a faster rate than the costs of automation, more jobs will be lost to machines.

In earlier eras, taxing employment made sense. There was little alternative to human labour in many occupations. However, in a world in which too few jobs might be a permanent fixture, deterring the employment of people is much less justifiable. Taxes on employers (employer's National Insurance Contributions in the UK) will come under scrutiny in the years ahead.

Regulation of employment

The less flexible the labour market and the greater the level of regulation, the more obvious the benefits of automation.

The debate over the appropriate balance between protecting workers and facilitating automation in a competitive world

will extend to the appropriate level of workers' rights in an increasingly automated world of work. The TUC has set out its own manifesto for protecting workers which covers some of these issues.

British employers are getting used to diversity targets. How long before these targets extend to equity and inclusion between workers and machines?

Steps taken by professional regulators to loosen requirements will also be material in some occupations where access to the profession is closely controlled but the pool of workers could be expanded to people with different or lesser qualifications, complemented by technology.

Availability of workers

Too few workers with the necessary skills and experience will accelerate automation. 22% of companies introducing AI say labour shortages are a factor in their decision.

Neil Carberry, the Chief Executive of the Recruitment Employment Confederation, attributes labour shortages in the UK to employers across the economy reconsidering their use of technology noting that companies are thinking about their mode of production - what their people do, and what the machines do, in a way that maybe they haven't for 20 years.

Identifying the causes for 20% of the UK's population currently being economically inactive will help overcome a barrier to people being able to accept jobs once created. The data shows that improving and making affordable childcare, and care for the elderly and those with disabilities, would release some of those with caring responsibilities into the labour market. Addressing the country's creaking healthcare system should release others into the workforce from the growing numbers of those economically inactive through long-term ill-health. Employers also have a responsibility in reducing long-term ill-health by addressing wellbeing and burnout.

A migration policy which facilitates the entry of workers with in-demand skills will contribute to ensuring enough workers with the necessary skills and experience are available. Further, encouraging more employees to work later in life will help to retain skills.

Other obstacles or costs to employing people

Other obstacles or costs to employing people could potentially drive automation. Robots or AI platforms won't be disrupted by health scares - robots don't catch Covid; don't take holidays or family leave; and don't fail to turn up for work.

Even if barriers to creating jobs and barriers to enabling people to take those jobs can be addressed, the final piece of the jigsaw is encouraging people to actually take those jobs available. Employers will need to offer the work and working environments valued by ever-more mobile workers and stave off competition from employers in other countries.

Increase public sector employment

Employing many more in the health, care and education sectors will, in all likelihood, mean a bigger public sector and will help to address any shortage of jobs whether public services are delivered by the public or private sector. An alternative would involve increased privatisation of these sectors and a move to other forms of funding healthcare such as insurance. Of course, if an individual pays for healthcare through insurance rather than taxes the costs to that person will not necessarily be any less. The NHS and healthcare free at the point of delivery is akin to national religion in the UK and changing this, notwithstanding the burgeoning costs, seems unlikely bearing in mind the political risks which would be involved.

Notwithstanding automation and AI, a rejuvenated public sector could see not only significant increases in teachers, health and care professionals, but in other areas desperately in need of more staff such as the police and the prison service.

In Q1 2023, of the 33 million people in the UK workforce, 24% considered themselves employed in the public sector and 76% in the private sector. The proportion in the public sector has declined slightly from 26% at the beginning of 2000.

Looking further back, the proportion of the UK workforce employed in the public sector has declined by about a third from the mid-1980s This, however, disguises the rapid growth in the proportion of the workforce employed by the NHS and in education since the early 1960s and is accounted for largely by the privatisation of public corporations and utilities.

Of course, any significant increase in the public sector (including any public services provided through the public sector) would require funding and takes back to the debate about tax reform (see above).

Reduce the hours people work

Automation can lead to increased productivity which can lead to fewer hours needing to be worked for the same output. Reducing the average hours worked per person so that the available work is spread out more thinly is an obvious response to insufficient work for the available workers. One response is a reduced working week.

Average hours worked by full-time workers in the UK has been coming down. Over the last 30 years they have declined steadily from 38.1 hours per week in 1993 to 36.7 hours per week today. Over the last 100 years the decline has been much steeper. Taking full-time and part-time workers, between 1913 and 2013 average hours nearly halved from 55.9 hours per week to 32.1 hours per week.

Full-time workers generally work five days per week today. This hasn't always been the case. The six-day working week, with only the Christian day of worship on a Sunday or the Jewish sabbath on a Saturday off, was the norm for many centuries. In the latter half of the 19th Century, pressure from trade unions and from employers keen to put an end to an informal practice of taking Monday off (referred to as "Saint Monday") led to many employers moving to a five and a half day working week with Saturday afternoons off work.

It was only a century ago that Henry Ford pioneered the shift from a six-day working week to a five-day 40 hour working week with no reduction in pay in the US in the 1920s. Jesse Boot, the founder of Boots the Chemist, followed with something similar in the UK.

In 2017 McKinsey identified one of their five lessons from history on AI, automation and employment that we will all work less and play more thanks to technology. They noted that over the long-term, productivity growth enabled by technology has reduced the average hours worked per week and allowed people to enjoy more leisure time. Across advanced economies, the length of the average workweek has fallen by nearly 50% since the early 1900s, reflecting shorter working hours, more paid days off for personal time and vacations, and the recent rise of part-time work. This growth in leisure has led to the creation of new industries, from golf to video games to home improvement.

With the movement promoting a shift to a four-day working week (often with no reduction in pay) gaining momentum, how long before a call for a the three-day week emerges?

As long ago as 1930, as mentioned in the main report, John Maynard Keynes was predicting that his grandchildren will be working 15-hour weeks. A rosy look into the future could see a working population with more time for leisure, voluntary work, caring responsibilities and study while being as well off or better than today.

Juliet Schor, an economist at Boston College, has suggested that it would be far better if employers, instead of laying off people because of AI, would trim employees' work time, perhaps to three or four days a week, instead of five.

More leisure time can mean more jobs as workers spend increased leisure time buying more goods and services. On the other hand, it can reduce jobs as people spend more time gardening or decorating, for example, and not hiring gardeners or decorators.

Manage automation

Automation is inevitable and has the potential to be a positive force for the economy, improving productivity and competitiveness, as goods and services can be produced or delivered more cheaply, more efficiently and often better. Resisting change would be like King Canute seeking to hold back the tide.

Many factors will determine the pace and extent of automation. Merely because jobs have the potential to be automated does not necessarily mean that they will.

Managing the design, development and deployment of automation will be an ingredient in any future strategy to prepare for less work. Policymakers and business will need to get the balance between automating and protecting workers' jobs. Where little is to be gained in productivity in automating, unnecessary barriers to employing people need to be absent.

How automation is introduced into the workplace will be critical to a seamless transition to a more automated world of work. Employment laws designed for a previous era are unprepared for today's workplace never mind tomorrow's workplace. As well as obliging employers to consider re-skilling in any redundancies created by automation, employment laws could be changed to require employers to consult effectively about the introduction of automation into the workplace where it affects employees' tasks, not only where it displaces jobs entirely.

Support those without work or with less work

Looking at the challenge of a world of work with potentially too few jobs from a different perspective, even with investment in skills; a growing economy; reduced barriers to employing people; a bigger public sector; a shorter working week and controls on automation; and a working age population which could easily shrink as a result of demographic factors, society could still face a situation with insufficient work for anything like full employment. Not everyone will be able to acquire the skills and experience for the jobs of tomorrow.

Even then, with the gradual eradication of routine and repetitive work and the jobs of tomorrow requiring important new skills, it is reasonable to foresee a section of the working age population underemployed or unemployed. Any plans for the future should consider managing with less work. The debate about a universal basic income is sure to resurface.

The responses could include:

- reducing the size of the available workforce
- managing unemployment.

Reducing the size of the workforce

If the world work will feature too few jobs and not too few workers, preparing for systemic under-employment or unemployment could involve actively taking steps to reduce the size of the labour market and positively promoting economic inactivity.

Strategies could include:

- increasing numbers in education
- encouraging and supporting carers outside of paid employment
- supporting voluntary work
- supporting career breaks and early retirement.

In addition, an active strategy to reduce the size of the workforce could entail a more restrictive approach to migration.

Issues to address with a reduced workforce include:

- needing to attract and retain the skills for the jobs which remain but reducing the numbers seeking jobs which do not exist
- growing the economy from a shrinking workforce.

Managing unemployment

A critical challenge to address is providing financially for the economically inactive. If the economically inactive grow – whether as students, carers, volunteers, career breaks, or early retirees - they will either need to rely on savings, earnings away from work or funds from the state.

The UK's spending on unemployment benefits is tiny compared with comparable nations. Based on 2020 data spending was 0.12% of GDP, suggesting some room for give here. This brings the debate on tax reform to the fore.

Universal basic income, where the working age population, whether in work or not, are paid a fixed monthly "wage", also then comes into play. Various countries have trialled this with mixed results. There has to date been limited enthusiasm among politicians in the UK, with the obvious concern about where funds might come from to finance this. The Green Party is, however, an outlier advocating this benefit.

Producing alternative cash flow projections for universal basic income to see if/when and where it is financially sustainable was among the highlighted actions put forward by The Millennium Project to prepare for work in 2050. Worker morale and motivation will be even more important if universal basic income emerges between now and 2050 with quality of life, work-life balance, interesting work, and happiness becoming particularly important.

IMPACT OF AUTOMATION ON THE LABOUR FORCE – TOO FEW JOBS OR TOO FEW WORKERS?

A review of leading commentary and reports on the impact of automation on the labour force and whether we face a future of too few jobs or too few workers.

The past decade has seen a series of reports and predictions on the impact of automation and, more recently, AI on the labour force.

The numbers of these reports and predictions have accelerated in light of fears for jobs from generative AI and barely a week goes by now without new predictions or reports being published.

In the years leading up to Covid, academics and economists, supported by the reports from the leading consultancies, were predicting a rosy future with technology creating new jobs and driving long-needed increases in productivity.

Many of these reports, however, considered the relatively near future mostly looking five to fifteen years ahead, and none much beyond 2030. Where these reports looked at the implications for more than one country, their forecasts did differ somewhat from country to country, but the themes were broadly consistent across borders. The reports also tended to consider the potential disruption of the labour market rather than predicting the actual disruption. In other words, they considered the jobs at risk of automation and did not seek to predict how many jobs would actually be lost.

Post the emergence of Covid, reports, many of which pre-dated the emergence of generative AI, generally continued to paint a broadly optimistic picture, looking at: historical precedent; the needs created by new technologies; and the potential impact of advances in technology on productivity. Reports

from McKinsey, PwC and the World Economic Forum, amongst others, all predicted that, notwithstanding the unprecedented scale and pace of change, the new jobs created by technological advances and the increased productivity which would flow from these developments would result in a net increase in jobs.

Others, however, looked with trepidation at the magnitude of change, pointing to the importance of decisions taken by society now in determining the future. Nonetheless, authors and commentators all agreed that the future is uncertain, and all shared a vision that the jobs of the future will differ greatly from the jobs of today.

Below is a summary of some of the leading reports and predictions exploring the impact of automation on jobs.

Pre-Covid

The Future of Employment: How susceptible are jobs to computerisation?
Professors Carl Benedikt Frey and Michael A. Osborne, University of Oxford (2013)

The first detailed consideration of the potential impact of automation on jobs was published ten years ago. In their seminal work, Frey and Osborne foresaw today's debate and estimated that about 47% of total US employment was at risk of computerisation over the next decade or two.

They stated: "Our model predicts that most workers in transportation and logistics occupations, together with the bulk of office and administrative support workers, and labour in production occupations, are at risk ... More surprisingly, we find that a substantial share of employment in service occupations, where most US job growth has occurred over the past decades ...are highly susceptible to computerisation".

Frey and Osborne noted that nineteenth-century manufacturing technologies largely substituted skilled labour through the simplification of tasks. They noted that their model predicted "a truncation in the current trend towards labour market polarisation, with computerisation being principally confined to low-skill and low-wage occupations." In other words, they predicted that it would be the routine, lower-skilled jobs most at risk going forward. They noted that "as technology races ahead, low-skill workers will need to reallocate to tasks that are non-susceptible to computerisation – i.e., tasks requiring creative and social intelligence. For workers to win the race, however, they will have to acquire creative and social skills".

Agiletown: the relentless march of technology and London's response
Professors Carl Benedikt Frey and Michael A. Osborne, University of Oxford for Deloitte (2014)

A year after the publication of their ground-breaking report, Frey and Osborne authored a report for Deloitte, looking at the potential impact of new technologies on London. They included, amongst their conclusions, that nearly one in three London jobs were at risk of automation over the next ten to twenty years and it would be the lowest paid jobs which would be most at risk.

Technology and people: The great job-creating machine
Ian Stewart, Debapratim De and Alex Cole, Deloitte (2015)

This report, considering the likely impact of automation on jobs, concluded that jobs were likely to be created, enhanced and destroyed much as they had over the previous 150 years. They noted that the last 200 years demonstrated that when a machine replaced a human, it resulted in faster economic growth and, in time, rising employment.

From brawns to brains: the impact of technology on jobs in the UK
David Sproul, Angus Knowles-Cutter and Harvey Lewis, Deloitte (2015)

Deloitte painted a positive picture, concluding that technological advances were resulting in the replacement of lower-skilled routine jobs by higher-skilled, non-routine jobs which require "dexterity, creativity, digital know-how and other softer skills." It noted that the technology shift over the previous fifteen years had created four times as many jobs as it had lost.

The Risk of Automation for Jobs in OECD Countries
Melanie Arntzi, Terry Gregoryi and Ulrich Zierahni, OECD (2016)

This study reviewed Frey and Osborne's work as well as considering other academic papers on the subject. It maintained the optimistic predictions and argued that many jobs susceptible to disruption are more likely to change than disappear due to automation. They predicted, across 21 OECD countries, that 9% of jobs were at high risk of automation. Like Frey and Osborne, this was a prediction of the susceptibility to automation rather than how many jobs would actually be lost.

Jobs lost, jobs gained: What the future of work will mean for jobs, skills, and wages

James Manyika, Susan Lund, Michael Chui, Jacques Bughin, Jonathan Woetzel, Parul Batra, Ryan Ko and Saurabh Sanghv, McKinsey Global Institute (2017)

In this report the authors compared the number and types of jobs which might be created and lost by 2030 (a period we are already halfway through). The authors concluded that the adoption of then demonstrated technology could displace up to 30% of work but that increased demand for work could increase work by up to 33% taking into account: rising incomes; demand for healthcare from an ageing population; investment in technology; infrastructure and energy transitions; and the predicted marketisation of unpaid work such as childcare.

Which occupations are at highest risk of being automated?
ONS (2019)

This analysis from 2017 concluded that 7.4% of jobs were at high risk of automation (at least a 70% probability). This percentage was down from its previous analysis in 2011, a development it considered could be down to automation which had taken place in the intervening years.

Jobs lost, jobs gained: workforce transitions in a time of automation
James Manyika, Susan Lund, Michael Chui, Jacques Bughin, Jonathan Woetzel, Parul Batra, Ryan Ko and Saurabh Sanghv, McKinsey Global Institute (2017)

In December 2017, McKinsey compared the jobs across six countries which might be created with the jobs which might be lost in the period to 2030. They considered various scenarios and concluded: "The results reveal that, in nearly all scenarios, the six countries that are the focus of our report (China, Germany, India, Japan, Mexico, and the United States) could expect to be at or very near full employment by 2030. However, the model also illustrates the importance of re-employing displaced workers quickly."

Artificial intelligence will replace half of all jobs in the next decade
Sophia Yan, CNBC (2017)

Back in 2017, Kai-Fu Lee, founder of Chinese venture capital firm Sinovation Ventures claimed that robots were likely to replace 50% of all jobs in the next decade. We are now more than two thirds of the way through that decade and, whilst it does not look like 50% of jobs will be replaced, his predictions of the transformative impact of technology look insightful.

Gartner Says By 2020, Artificial Intelligence Will Create More Jobs Than It Eliminates
Svetlana Sicular, Gartner (2017)

In 2017, Svetlana Sicular of management consultants Gartner predicted a rosy future, after initial disruption where "a combination of human and artificial intelligence...both complement each other". She forecast that "starting in 2020, AI-related job creation will cross into positive territory, reaching two million net-new jobs in 2025".

Will robots really steal our jobs? An international analysis of the potential long term impact of automation
John Hawksworth, Richard Berriman and Saloni Goel, PwC (2018)

In 2018, PwC published a report looking at the impact of automation across a range of sectors and range of countries. They followed a similar optimistic vein and concluded: "AI and robotics will be disruptive for labour markets and some jobs will be displaced or fundamentally changed in nature. But many new jobs will also be created and the long term net effect should be positive for the economy as a whole". Looking at jobs at high risk of automation by the early 2030s across 29 major economies, PwC estimated that around 30% of jobs were at high risk of automation. The UK was placed in the middle of countries vulnerable to job losses through automation at around 30%, with some Eastern European countries at over 40% and heavily automated Korea at other end of the spectrum but still with a quarter of jobs at risk.

Automatic for the people? Experts predict how AI will transform the workplace
SA Mathieson, The Guardian (2019)

Back in 2019, an expert panel convened by The Guardian newspaper in the UK considered AI's potential impact on jobs. Chelsea Chen, co-founder of Emotech, claimed that "Humans should not worry too much about replacement, but need to find new ways to work together with AI". Other panellists were similarly optimistic about AI's growing role in the workplace.

A World Without Work
Derek Thompson, The Atlantic (2015)

Even before the arrival of Covid in 2020, not all commentators shared this optimism, Derek Thompson posed the question: "A

World without work: For centuries, experts have predicted that machines would make workers obsolete. That moment may finally be arriving. Could that be a good thing?"

Humans need Not Apply: a guide to wealth and work in the age of artificial intelligence
Jerry Kaplan, Yale University Press (2016)

Jerry Kaplan's work warned of a protracted and brutal transition if steps to mitigate were not taken.

Will jobs exist in 2050?
Charlotte Seager, The Guardian (2016)

Interviewed by The Guardian in 2016, Dan Collier, CEO of Elevate, was quoted as saying "there will be a lot of unemployment – and perhaps no impetus to help these people. There will end up being a division between the few jobs that need humans, and those that can be automated."

Robots and Jobs: Evidence from US Labor Markets
Daron Acemoglu and Pascual Restrepo, Journal of Political Economy (2020)

Acemoglu and Restrepo were more pessimistic than most other commentators in their 2020 article. Their research showed that robots (as opposed to other capital and technology investments) depressed employment and wages.

Emergence of Covid – February 2020

The Future of Jobs Report 2020
Saadia Zahidi, Vesselina Ratcheva, Guillaume Hingel and Sophie Brown, The World Economic Forum (2020)

The World Economic Forum's report predicted that by 2025, globally, the number of jobs destroyed by automation would be surpassed by the number of "jobs of tomorrow" created but noted that job creation was slowing whilst job destruction was accelerating. It predicted, based on employer expectations, that by 2025 (barely a year from now), 85 million jobs globally would be displaced by machines whilst emerging professions would more than compensate by creating 97 million jobs adapted to the new division between humans, machines and algorithms.

Artificial Intelligence and the Future of Work
Professor Thomas W. Malone, Daniela Rus and Robert Laubacher, MIT (2020)

In their December 2020 research brief paper, MIT academics Malone, Rus, and Laubacher concluded that "recent fears about AI leading to mass unemployment are unlikely to be realized. Instead, we believe that—like all previous labor-saving technologies—AI will enable new industries to emerge, creating more new jobs than are lost to the technology."

The future of work after COVID-19
Susan Lund, Anu Madgavkar, James Manyika, Sven Smit, Kweilin Ellingrud, Mary Meaney, and Olivia Robinson, McKinsey Global Institute (2021)

In response to the pandemic, the McKinsey Global Institute recognised that the drivers of change were accelerating the labour market upheaval and noted that "our scenarios suggest that more than 100 million workers in the eight countries may need to switch occupations by 2030, a 12 percent increase from before the virus overall and as much as 25 percent more in advanced economies".

The Potential Impact of Artificial Intelligence on UK Employment and the Demand for Skills
PwC for the Department of Business, Energy and Industrial Strategy (2021)

PwC estimated "that around 7% of existing UK jobs could face a high (over 70%) probability of automation over the next 5 years, rising to around 18% after 10 years and just under 30% after 20 years". Whilst less optimistic than many others, this report, focused on the UK, concluded that: "The overall net effect on employment is unclear, with the most plausible assumption based on historical trends and past macroeconomic research for the UK being for a broadly neutral long-term effect".

AI Will Not Replace You, It Will Make You More Valuable
Ike Kavas, Forbes Magazine (2021)

Kavas, founder and CEO of Ephesoft, argued that fears of AI disruption to jobs were overblown and that humanity's "facility for creativity, reasoning and hard work will ensure our survival — whether at home or in our careers — regardless of automation's rise".

Will a robot take my job? Researcher says this view is overly pessimistic
Tracy DeStazio, Phys.org (2023)

Research published in 2022 from academics Yong Suk Lee and John Chung further supported the optimists. They argued

that the introduction of robots between 2005 and 2016 in US motor manufacturing had benefitted human workers by increasing productivity and creating new tasks even if there was initially a short-term negative impact on the number of employees.

These studies pre-date the arrival on the scene of generative AI and the ensuing panic about its potential impact on jobs. Nonetheless, this optimism has persisted in some more recent reports from 2023.

Launch of ChatGPT – November 2022

Future of Jobs Report 2023
Attilio Di Battista, Sam Grayling, Elselot Hasselaar, Till Leopold, Ricky Li, Mark Rayner, Saadia Zahidi, The World Economic Forum (2023)

The World Economic Forum's latest Future of Jobs Report published in April 2023 surveyed over 800 business leaders employing 11.3 million employees Around the World between November 2022 and February 2023 and, perhaps surprisingly, found that businesses said that they were introducing automation into their operations at a slower pace than previously anticipated in the last WEF report three years' previously. The report finds that "the impact of most technologies on jobs is expected to be a net positive over the next five years" with "job displacement in their organizations, offset by job growth elsewhere to result in a net positive." [pgs 5 and 6]

A quarter of the firms said they expected AI to create job losses, although 50% said they expected it to spur jobs growth.

The Potentially Large Effects of Artificial Intelligence on Economic Growth
Joseph Briggs and Devesh Kodnani, Goldman Sachs (2023)

With the implications for jobs of generative AI now in play, Goldman Sachs sounded a more cautionary note. Three hundred million jobs globally could be exposed to automation from ChatGPT and other forms of generative AI according to their March 2023 research paper. Like earlier reports, this looked at the potential for automation rather than predicting the actual disruption.

They found that "roughly two-thirds of current jobs are exposed to some degree of AI automation, and that generative AI could substitute up to one-fourth of current work". They note that

"worker displacement from automation has historically been offset by creation of new jobs, and the emergence of new occupations following technological innovations accounts for the vast majority of long-run employment growth. The combination of significant labor cost savings, new job creation, and higher productivity for non-displaced workers raises the possibility of a productivity boom that raises economic growth substantially" predicting annual GDP globally could increase by 7%.

The report noted that AI's impact will vary across different sectors. They assessed that 46% of tasks in administration and 44% in legal professions could be automated but only 6% in construction and 4% in maintenance.

Generative AI and the UK labour market
KMPG, (2023)

KPMG's report continued the optimistic vein of the other reports. It predicted that 40% of jobs will see some impact from AI. KPMG argued that 50% of the jobs displaced will be replaced by new jobs managing the disruptive technology responsible for displacing those jobs. For example, it pointed to jobs verifying content from generative AI. KPMG concluded that they "do not anticipate the introduction of AI to lead to falls in overall employment in the long term."

Though, noting generative AI's tendency to make mistakes including "hallucinating", the authors asked – how long will it be before there is much more confidence in the accuracy of AI-generated content?

GPTs are GPTs: An Early Look at the Labor Market Impact Potential of Large Language Models
Tyna Eloundou, Sam Manning, Pamela Mishkin, and Daniel Rock, OpenAI, OpenResearch and the University of Pennsylvania (2023)

Researchers from OpenAI, OpenResearch and the University of Pennsylvania published research into the potential implications of large language models (LLMs) such as Generative Pre-trained Transformers (GPTs) on the US labour market. They concluded that: "that around 80% of the U.S. workforce could have at least 10% of their work tasks affected by the introduction of LLMs, while approximately 19% of workers may see at least 50% of their tasks impacted".

The future of employment law in an AI-driven world
Ius Laboris (2023)

Stijn Broecke, senior economist at the OECD, and leading its initiative on the future of work, spoke to Ius Laboris, the leading international employment law alliance and his views were reported in its June 2023 report on the future of employment in an AI-driven world, (pgs 15 to 17). Referring to OECD research which suggested modest job disruption to date from AI, he noted the uncertainty expressed by other commentators and that "further research is needed to fully understand the long-term implications". Foreseeing much greater impact ahead, he concluded that "it is important to note that AI differs from previous technologies in its potential to impact a larger number of jobs. As a general-purpose technology, it carries a broader scope of influence, which warrants some concerns. It's likely to affect every single occupation in every single sector. So the scale of its impact is likely to be bigger than the impact of robots has been."

Broecke went on to note the risks of abrupt disruption due to the pace of change: "Another aspect that raises some concern for me regarding AI is the rapid pace of its development. This is significant because the labour market is accustomed to changes involving job destruction and creation, but these transitions require time for adjustment. If the speed of development and adoption is excessively high, one risk is that the necessary time for a smooth adjustment might be lacking, leading to abrupt disruption."

Generative AI and the future of work in America
Kweilin Ellingrud, Saurabh Sanghvi, Gurneet Singh Dandona, Anu Madgavkar, Michael Chui, Olivia White, and Paige Hasebe, McKinsey (2023)

Looking at the implications for US jobs of generative AI, McKinsey predicted that, along with other advances in automation, 30% of hours worked today could be automated by 2030. As with other predictions, this prediction relates to the potential to automate and not an assessment of actual automation.

Generative AI and Jobs: A global analysis of potential effects on job quantity and quality
Pawel Gmyrek, Janine Berg, and David Bescond ILO (2023)

Considering the likely impact of generative AI rather than automation in general on jobs around the World, this ILO report concluded that the effects of generative AI would be to transform rather than displace jobs. The authors conclude that their analysis "might have been expected to generate alarming estimates of net job loss – but it did not. Rather, our global estimates point to a future in which work is transformed, but still very much in existence."

Stability AI CEO says AI will prove more disruptive than the pandemic
Goldman Sachs (2023)

Emad Mostaque, CEO of Stability AI, has said that artificial intelligence represents "a much bigger disruption than the pandemic."

IBM to Pause Hiring for Jobs That AI Could Do
Brody Ford, Bloomberg (2023)

IBM's CEO, Arvind Krishna has predicted that nearly 8,000 back-office jobs at the business to be replaced by AI over a five-year period.

AI could affect jobs as much as the industrial revolution – Patrick Vallance
Jane Kirby, The Independent (2023)

Sir Patrick Vallance, the former UK government chief scientific adviser, has said that artificial intelligence could have as big an impact on jobs as the industrial revolution.

PM London Tech Week speech: 12 June 2023
Rishi Sunak, (2023)

In his speech at the London Tech Week conference, Rishi Sunak argued that technological innovation today "amounted to an opportunity for human progress that could surpass the industrial revolution in both speed and breadth".

US experts warn AI likely to kill off jobs – and widen wealth inequality
Steven Greenhouse, The Guardian (2023)

In February 2023, The Guardian newspaper interviewed various economists in the US who shared their views on the likely impact of AI on jobs. They all foresaw a major change, but most were reasonably optimistic whilst raising obvious questions about an uncertain future.

'Inevitable' jobs will be more automated, says new AI adviser
Zoe Kleinman, BBC News (2023)

Speaking to the BBC, Ian Hogarth, the head of the UK government's AI taskforce, commented that it was inevitable that more jobs would become increasingly automated and that "The whole world will have to rethink the way in which people work". Predicting increased global competition for skills, he added that "There will be winners or losers on a global basis in terms of where the jobs are as a result of AI."

WHICH JOBS WILL BE DISRUPTED AND WHERE WILL NEW JOBS COME FROM?

A review of leading commentary and reports on which jobs are likely to be most disrupted and sources of new jobs.

As well as predicting the implications of automation on the future number of jobs which will remain for humans, experts but have been considering which jobs are likely to be most disrupted, which will be relatively immune to the march of technology and what new jobs might be created.

Commentators, management consultants and government bodies have also published reports with their forecasts about occupations and sectors most likely to be disrupted. These suggest most sectors and occupations as being vulnerable to disruption, from the routine to the highly-skilled. Below is a summary of some of the leading comments and reports.

At risk jobs

Year	Report/ commentator	Geography	At risk jobs	Time period	Comments
2017	By 2020, Artificial Intelligence Will Create More Jobs Than It Eliminates (Gartner)	US	Manufacturing and labour-intensive, repetitive retail jobs like check-out operators	2020-2025	Gartner thought manufacturing would be hit the hardest.
2019	The probability of automation in England: 2011 and 2017 (Office for National Statistics)	England	Food, accommodation, and retail		Waiting staff were scored as having the highest risk of automation (72.8%). This report reviews several other reports.

2020	Working Futures 2017-2027: Long-run labour market and skills projections for the UK (Department for Education)	UK	Manufacturing and, to a lesser extent, retail, accommodation, and transport	2017-2027	
2021	The future of work after COVID-19 (McKinsey)	UK	Office support, customer service and sales, and food services	2018-2030	These represent the biggest declines relative to the total share of the labour market.
2023	ChatGPT: the 10 Jobs Most at Risk of Being Replaced by AI (Business Insider)	Unspecified (US article)	Technology, finance, legal, accounting, customer service and teaching		
2023	Future of Jobs Report 2023 (World Economic Forum)	Global	Bank tellers and related clerks; postal service clerks; cashiers and ticket clerks; data entry clerks; and administrative and executive secretaries	2023-2027	This report considered the jobs potentially most affected by the introduction of generative AI.
2023	Generative AI and the future of work in America (McKinsey)	US	Office support, customer service and sales	2022-2030	

2023	The state of AI in 2023: Generative AI's breakout year (McKinsey)	Global	Service operations, supply chain management; HR and manufacturing	2023-2026	These will see the greatest decreases in workforce size according to the annual survey respondents.
2023	Generative AI and Jobs: A global analysis of potential effects on job quantity and quality (International Labour Organisation)	Global	Clerical support workers including typists, travel consultants and bank tellers.		24% of their tasks were considered highly exposed to generative AI and 58% were considered exposed to a medium extent.
2023	The AI industrial revolution puts middle-class workers under threat this time (Larry Elliott in The Guardian)	Unspecified (UK article)	"white-collar, middle-class jobs"		Elliott thought that conversely "many of the jobs created might be of the low-paid, dead-end variety".
2023	ChatGPT-maker Sam Altman reveals the one kind of job that will vanish soon (Priya Singh in Business Today)	Unspecified (Indian article)	Customer service	"relatively soon"	Altman believes AI chatbots will "eliminate a lot of current jobs".
2023	'Why would we employ people?' Experts on five ways AI will change work (Phillippa Kelly in The Guardian)	Unspecified (UK article)	Healthcare, education, call centres, agriculture, and the military		Predictions came from various experts and academics in fields from philosophy to technology.

2023	If bosses fail to check AI's onward march, their own jobs will soon be written out of the script (Gaby Hinsliff in The Guardian)	Unspecified (UK article)	Creative jobs; screenwriters and musicians		Hinsliff predicted that AI is coming for the "fun stuff", with machines moving from "drudge" work to "the dream jobs: well-paid, absorbing work done by people who love what they do".

Other commentators have predicted occupations as diverse as psychics and the House of Lords being at risk of displacement.

In demand jobs

Year	Report/ Commentator	Geography	In demand jobs	Time Period	Comments
2017	Jobs lost, jobs gained: What the future of work will mean for jobs, skills, and wages (McKinsey)	Germany and US	Technology, care, and construction	2017-2030	McKinsey considered that the biggest increase in demand would be for technology professionals followed by care providers and those in construction.
2017	Gartner Says By 2020, Artificial Intelligence Will Create More Jobs Than It Eliminates (Gartner)	US	Healthcare, the public sector, and education	2020-2025	Gartner thought these sectors would see continuously growing job demand.

2019	The probability of automation in England: 2011 and 2017 (Office for National Statistics)	England	Health, care and education sectors, and scientific, technical and professional roles		These sectors were predicted to be the least susceptible to automation.
2020	Working Futures 2017-2027: Long-run labour market and skills projections for the UK (Department for Education)	UK	Technical and professional services and in health and care	2017-2027	
2020	Jobs of Tomorrow: Mapping Opportunity in the New Economy (World Economic Forum)	Global	Data and AI; engineering and cloud computing; people and culture; product development; and sales, marketing and content		In the US, they pointed to increased opportunities in the care economy and the green economy.
2021	The Potential Impact of Artificial Intelligence on UK Employment and the Demand for Skills (PWC)	UK	Health and care sectors.	2021-2041	The report predicted that "these additional jobs created will mostly be in providing relatively hard-to-automate services [...] that are in greater demand due to the additional real incomes and spending arising from higher productivity generated by AI".

2021	Employment Projections: 2021-2031 Summary (US Bureau of Labor Statistics)	US	Nursing practitioners and wind turbine engineers	2021-2031	
2021	The future of work after COVID-19 (McKinsey)	UK	Health aides, technicians and care workers; health professionals; science, technology, engineering and mathematics professionals; and managers	2018-2030	These roles, the report suggested, represent the biggest growth relative to the total share of the labour market.
2022	As AI Advances, Will Human Workers Disappear? (Charles Simon in Forbes)	Unspecified (US article)	Machine learning engineers, robotics engineers and data scientists, and jobs in AI maintenance		Charles Simon is the founder and CEO of Future AI.

2023	Future of Jobs Report 2023 (World Economic Forum)	Global	AI and machine learning specialists; sustainability specialists; business intelligence analysts; information security analysts; and fintech engineers	2023-2027	Please see comment in the table above.
2023	Generative AI and the future of work in America (McKinsey)	US	Health professionals; health aides, technicians, and wellness; and STEM professionals	2022-2030	
2023	Generative AI and Jobs: A global analysis of potential effects on job quantity and quality (International Labour Organization)	Global	Primary school teachers, actors, specialist medical practitioners, and hairdressers		These were the jobs identified as most susceptible to augmentation by generative AI.

2023	The jobs AI won't take yet (Kate Morgan in BBC Worklife)	Unspecified (UK article)	Legal or business strategy; nurses; business consultants; investigative journalists; electricians, plumbers and welders.		These in-demand roles were divided into three categories by Martin Ford, author of Rule of the Robots: How Artificial Intelligence Will Transform Everything: 1) Genuinely creative roles; 2) Jobs requiring sophisticated interpersonal relationships; and 3) Jobs requiring lots of mobility and dexterity and problem-solving ability in unpredictable environment.
2023	These are the jobs that AI can't replace (World Economic Forum)	Global	Agricultural workers; heavy truck and bus drivers; and jobs in education.	2023-2027	These jobs were identified by the World Economic Forum when extrapolating ILO Occupation Employment statistics. This report recognised that these jobs were less vulnerable to generative AI. There is a clear threat to these jobs from advances in robotics and driverless vehicles but probably not over the next four years.

ABOUT THE FUTURE OF WORK HUB

Lewis Silkin LLP launched our Future of Work Hub eight years ago. The interest in and impact of the future of work continues to grow and plays a central role in both business and political thinking in the UK and across the world.

The world is changing continuously and at an unprecedented pace due to rapid technological advances, shifting demographics and evolving societal expectations. The convergence of these drivers of change is having a significant and direct impact on the world of work, bringing complex challenges for government, businesses and individual's alike.

The Future of Work Hub is a resource that supports organisations in their horizon-scanning - enabling them to see ahead, identify and anticipate future opportunities and challenges and evaluate how best to respond. The Hub website brings together leading resources on the drivers shaping the world of work and regularly produces and curates original content from a broad range of stakeholders on how organisations can respond and adapt. The Hub also acts as a forum to generate and inform debate through conversations with leading experts, innovative thinkers and peer-to-peer insight sharing.

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ABOUT JAMES DAVIES

As a founder partner of Lewis Silkin's employment practice, James has over 30 years' experience of advising clients on employment issues large and small.

Through his role with the global alliance of employment lawyers, Ius Laboris, James enjoys an international focus to his work, as well as advising organisations on a wide range of domestic employment law issues. He founded the firm's employment practice with Michael Burd in 1992 and has seen it grow to over 150 employment lawyers.

James has written and spoken widely both nationally and internationally on topical issues relating to employment law and the future world of work.

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