RSA

Action and Research Centre

The Four Futures of Work

Coping with uncertainty in an age of radical technologies

by Benedict Dellot, Rich Mason and Fabian Wallace-Stephens

March 2019

Contents

About the RSA Future Work Centre

The RSA (Royal Society for the encouragement of Arts, Manufactures and Commerce) believes that everyone should have the freedom and power to turn their ideas into reality – we call this the Power to Create. Through our ideas, research and 29,000-strong Fellowship, we seek to realise a society where creative power is distributed, where concentrations of power are confronted, and where creative values are nurtured. The RSA Action and Research Centre combines practical experimentation with rigorous research to achieve these goals.

With the support of our partners, the RSA has launched a Future Work Centre to explore the impact of new technologies on workers. Our goal is to cut through the hype that often plagues this debate and present a more accurate account of how the world of work is changing. The Future Work Centre is supported by Taylor Wessing, Friends Provident Foundation, Google.org and a philanthropic donation from an RSA Fellow. The arguments and recommendations made in this report are the views of the RSA, not necessarily those of our supporting partners.

This report has been produced in collaboration with Arup, an independent firm of designers, engineers, consultants and technical specialists. Arup's Foresight team advised on our approach and methodology in constructing the four scenarios. They provided input into the identification and analysis of the trends shaping the future world of work. In addition, they supported the design and delivery of the two workshops we ran with our collaborators and participants.

Acknowledgements

We are grateful to our sponsors Friends Provident Foundation, Taylor Wessing , Google.org and an anonymous RSA Fellow grantor. We would like to thank everyone who attended our two expert roundtable sessions which were invaluable in developing this research, as well as our RSA colleagues who helped us deliver the first session, and the team at Taylor Wessing for hosting us. Thanks to our RSA colleagues for their input and help, including Atif Shafique, Matthew Taylor, Anthony Painter, Asheem Singh, Ash Singleton and Toby Murray. We are grateful to Nic Hinton for supplying the illustrations.

TaylorWessing

Google.org

RSA Fellowship

Friends Provident Foundation

Research Partner

ARUP

Foreword

Before the crisis of 2008 there was a widely-repeated story about globalisation. It had four parts. First, that globalisation is an unstoppable force. Second, that it will have winners and losers, and the latter must either adapt or suffer. Third, that the things people care about, like national identities and local industries, are relics of a past age. Fourth, that however complicated financialisation may seem, it is held safely in the hands of a technocratic elite.

The hubris and denial of agency implicit in that message was fuelling an angry backlash long before the 2008 crisis and the consequent decision by most liberal democracies to use massive amounts of public money to bail out banks, while almost everyone else suffered from economic stagnation and the erosion of the public sphere.

But here we are again, playing out the same jarring tune. Advances in AI, robotics and other technologies are likely to change our lives, whether we like it or not. Many people, particularly low-skilled workers, may have to accept ever more insecurity and ever tighter control. Things we care about, ranging from protecting our data to a sustainable tax system, could be necessary casualties to progress. But there is no need to worry, we are told, because a small number of fabulously rich company owners in California and Shenzhen are wise and well-meaning.

One of the many reasons I am proud of this report, the latest output from the RSA's growing Future Work Centre, is that it sends a driverless coach and horses through this complacent and dangerous narrative. By developing a set of contrasting scenarios for the social and economic impact of technology, The Four Futures of Work reminds us that whatever futurists may speculate about the singularity, right now and for the foreseeable future it is human beings, not algorithms, who will decide whether technology will make our lives better or worse.

Clearly we have a long road ahead of us. Our survey of MPs that accompanies the publication of this report shows that our law makers have a deepening concern about the impact of technology while being clueless about how that impact could unfold. Less than half feel they have the expertise to make sound judgements about tech policy, and only 15 percent feel MPs are doing enough to prepare workers for new technologies.

Yet we do have choices. We can choose to establish a robust regulatory regime for technology and data rights. We can choose to create a tax system that shifts the burden onto those with the broadest shoulders. We can choose to overhaul our education system so that we treat lifelong learning more seriously. And we can choose to create a competition policy that stands up to the power of large firms when they impinge on the wellbeing of workers.

Readers of this report may be tempted to feel despondent about the future. But so much is still to play for. With the right policies and practices in place, we will not just be able to rein in the worst effects of technology, be that job losses or surveillance, but marshal it for the betterment for workers, minimising drudgery and expanding those jobs that bring meaning and fulfilment to our lives.

Matthew Taylor
Chief Executive

Executive summary

Scenario planning: a method for uncertain times

The debate around technology and the future of work grows louder by the day. Rightly so; we're confronted regularly with news of apparent breakthroughs in radical technologies, seemingly capable of disrupting whole industries, perhaps our very conception of work itself. With livelihoods at stake, it is natural that the public conversation is growing in urgency, along with the expectation for positive action to safeguard a future of good work. This is the need the RSA Future Work Centre was founded to address. Now eight months into our programme, this report marks our attempt to look into the future, highlight critical challenges that may face workers, and offer policy and practice interventions as potential remedies.

In doing so we have entered a crowded field. Consultancies, think tanks, government departments, media pundits – a wide range of stakeholders have offered their view on how the world of work will shape up in the coming years. But such opinions are largely expressed as predictions: one commentator says 10 percent of jobs are at risk of automation. Another says 5 percent. Yet another claims the true figure is closer to 35 percent. We find these numerical forecasts to be flawed. They are reductive, prone to bias and often based on mistaken assumptions. Above all, they are futile in the face of the vast complexity and unpredictability of major forces in the world, including the development and adoption of new technologies; trends that are impossible to predict with certainty.

In this report we suggest an alternative futures method in the form of **scenario planning**. Rather than offering a singular prediction for the future of work, this method yields several distinct and divergent visions of what may come to pass. Following this exercise led us to generate four scenarios for the UK labour market in 2035: **the Big Tech Economy, the Precision Economy, the Exodus Economy, and the Empathy Economy**. While they are not exhaustive portrayals of the future, they capture a wide range of plausible outcomes and present them in a way that is vivid and easy to grasp. Ultimately, we hope these scenarios are a practical tool to help those in positions of responsibility adequately prepare today's workforce for tomorrow's workplace, whether that is civil servants in the Treasury advising on changes to tax policy, or FE college leaders questioning how their curricula should evolve to meet new skill demands.

Conceptual framework: a tech taxonomy and critical uncertainties

In Chapters 3 and 4, we lay out the conceptual toolkit that enabled us to construct our scenarios and give them greater validity.

Chapter 3 offers a new **tech taxonomy** for the various ways technology can and does impact work. In a public debate often focussed exclusively

on automation, it is imperative not to overlook the many other ways technology can profoundly shape not just the quantity of work, but the quality and sometimes the entire nature of employment. The four-part taxonomy is as follows:

- **Automation**: Where technology completes tasks or changes who is responsible for undertaking them (eg autonomous vehicles and self-service checkouts).
- **Brokerage**: Where technology mediates between buyers and sellers, sometimes replacing multiple brokers with a single platform (eg eBay, Etsy and Uber).
- **Management**: Where technology aids the recruitment, monitoring and organisation of workers (eg video surveillance tools and scheduling software).
- **Digitisation:** Where technology turns physical goods and knowledge into data that can be captured, shared and replicated at low cost (eg Netflix and Microsoft Office).

Chapter 4 explains in greater detail our chosen version of scenario planning: morphological analysis. Key to this method is identifying high impact, highly uncertain drivers of change (or **"critical uncertainties"**) and then exploring their potential **projections** – the different ways they could play out over time. We argue that the development and adoption of most major technologies is uncertain. Many experts, for example, believe that the potential of artificial intelligence has been inflated, and that progress in its subdomain of deep learning is running out of steam. Similarly, there are critics who say robotics will never be able to mimic the manual dexterity of humans, and point to the recent closure of several robotics companies to make their case. For nearly every radical technology (distributed ledgers, the Internet of Things and additive manufacturing, among others) we found ample evidence to both support and refute its significance.

But technological progress is not the only uncertainty. Indeed, while public debates on the future of work concentrate heavily on the '4th industrial revolution', there are other influential forces at play that must be recognised, and which are equally uncertain. One of these is the health of the global economy, with some believing that another major recession is around the corner and others thinking the last crash was a once in a lifetime event. Another uncertainty is the future of worker voice. On the one hand, membership of traditional trade unions has been falling since the 1970s, but on the other an alternative movement is gathering steam, including new unions for the self-employed and gig workers. Still another uncertainty is the level of net migration to the UK, which could be damaged by our departure from the EU or equally remain buoyant over the long run.

Together, these uncertainties formed the basis of our scenarios. In practice, we selected a projection for each uncertainty and combined these to form a coherent vision for the future of work. A helpful way of thinking about uncertainties is as though they are dials, which can be lined up and set at different levels (or 'projections') to arrive at a clear pattern. One dial, for example, may point to economic stagnation while another may

refer to a slowdown in technological adoption.

The four futures of work

In Chapter 5 we present the results of this exercise: four scenarios for the UK labour market in 2035:

- **The Big Tech Economy** describes a world where most technologies develop at a rapid pace, from self-driving cars to additive manufacturing. A new machine age delivers significant improvements in the quality of products and public services, while the cost of everyday goods including transport and energy plummets. However, unemployment and economic insecurity creep upwards, and the spoils of growth are offshored and concentrated in a handful of US and Chinese tech behemoths. The dizzying pace of change takes workers and unions by surprise, leaving them largely incapable of responding.
- **The Precision Economy** portrays a future of hyper surveillance. Technological progress is moderate, but a proliferation of sensors allows firms to create value by capturing and analysing more information on objects, people and the environment. Gig platforms take on more prominence and rating systems become pervasive in the workplace. While some lament these trends as invasive, removing agency from workers and creating overly competitive workplace cultures, others believe they have ushered in a more meritocratic society where effort is more generously rewarded. A hyper connected society also leads to wider positive spill overs, with less waste as fewer resources are left idle.
- **The Exodus Economy** is characterised by an economic slowdown. A crash on the scale of 2008 dries up funding for innovation and keeps the UK trapped in a low skilled, low productivity and low pay paradigm. Faced with another bout of austerity, workers lose faith in the ability of capitalism to improve their lives, and alternative economic models gather interest. Cooperatives and mutuals emerge in large numbers to serve people's core economic needs in food, energy and banking. While some workers struggle on poverty wages, others discover ways to live more self-sufficiently, including by moving away from urban areas.
- **The Empathy Economy** envisages a future of responsible stewardship. Technology advances at a clip, but so too does public awareness of its dangers. Tech companies self-regulate to stem concerns and work hand in hand with external stakeholders to create new products that work on everyone's terms. Automation takes places at a modest scale but is carefully managed in partnership with workers and unions. Disposable income, kept aloft by high employment, flows into 'empathy sectors' like

education, care and entertainment. This trend is broadly welcomed but brings with it a new challenge of emotional labour, defined as managing one's emotions, even suppressing them, to meet the needs of others.

Good work, come what may

How, then, should we make use of these scenarios? We could decide that one vision of the future is more desirable than the others, and therefore direct our attention and resources to make it happen. Yet not only is this impossible given the global forces we are contending with, it also ignores that each scenario has merits and shortcomings, pros and cons. The Big Tech Economy comes with the obvious threat of widespread joblessness and depressed wages for workers. But this scenario could also result in a radical reduction in the cost of living, for example with AI making expensive services like legal and financial advice available to those on lower incomes. In contrast, while the Empathy Economy may appear the most desirable scenario, scratch the surface and one can see its dangers, including the growth of emotionally exhausting work.

The challenge for policymakers, educators and employers is to ensure good work prevails regardless of the path we travel down. Our report therefore concludes with a series of preliminary recommendations, the urgency of which are assessed in the context of different scenarios. In the Precision Economy, for example, we could see a sharp increase in gig work and self-employment, in turn increasing the pressure on the government to equalise tax rates and rights across all worker types. A proposal which seems to be both urgent and effective for every future of work can be seen as a 'no regret' proposal, one that we can develop without waiting for further information. Among our recommendations, laid out in more detail in Chapter 6, are to:

- Pilot **Personal Learning Accounts** to power lifelong learning, moving away from the current Apprenticeship Levy.
- Professionalise low-skilled jobs through **occupational licensing**, which would lend status to more job types and encourage career progression.
- Establish **a new settlement for the self-employed**, which would see them pay higher rates of taxation in return for more rights (e.g. Statutory Maternity Pay).
- **Rebalance the burden of the UK's tax system**, such that tax on unearned income (e.g. dividends and inheritances) grows while that on earned income (e.g. wages and profits) falls.
- Promote **a union model built on 'new power' principles**, with unions meeting the needs of workers in the new economy, while also delivering new services (e.g. sickness insurance).

- Launch a **Future of Work Research Alliance**, which would bring together academics, think tanks and journalists to share insights and agree on a common research agenda.
- Introduce a **Charter for Ethical Technology Investments**, laying out principles for the creation and development of technology that socially conscious investors could use to screen potential investments.

As an interim publication by the RSA Future Work Centre, these recommendations are to be viewed as provocations and points of further discussion rather than fully baked proposals. In the coming months, the RSA Future Work Centre will be testing these preliminary proposals via a series of practical interventions and pilots in key sectors of the economy, after which we will present a final set of proposals, across both policy and practice, to lay the foundations of a **new social contract** for 21st century work.

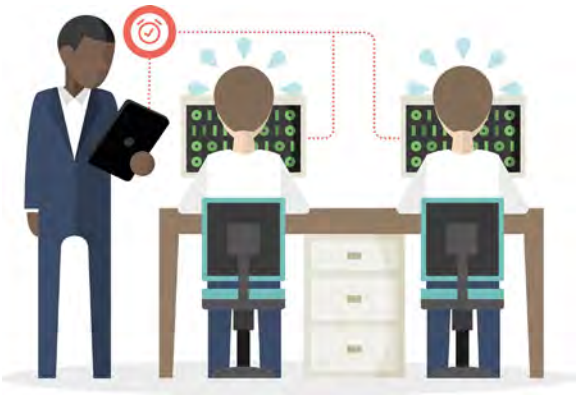
RSA/YouGov survey of MPs on the future of work.

As part of this study, we commissioned YouGov to undertake a survey of MPs. We wanted to find out how prepared MPs felt for the future of work, who they believe is taking sufficient action, who would gain from new technologies, and what policies they would support to deal with the challenges of the future. MPs were generally fearful of the impact of technology on the workplace, but by their own admission do not feel prepared for the changing nature of work.

- 43 percent of MPs feel they do not personally have the expertise to make sound judgements on technology policy. Only 15 percent feel that MPs in general are doing enough to prepare workers for new technologies, and just 14 percent feel the same about civil servants.
- 40 percent of MPs fear the impact of new technologies on workers in their constituency, and 46 percent see dealing with the ramifications of new technologies as big of a challenge as dealing with Brexit, with more agreeing than disagreeing among both leave and remain supporters.
- With 31 percent of MPs saying so, technology companies are perceived as the group that will gain the most from the introduction of new technologies. 29 percent say consumers and 27 percent employers. However, just 13 percent of MPs believe workers stand to gain the most.
- There are noticeable differences in the views of the two main political parties. Nearly half (45 percent) of Tory MPs think consumers will be the biggest winners from new technology, compared to just 12 percent of Labour MPs. Meanwhile, 43 percent of Labour MPs think employers will gain the most, with just 15 percent of Conservatives agreeing.
- Regarding policies and practices to deal with these issues, the greatest support was for personal learning accounts (65 percent of all MPs support this idea) and stricter competition policy to contain the power of large firms (64 percent). Support for other policies is as follows:
    - Regulate to have workers represented on company boards (52 percent).
    - Creating a sovereign wealth fund (48 percent).
    - Promoting a four-day working week (46 percent).
    - Introducing a Universal Basic Income (30 percent).
    - Reintroducing 'closed shop' rules for unions (25 percent).

- Again, views on policy and practice solutions differ between MPs of the two main parties. 72 percent of Labour MPs want a four-day working week vs 21 percent of Conservative MPs. And while 44 percent of Labour MPs support Universal Basic Income, the same is true of just 11 percent of Conservative MPs.
- Only 19 percent of MPs see technology as having more of a negative impact on women than men. This may demonstrate a lack of understanding on the impact of tech in the workplace; RSA research carried out in December 2018 suggests that only one in 20 new coding or programming jobs go to women.
- Parliament's attitude may be changing as a new generation of MPs enter Parliament. MPs elected from 2015 onwards were more likely to support progressive ideas such as Universal Basic Income and stricter competition policy.
- Polling was undertaken by YouGov on 100 MPs, including 41 Conservative and 50 Labour MPs. The survey was completed between 12 and 26 February 2019. Results for MPs are weighted by party, gender, electoral cohort, and geography to give a sample that is representative of the House of Commons.


ZHC
ZHC



Introduction

A spectacle to behold

The British sci-fi writer Arthur C Clarke used to say that "any sufficiently advanced technology is indistinguishable from magic". If that is true, and the hype is to be believed, then the coming years look set to be one of the most sensational magic shows around. Only recently we have witnessed the roll out of checkout-less supermarkets (led by Amazon), the trialling of an AI news anchor (on the Chinese Xinhua News station), the launch of a drone delivery network (powered by JD.com in China), and the unveiling of a digital assistant that can mimic the voice of humans with uncanny likeness (under the name of 'Google Duplex').

As the list of technological accomplishments grows, so does speculation about what the future has in store for workers. Barely a month passes without another book, report or conference speculating on how technology will change the world of work. Consultancies like McKinsey, PwC, Accenture and Deloitte regularly release predictions of how many jobs are likely to be lost to automation. So too do international bodies like the World Economic Forum and the OECD. Politicians, too, have lined up to voice their opinions. An All Party Parliamentary Group on AI was set up in 2017, while MPs including Yvette Cooper and Tom Watson have thrown their weight behind commissions exploring the likely scale of automation.[1]

Yet for all the commentary and forensic analysis, there is still little consensus about what technology will mean for workers. At least four distinct schools of thought can be identified:

- **The Alarmists** who believe new technologies will decimate industries and lead to mass unemployment and economic turmoil.
- **The Dreamers** who believe new technologies will be game-changing, but that their power will be used to diminish the burden of work and phase in more leisure time.
- **The Incrementalists** who claim new technologies will bring only

1. For more detail, see: www.tom-watson.com/fow; and www.fabians.org.uk/about-us/our-projects/workers-and-technology/

marginal disruption as 'lousy' jobs are replaced by 'lovely' ones.

- **The Sceptics** who suspect technological progress is slowing, and that new technologies like AI and robotics are less impressive than the innovations that preceded them.

Perils of predictions

While they may be divided in their opinions, pundits share one thing in common: a tendency to make assertive and unjustifiably confident predictions about how the future will play out. In 2013, the University of Oxford famously predicted that 35 percent of UK jobs could be at risk of automation.[2] Since then, a flurry of different estimates has been published, ranging from the optimistic to the catastrophic, and each arrived at using a different methodology. The OECD warns that 10 percent of UK jobs are at significant risk of automation, while McKinsey puts the figure closer to 5 percent.[3] PwC, meanwhile, thinks as many jobs will be created as destroyed by new innovations.[4] The MIT Tech Review has identified no fewer than 18 separate automation predictions.[5]

Yet the reality is that most forecasts tend to fall wide of the mark. Indeed, history is littered with incorrect estimates of technology's progress and impact. In 1876, the President of Western Union William Orton proclaimed that "this 'telephone' has too many shortcomings to be seriously considered as a means of communication".[6] In 1936, the New York Times faithfully wrote that a rocket will never be able to leave the Earth's atmosphere.[7] And in 2007, Steve Ballmer of Microsoft boasted "there's no chance that the iPhone is going to get any significant market share".[8] In each case, the tech sceptics got it wrong.

Tech optimists are just as frequently way off in their forecasts. Marvin Minksy, one of the founding fathers of the AI research field, claimed in 1970 that "[within] three to eight years we will have a machine with the general intelligence of an average human being".[9] More than 50 years on and we are still waiting. Even today, after all the false dawns of the 20th century, public figures continue to overestimate the pace of technological progress. Jeff Bezos was recently reminded of a claim he made in 2013 that, within five years (ie by 2018), drones would be delivering packages to people's doorsteps at scale.[10] Clearly this has not been the case.

Why are people so bad at making predictions about technology's trajectory? Roboticist Rodney Brooks says one reason is that we are too

2. Frey, C. B., Osborne, M. A., and Holmes, C. (2016) *Technology at Work v2.0*.

3. OECD (2016) *Automation and Independent Work in a Digital Economy*; and McKinsey Global Institute (2017) *A Future that Works*.

4. PwC (2017) *UK Economic Outlook: March 2017*

5. Winick, E (2018) *Every study we could find on what automation will do to jobs, in one chart* [article] MIT Tech Review, 25 January 2018.

6. Pestov, I. (2017) *The absolute worst technology predictions of the past 150 years*. Available: www.medium.freecodecamp.org/worst-tech-predictions-of-the-past-100-years-c1865421 1375

7. New York Times (1920) Editorial, 13 January. Referenced (and retracted) in Kuntz, T (2001) *150th Anniversary: The Facts That Got Away [article]* New York Times, 14 November 2001.

8. Pestov, I. (2017) *The absolute worst technology predictions of the past 150 years*. Available: www.medium.freecodecamp.org/worst-tech-predictions-of-the-past-100-years-c1865421 1375

9. Wadhwa, V. (2016) *The amazing artificial intelligence we were promised is coming, finally.* The Washington Post, 17 June.

10. Koenig, D. and Pisani, J. (2018) *Where are the drones? Amazon's customers are still waiting* [article] Associated Press, 3 December 2018.

quick to **generalise**, making broad assumptions about a technology's potential based on a single observation.[11] When we interact with a voice assistant like Alexa, for example by asking it for directions or to book a flight, it is tempting to assume that it won't be long before the device can engage us in a multi-faceted conversation. But there is an enormous technological gulf between an AI system that can retrieve and relay information and one that can answer open-ended questions.

A related problem is that we have a habit of **lumping technologies together**, mistakenly believing that a development in one domain (eg algorithms in healthcare diagnosis) implies progress in another (eg algorithms used in language translation). 'The march of technological progress' has become a popular term, yet it belies the fact that technologies advance at different paces. This also means we overestimate the progress of machines dependent on multiple technologies. A sophisticated humanoid robot such as Honda's Asimo requires computer vision to navigate its surroundings, natural language processing capabilities to understand verbal instructions, and fine sensorimotor functions to carefully grip and release items. It is seldom appreciated that progress needs to be made in all these fields for a machine like Asimo to be functional.

While these may be reasons for overestimating the impact of new technologies, there are also factors that lead us to underestimate the pace of progress. One is general **impatience**. If breakthroughs are not forthcoming, we are inclined to believe they never will be. Yet history shows game-changing technologies can often take years to materialise, and when they do can be deployed in more ways than was intended for. The Global Positioning System (GPS) is a case in point. Starting in 1978, the US military launched 24 satellites into orbit with the goal of improving the accuracy of munitions delivery.[12] The military considered terminating the GPS project on numerous occasions due to disappointing early results. But in 1995, nearly 20 years after its announcement, GPS became fully operational, and has since become a technology that many could not imagine living without.

Another reason technological progress is underestimated is because we struggle to grasp the concept of exponential growth. Since the mid-1960s, computing power has roughly doubled every two years: a trend known as Moore's Law that has continued to push the frontiers of technology. Think of a grain of rice that is placed on a chessboard square, and subsequently doubled from one square to the next. The second square would have two grains, the third square four grains, and so on. But the final 64th square would have 9,223,372,036,854,775,808 grains, more than two billion times as many as on the entire first half of the chessboard. Even when made aware of the idea of exponential growth, we still have difficulty understanding its ramifications, including for technological progress.

Shedding light with scenarios

The development of most new technologies is more uncertain than those in thinktanks, consultancies, VC investors and tech companies would have us believe. Autonomous vehicles may be visible on the streets of most

11. Brooks, R. (2017) *The seven deadly sins of AI predictions* [article] MIT Tech Review, 6 October 2017.
12. Ibid.

major cities in twenty years' time, or they may come to nothing. Carebots may be deployed in every care home in a generation, or they may only ever be used by a wealthy elite. Additive manufacturing tools may soon be used to print everything from buildings to clothing, or they may never make it past the doors of makerspaces and the clutches of hobbyists. Even those who work in the highest echelons of Silicon Valley and Shenzhen cannot say for certain how the future will unfold.

But if predictions are folly, what can be used in their place to prepare for the future?

One alternative method is scenario planning. Pioneered by the oil giant Shell in the 1970s to help it evaluate its drilling strategies, scenario planning typically involves identifying critical uncertainties about the future and combining different possibilities into a series of internally consistent and plausible narratives (usually four to six in total).[13] Unlike other methods such as contingency planning and sensitivity analysis, which question what would happen as a result or X or Y event, scenario planning examines multiple variables and the way they interact. The method has since been used in varied settings, from helping educators assess future skill needs to aiding utility regulators as they consider the consequences of deregulation.

Scenario planning has several advantages. First, it can break people out of 'business as usual' thinking. Thoughtfully constructed, scenarios can introduce readers to novel possibilities while bringing into sharper focus those trends that are relatively certain to play out over time, but which had previously seemed inconsequential, their impact hiding in plain sight. Secondly, scenario planning is driven by a democratic, collaborative process. Its practitioners emphasise the importance of consulting experts, acknowledging that what makes or breaks scenarios is often the ability to gather expertise on myriad and niche drivers of change. And third, scenario planning helps by simplifying a wealth of information into memorable narratives that are easily recalled. Being evocative and colourful, scenarios may have a longer shelf life than typical studies and reports.

The world of work in 2035

Beginning in the Summer of 2018, the RSA (Royal Society for the encouragement of Arts, Manufactures and Commerce) in partnership with Arup's Foresight team put this method into practice. Our goal was to formulate several scenarios for the UK labour market in 2035, with the aim of encouraging those in positions of power to prepare workers for multiple eventualities. We wanted to show to key decision makers, from civil servants in central government to FE college leaders to the CEOs of leading UK companies, that the future of work is more complex than the blinkered narrative of simply more or less automation. Consequently, there are a wider range of policy and practice interventions to consider than those typically put forward as responses to mass automation: namely taxing robots (if that is even desirable) and establishing a Universal Basic Income.

13. For short history of Shell and scenario planning, see Wilkinson, A. and Kupers, R. (2013) *Living in the Futures*. Harvard Business Review, May 2013 issue.

We chose 2035 as our horizon as it felt suitably far away that the exercise would stretch people's imaginations, but not so distant that it would be impossible to speculate on what might happen. Look back 16 years, the same distance as between now and 2035, and one can see the seismic changes that may occur in a short period. 2003 was the year Apple launched iTunes, the human genome project was completed, the US invaded Iraq, and Concorde made its last commercial flight. Facebook did not exist, and China had only just joined the World Trade Organisation. In 2003, these events were not impossible to foresee, but neither were they assured.

In crafting our scenarios, we followed five overarching principles designed to sharpen our analysis and help us create more detailed visions of the future:

- **Look beyond automation**: Our scenarios had to reflect the full range of technology's impact. While the media, consultancies and think tanks fixate on automation – the act of substituting human labour for machines – this is just one among many ways technology can change the world of work. It can also alter recruitment practices, power surveillance and monitoring, enable new patterns of employment via gig platforms, and alter the wider balance of power in the economy (eg with digitisation spurring the growth of superstar firms). The next chapter explores the many, often overlooked, ways technologies can impact work.
- **Tame the fixation on AI:** Our scenarios had to speak to a wide spectrum of digital technologies. Artificial intelligence has dominated the media limelight in recent years, largely because many see it as a 'general purpose technology' like electricity that will alter every aspect of our economy. But other technologies can and are changing the nature of work. This includes e-commerce platforms, the Internet of Things, additive manufacturing tools and distributed ledgers.
- **Consider technological diffusion:** We wanted our scenarios to factor in not just which technologies are developed and what is theoretically possible, but the extent to which they are actually adopted and integrated. There is no guarantee that a technology will be taken up en masse after it has been created. The NHS still relies heavily on fax machines for internal communication, while a new Internet Protocol created in 1996 has yet to be fully adopted.[14] While individuals may be quick to recognise the potential of new technology, the institutions in which they reside may not be. The diffusion of technology will be influenced by cost, regulation and consumer attitudes, all of which are uncertain.
- **Capture system wide consequences**: Our scenarios had to account for the ripple effects of technology. Typically, researchers

14. Brooks, R. (2018) *The Rodney Brooks rules for predicting a technology's commercial success* [article] IEEE Spectrum, 25 October 2018.

only look at what happens within firms when trying to understand the impact of new innovations (eg if a factory buys a new machine, what will this mean for its workers?). But we also need to account for system-wide effects like 'recycled demand'. This is where the adoption of new technology lowers the cost of consumer goods, freeing consumers to spend money (and drive up demand) in another part of the economy.

- **Factor in non-tech drivers**: Finally, our scenarios had to factor in critical uncertainties outside the sphere of technological progress. With all the talk of a 'fourth industrial revolution', it is easy to lose sight of non-tech trends that may shape our labour market. This includes the level of net migration to the UK, the strength of trade unions, the degree of investment in education and skills, the extent of climate change and the state of the global economy.

The four futures of work

Guided by these principles, and drawing on expert opinion over several months, we arrived at four scenarios for the UK labour market in 2035:

- **The Big Tech Economy** describes a world where most technologies develop at a rapid pace, from self-driving cars to additive manufacturing. A new machine age delivers significant improvements in the quality of products and public services, while the cost of everyday goods including transport and energy plummets. However, unemployment and economic insecurity creep upwards, and the spoils of growth are offshored and concentrated in a handful of US and Chinese tech behemoths. The dizzying pace of change takes workers and unions by surprise, leaving them largely incapable of responding.
- **The Precision Economy** portrays a future of hyper surveillance. Technological progress is moderate, but a proliferation of sensors allows firms to create value by capturing and analysing more information on objects, people and the environment. Gig platforms take on more prominence and rating systems become pervasive in the workplace. While some lament these trends as invasive, removing agency from workers and creating overly competitive workplace cultures, others believe they have ushered in a more meritocratic society where effort is more generously rewarded. A hyper connected society also leads to wider positive spill overs, resulting in less waste as fewer resources are left idle.
- **The Exodus Economy** is characterised by a protracted economic slowdown. A crash on the scale of 2008 dries up funding for innovation and keeps the UK trapped in a low skilled, low productivity and low pay paradigm. Faced with another bout of austerity, workers lose faith in the ability of capitalism to improve their lives, and alternative economic models gather interest. Employee-owned organisations, cooperatives and mutuals emerge in large numbers to better serve people's core economic needs in food, energy and banking. While some

workers struggle on poverty wages, others discover ways to live more self-sufficiently, including by moving away from expensive urban areas.

- **The Empathy Economy** envisages a future of responsible stewardship. Technology advances at a clip, but so too does public awareness of its dangers. Tech companies self-regulate to stem concerns and work hand in hand with external stakeholders to create new services and products that work on everyone's terms. Automation takes places at a modest scale but is carefully managed in partnership with workers and unions. Disposable income, kept aloft by high employment, flows into 'empathy sectors' like education, care and entertainment. This trend is broadly welcomed but brings with it a new challenge of emotional labour, defined as managing one's emotions, even suppressing them, to meet the needs of others.

The future could, of course, play out in an infinite number of ways. But these four scenarios frame and showcase the breadth of possible changes to our labour market, and in a way that is memorable and animating. We hope the four labels of Big Tech, Precision, Exodus and Empathy give people a language with which to describe their hopes and fears. More to the point, it is our hope that policymakers, educators and employers use these scenarios to fine tune their policies and in so doing leave today's workforce better prepared for tomorrow's workplace. Indeed, our intention is that the scenarios act as a call to arms. A reminder of all that is at stake if we allow technology to progress unchecked.

To be clear, we are not advocating one scenario over another. Given all the global forces at play, it is frankly not within the power of the UK government let alone UK employers or educators to work towards one of these four futures over another. Rather, we are asking that those in positions of responsibility ready workers for all eventualities, to mitigate the risks inherent in every scenario while capitalising on the many opportunities that will also emerge. This will require a level of humility and deftness that does not come naturally to decision makers, not least politicians who face the expectation of setting visions and duly delivering on them. However, with the right policies and practices, we can steward technology in a more benevolent direction, while ensuring that the gains and losses it creates are evenly balanced across society. We may not be able to predict the future, but we can certainly prepare for it.

The rest of this report breaks down as follows:

- Chapter 2 outlines a four-part taxonomy showing the different ways technology can impact the labour market: automation, brokerage, management and digitisation.
- Chapter 3 explains the method for constructing our scenarios, highlighting the critical uncertainties that can be dialled up and down within each possible future.
- Chapter 4 presents narrative accounts for each of our four futures of work, highlighting the opportunities and threats associated with each.

- Chapter 5 suggests ways that we can ready workers for these scenarios, with specific recommendations for government, employers, unions and others.

A tech taxonomy

Finding a signal in the noise

The sheer breadth of emerging technological applications can make it difficult to comprehend what tech advancement means for workers. We cannot take in every example and analyse every use case. Instead we need a broad framework for making sense of technology's impact, something that can help us organise our thoughts and be the basis for constructing our future work scenarios. Surprisingly, we came across no such framework when we commenced our research. We have therefore formed a simple taxonomy of our own, capturing what we feel are the four key ways technology can influence the quantity and quality of work:

- **Automation**: Where technology completes tasks or changes who is responsible for undertaking them (eg autonomous vehicles and self-service checkouts).
- **Brokerage**: Where technology mediates between buyers and sellers, sometimes replacing multiple brokers via a single platform (eg eBay, Etsy and Uber).
- **Management:** Where technology aids the recruitment, monitoring and organisation of workers (eg video surveillance tools and scheduling software).
- **Digitisation**: Where technology turns physical goods and knowledge into data that can be captured, shared and replicated at low cost (eg Netflix and Microsoft Office).

The rest of this chapter unpacks each category in turn, drawing on evidence and examples of how workers have been affected to date. Some channels of impact, like automating and digitising, predominantly affect the *quantity* of work. Yet most have a stronger bearing on its *quality*, including on levels of pay, meaning and autonomy. At the end of the chapter we emphasise the importance of understanding the distributional impact of technology, for example how gains and losses vary by demographic group, skill level and place.

Automation

When people think of automation, many envisage a machine that **substitutes** for human labour. It is not hard to imagine autonomous vehicles displacing taxi drivers or delivery drones removing the need for logistics workers. Recent advances in machine learning in particular have shifted the focus for potential substitution from low-skilled and physical work to high-skilled and cognitive work. Sberbank, the largest bank in Russia, uses artificial intelligence to make 35 percent of its loan decisions, while

'robot lawyers' are reported to have replaced 3,000 workers in its legal department.[15]

Alongside substitution, another form of automation is **augmentation**. This is where technology expands the capacity of workers, allowing them to undertake more work at a higher quality and value. Examples include CAD software used by designers to produce higher quality images, robotic medical tools used by surgeons to make more precise incisions, and augmented reality headsets that help engineers make sense of machinery by showing its intricate parts on a visual interface. Many companies have been founded on augmentation technology. Lilt, for example, is a startup that provides AI-powered translation services to translators.[16] As human translators write text, the algorithm predicts what they are likely to write next, speeding up the process of interpretation and allowing workers to get through more jobs.

Both augmentation and substitution are well-known features of automation. Less considered are **generation** and **transference**. Generation is where technology creates tasks that were never done previously by a human; more work is done, but no human work is displaced. Fish farming giant Cermaq Group has developed image recognition technology that can spot salmon infected with sea lice.[17] In this instance, technology is not replicating what a human already does. Transference, meanwhile, is where technology shifts responsibility for undertaking a task from workers to

15. The World Bank (2019) *The Changing Nature of Work*.

16. Stolzoff, S. (2018) *Human translators are the perfect microcosm of the future of work* [article] Quartz, 5 December 2018.

17. De Sousa, A. (2018) *Salmon farmers are scanning fish faces to fight killer lice* [article] Bloomberg Businessweek, 8 October 2018.

consumers. A good example is self-service checkouts, which move the task of ringing up items from checkout operators to shoppers. US activist Astra Taylor describes such behaviour as 'fauxtomation'.[18]

Automation is, then, a multi-faceted phenomenon. But what does it mean for workers? One obvious consequence of substitution is the loss of jobs. Even in instances where some tasks are replaced by automation, organisations may restructure workplaces so that fewer employees complete a reduced aggregate workload. Augmentation can also have drawbacks for workers, particularly if it deskills jobs. A healthcare algorithm that makes it easier to diagnose rare diseases could lower the barriers to entry for esteemed clinical roles, and thus reduce the bargaining power of highly skilled professionals. The outcome for workers depends on whether they can move up the value chain and take on higher value activities.

But automation could also strengthen the hand of workers. It could, for example, drive up productivity and therefore, in theory, wages, as machines produce more goods and services with less human input (although whether firms share productivity gains with workers is another matter). A 2015 study looking at the use of robots across 17 countries found they raised labour productivity by 0.36 percentage points annually over the period 1993 to 2007.[19] Automation can also make jobs more pleasurable by removing the dull, dangerous and dirty aspects of work that few humans want to shoulder. Amazon's warehouse robots may take away the task of shifting pallets around warehouses, just as blockchain technology may remove the task of verifying transactions in banking. But are these the kind of activities we want to shield from automation? McKinsey says the average worker spends 67 percent of their time 'recognising known patterns' and just 2 percent on creative tasks.[20]

It is also worth looking at the wider system in which automation takes place. For example, if automation occurs at scale in other countries, as it has done in Germany, South Korea, Japan and other manufacturing powerhouses, their industries could become more productive and more competitive relative to the UK's. In tradeable sectors like finance and manufacturing where goods and services can be exported, UK firms may therefore have to automate to stay ahead of their overseas rivals. In this way, domestic automation could be a means of protecting UK jobs rather than putting them at risk.

Brokerage

Brokerage describes the role of technology in mediating between buyers (employers and individual customers) and sellers (workers), often by replacing multiple brokers with a single platform. Andrew Chen from VC company Andreessen Horowitz outlines several types of platform and how these marketplaces have evolved since the advent of the internet.[21] First came listing sites like Craiglist and eBay, where goods and services were displayed with little sophistication. Then came the 'Uber for X' era, with platforms that brokered on-demand connections between buyers

18. Taylor, A. (2018) 'The faux-bot revolution' in *A Field Guide to the Future of Work*. London: The RSA.

19. Graetz, G. and Michaels, G. (2015) Robots at work. Centre for Economic Performance.

20. McKinsey Global Institute (2017) Op cit.

21. Chen, A. (Date of publication not stated) *What's next for marketplace startups? Reinventing the $10 trillion service economy, that's what* [article] Andrew Chen blog.

and sellers in a geographically limited area (eg Deliveroo and Handy). Most recently, we have seen the emergence of the 'Managed Marketplace', where platforms facilitate the exchange of more elaborate goods and services. This includes Honor, a marketplace for care professionals that not only displays the profiles of carers but screens them for suitability.

Whether platforms strengthen or undermine the hand of workers remains the subject of intense debate. Proponents claim they give workers greater flexibility, unshackling them from nine to five employment and allowing them to work at a time and place of their choosing. For those managing physical or mental health conditions, or looking after loved ones, this autonomy can be essential. In a recent study of London's Uber drivers, 93 percent agreed or strongly agreed that they partnered with Uber to have more flexibility in their schedule and to balance their work with their life and family.[22] Platforms have also helped self-employed workers find more clients and substantiate their credentials in a way that wasn't before possible. Handy helps cleaners and handymen and women connect more easily with potential buyers. Upwork gives freelancers the chance to sell to customers the world over.

But platforms are not without their critics. Detractors say the flexibility they offer is an illusion. Uber may allow drivers to log on whenever they wish, but the reality is that they will have to work certain shifts, often during antisocial hours, to reap the greatest rewards. Platform workers also lack important protections that workers in conventional employment take for granted, among them Statutory Sick Pay, Statutory Maternity Pay and holiday pay (depending on the platform).[23] Where platforms allow workers to compete on price, there is also the risk of a race to the bottom, with workers outbidding each other to a point where they work on poverty wages. Amazon's Mechanical Turk, which offers bitesize jobs, is renowned for its bitesize remuneration.

The international, borderless nature of platforms creates additional risks and opportunities. On the one hand, this has meant that domestic workers have faced more competition for jobs, and that they feel the pressure of what Professor Mark Graham of the Oxford Internet Institute calls a 'Planetary Labour Market'.[24] On the other hand, platforms have opened up new markets for UK workers and businesses, including in accounting, legal services and business consulting. According to the Online Labour Index (OLI), UK workers account for a fifth (22 percent) of all professional services traded online.[25]

Management

As well as automating tasks and brokering connections, technology can be used in the management of workers, including for surveillance. Today's technology can be used to monitor everything from the files opened by office workers to the routes taken by delivery drivers to the tone of voice

22. Berger, T. et al. (2018) *Uber happy? Work and wellbeing in the 'gig economy'*. Oxford Martin School.

23. For a detailed account of the characteristics of UK gig workers, see Balaram, B. (2017) *Good Gigs: A fairer future for the UK's gig economy*. London: RSA.

24. Graham, M. (2018) 'The rise of the planetary labour market' in *A Field Guide to the Future of Work*. London: RSA.

25. Ojanperä, S. et al. (2018) *Data science, artificial intelligence and the futures of work*. The Alan Turing Institute.

of call centre operators. According to recent polling by the Trades Union Congress (TUC), half of all UK workers say they are being monitored by their employers.[26] In some cases, the data collected by technology remains private. Humanyze is a company that creates credit card sized devices that can be worn by workers to monitor their mood and understand team dynamics, while keeping people's individual data anonymised. Occasionally, however, the data captured on workers is publicly disclosed, such as in call centres where TV screens rank staff on their relative performance.[27]

Technology can also be used to manage workers through scheduling and the setting of tasks. Percolata helps retailers draft staff rotas using information collected by in-store sensors. Schedules are automatically arranged based on an assessment of worker performance, who works well together, and other information such as predicted footfall. Other employers use technology to orchestrate tasks for workers (ie to set to-do lists). One such firm is Bowery Farming in the US, a state of the art indoor farm, where workers are advised on how much to water each plant, the intensity of light required and when to harvest.[28] Some firms prefer to use a subtler approach to steer worker behaviour, for example through 'gamification'.[29] The ride hailing app Lyft has an 'accelerate awards' programme that gives drivers special rewards such as fuel discounts in return for completing goals (usually a set number of rides per month).

Recruitment is another domain of management that has been influenced by technology. HireVue creates AI-powered video technology that analyses candidates during job interviews, picking up on intonation, verbal responses and facial expressions. Mya provides employers with a 'conversational platform' that engages with job candidates throughout a recruitment round, using natural language processing and generation to pose basic questions and answer candidate queries. Technology has also been deployed to screen CVs and determine which job candidates are eligible for an interview, as well to target job ads at desirable workers. Facebook was criticised in 2017 for allowing firms including Goldman Sachs to target jobs ads to young people only.[30]

Finally, technology can be used in service of communication. This is not the most attention-grabbing application of technology, but it continues to have profound effects on workers. It is estimated that 281bn emails were sent every day in 2018.[31] The proliferation of smartphones has meant that many employees are theoretically forever on call. A survey undertaken by the CIPD found that a third of workers believe having remote access to the workplace means they can't switch off in their personal time.[32]

26. TUC (2018) *A future that works for working people*.

27. Woodcock, J. (2017) *As a call centre worker I saw how employees are stripped of their rights* [article] The Guardian, 16 February 2017.

28. Ito, A. (2018) *At this high-tech farm, the boss is an AI-powered algorithm* [article] Bloomberg, 20 September 2018.

29. Mason, S. (2018) *High score, low pay: why the gig economy loves gamification* [article] The Guardian, 20 November 2018.

30. Angwin, J. et al. (2017) *Facebook job ads raise concerns about age discrimination* [article] The New York Times.

31. Tschabitscher, H. (2019) *The number of emails sent per day in 2019 (and 20+ other email facts)* [article] Lifewire, 3 January 2019.

32. TUC (2018) Op cit.

Polling by the TUC corroborates such concerns, finding that one in seven UK workers fear new technology has increased their working hours.[33] Particularly affected are workers in the 'knowledge economy' (finance, law and business services) where work can be infinite and transportable to any location with an adequate internet connection.

For some, these developments have served to exacerbate discrimination, curtail privacy and colonise leisure time. Yet many are optimistic that technology may in fact produce the opposite effects. Percolata's algorithms set work schedules based on perceived performance and team fit rather than the whims and friendships of managers.[34] The company Info Talent Science claim their recruitment algorithms led to an average 26 percent rise in African American and Hispanic hires across the industries where it was used.[35] LinkedIn, meanwhile, recently launched a set of new tools to help recruiters find more representative candidate pools, including a service that suggests how the wording of posts can be altered to attract higher response rates from women.[36]

Digitisation

Digitisation is where technology turns physical goods and knowledge into data that can be easily replicated, shared and stored. Personal computers were the first technology to achieve this feat at mass scale, with tools like Microsoft Office that transformed documents into virtual and editable files. A second wave of digitisation was brought about by the internet, which enabled people not just to store content but to distribute and sell it to others. Nearly every form of codified information became digitised in the process, including music (eg Spotify), film (eg Netflix), books (eg Kindle), and news (eg Huffington Post). The third and most recent iteration of digitisation has been enabled by the Internet of Things, a vast network of internet-connected sensors that are collecting previously uncollectable data on objects and people, and on the wider environment.

What has digitisation meant for workers? One consequence has been the loss of jobs. The spread of personal computers brought about a reduction in administrative staff and typists, with fewer people needed to print, edit and manage paperwork. Similarly, the digitisation of music, film and literature resulted in job losses in the manufacturing of these goods. The number of workers employed in printing fell by 34 percent between 2010 and 2018.[37] It is too early to tell what impact the spread of IoT sensors will have on job numbers. However, it is plausible that some jobs in maintenance, stock checking and auditing will already have been compromised. Fewer maintenance engineers, for example, would be needed in factories if Internet of Things sensors were able to monitor machines for faults around the clock.

One sector particularly affected by digitisation is retail, which has had to grapple with the rise of e-commerce (ie digital shop fronts). Online sales of non-food items in the UK grew from 11.6 percent of total retail

33. Ibid.

34. O'Connor, S. (2016) *When your boss is an algorithm* [article] The Financial Times, 8 September 2016.

35. Lam, B. (2015) *For More Workplace Diversity, Should Algorithms Make Hiring Decisions?* [article] The Atlantic, 22 June 2015.

36. Kumar, R. (2018) LinkedIn Integrates Diversity Insights Into All of Its Talent Solutions [article] LinkedIn, 10 October 2018.

37. RSA analysis of UK Labour Force Survey data.

sales in 2012 to 24.1 percent in 2017.[38] Such a rapid shift in spending patterns has been felt by workers employed in bricks and mortar shops, with high streets suffering a slump in footfall and household names shutting up shop in many areas. Toys'R'Us, HMV, Homebase, Mothercare and House of Fraser are among the firms that have struggled to adapt to a digital age.

Perhaps the most significant impact of digitisation, however, has been on market concentration. The more digitised our economy has become, the easier it has been for a handful of firms to dominate the provision of services. Why? Because firms with the greatest number of customers collect the largest troves of data, which in turn enables them to provide a better service, attract more customers and harvest even more data to analyse. John van Reenen and Christina Patterson of MIT say the data advantages enjoyed by large firms has culminated in 'winner takes most' markets, which are dominated by what our RSA colleague Brhmie Balaram calls 'networked monopolies'.[39] Netflix has become dominant in TV entertainment, Instagram in image collection and sharing, Uber in ride hailing, and so on. Facebook and Google receive $3 for every $4 spent on digital advertising in the US, while Amazon accounts for 90 percent of online book sales.[40] This is concerning because market power can be used to stifle wage growth and erode worker rights. When a company is the only employer in a sector (or even in a town), workers have little option but to accept their terms and conditions.

Winners and losers

Whether it is automating, brokering, managing or digitising, in this chapter we have seen that technology can influence the type and quality of work in diverse ways. But such impacts of technology are rarely felt equally across society. Technology leans harder on some groups than it does on others, and the opportunities it generates are seldom made available to everyone. No account of technology's impact would be complete without acknowledging the potential for winners and losers along several lines:

- **Skill level**: Advances in technology have historically been more disruptive to lower and middle-skilled workers who tend to be in routine jobs that are easier to automate. The World Bank estimates that since 2000, the percentage of jobs involving routine skills has fallen from 42 to 32 percent in developed countries.[41] Altogether, technology may have helped to 'hollow out' the UK labour market, with jobs in the middle of the pay distribution (eg secretarial and manufacturing work) falling as a share of total UK employment between 1993 and 2014.[42]
- **Demographic group:** Technological progress can lead to

38. Bowsher, E. (2018) *Online retail sales continue to soar* [article] The Financial Times, 11 January 2018.

39. Van Reenen, J. and Patterson, C. (2017) Research: The Rise of Superstar Firms Has Been Better for Investors than for Employees [article] Harvard Business Review, 11 May 2017.

40. Giles, M. (2018) *It's time to rein in the data barons* [article] MIT Tech Review, 19 June 2018.

41. The World Bank (2019) Op cit.

42. Gardiner, L. and Corlett, A. (2015) Looking through the hourglass: Hollowing out of the UK jobs market pre- and post-crisis. Resolution Foundation.

different outcomes for men and women, young and old, white people and people of colour. The rise of e-commerce, for example, has meant that job numbers in bricks and mortar retail have fallen, while those in warehouse work have risen. But women are far more likely to be employed in the former than the latter. We have also seen how technology used in recruitment can be discriminatory. Amazon recently had to pull the plug on its hiring algorithm after it was revealed to penalise CVs that contained the word "women's".[43]

- **Place:** While we may talk of one UK labour market, the reality is that we are dealing with multiple *local* labour markets, each of which experiences technological disruption differently. Technology can create jobs in one location while simultaneously eliminating jobs in another. Towns that have relied on a single large, often industrial, employer have tended to suffer more, while cities with heterogeneous economies have boomed.[44] In 2014, 5.5 percent of all UK workers were in new job types that emerged after 1990, but the figure for London was almost double that at 9.8 percent.[45]
- **Beyond the workplace:** Finally, we should remember that workers can be affected by technology outside of the workplace. Workers are not just workers, after all. They are also consumers, patients, students and citizens in the round. As innovation progresses, products and services improve in quality and value, a trend that has meant more for people on low incomes than anyone else. In the last 250 years, global income per head in advanced economies has grown twenty-fold, with accompanying leaps in drug discovery, travel opportunities and entertainment.[46]

Having outlined a taxonomy to make sense of technology's impact on workers, we can now turn to the formation of our four scenarios and the critical uncertainties that underpin them.

43. Dastin, J. (2018) *Amazon scraps secret AI recruiting tool that showed bias against women* [article] Reuters, 10 October 2018.

44. A 2018 study finds that large cities like London are more likely to be home to highly specialised occupations that are less at risk of automation. See Frank, M. R. et al. (2018) *Small cities face greater impact from automation* in Journal of the Royal Society, Vol 15, Issue 139.

45. Frey, C. B. (2015) New job creation in the UK: which regions will benefit most from the digital revolution. PwC.

46. Lent, A. (2012) Generation Enterprise. London: RSA.

The known unknowns

Building our scenarios

Working with our research partners at Arup, we used a method called **Morphological Analysis** (MA) to help us create our future work scenarios. MA has several advantages but the main one is that it can account for several high impact, highly uncertain drivers of change (or "critical uncertainties"). Given most debates on the future of work hinge on a single uncertainty like the trajectory of artificial intelligence, MA felt certain to offer a fresh and more vivid outlook on the future of work.

The MA approach entails four main stages:

1. Identify which high impact drivers are relatively certain versus those that are relatively uncertain, and of the latter decide which are of critical importance (e.g. a critical, potentially highly impactful uncertainty could be the stance of regulators towards technology).
2. Devise a range of projections that describe how each area of uncertainty could play out over time (e.g. technology regulators could take a laissez faire stance or encourage self-regulation or even outlaw some innovations)
3. Undertake a critical analysis to see which projections naturally align across all areas of uncertainty to form a coherent narrative (e.g. a public backlash against technology could plausibly correlate with, or indeed lead to, a regulatory clampdown).
4. Select the most compelling combinations of projections and use these as the basis for crafting a set of 4-6 scenarios, being careful to ensure they are internally consistent and have limited overlap.

In this chapter, we explain the critical uncertainties and their different projections that formed the basis for our four futures of work. Many of these relate to technology, however a number speak to economic, environmental, social and political forces – from the strength of trade unions to the health of the global economy. As we will reveal, many of the trends that appear relatively certain are, upon closer inspection, far from guaranteed. A full list of our critical uncertainties and their projections, as well as our critical certainties, can be found in the Appendix of this report.

1. Technological uncertainties

Artificial intelligence

Many expect artificial intelligence (AI) to advance at a rapid pace over the coming years. Facebook CEO Mark Zuckerburg recently claimed his company would push AI systems to "get better than [a] human level

at all of the primary human senses: vision, hearing, language, general cognition".[47] Computer scientist and entrepreneur Andrew Ng , meanwhile, has likened AI to electricity, saying he has "a hard time thinking of an industry that I don't think AI will transform in the next several years",[48] Such claims are given credence by what appear to be major breakthroughs, particularly in AI's subdomains of machine learning and deep learning. Last year, DeepMind, a UK pioneer of deep learning, announced that one of its healthcare algorithms could detect over 50 eye diseases as accurately as a trained doctor.[49] 2018 was also the year an AI system engaged in a two-way debate with a human opponent, a world first that was widely reported on by the media.[50]

Yet AI is not without its doubters. Several prominent computer scientists say the technology's progress has been inflated. US scientist and entrepreneur Gary Marcus warns that deep learning systems lack ways of representing causal relationships (such as between diseases and their symptoms) and are still a long way from making sense of abstract knowledge, for example information about what objects are and what they are used for.[51] Others complain that AI systems are too fragile, being incapable of dealing with minor alterations in inputs. In one aptly named study called 'The Elephant in the Room', researchers found that adding a small icon of an elephant in the corner of a living room image led an image recognition algorithm to abruptly misclassify other objects in the frame.[52] MIT Tech Review journalist Karen Hao says AI systems face a "big baby problem", being unable to operate beyond the narrowly defined environments in which they are nurtured.[53]

While some of these failures occur in research labs, others take place in real world settings. IBM Watson, an AI system deployed in the detection of cancerous cells, was last year found to have made several unsafe and incorrect treatment recommendations.[54] So bad was the product's performance that one doctor described it as "a piece of shit".[55] The online technology publication, The Register, claims IBM is now scaling back its healthcare business after failing to win hospital contracts.[56] AI systems also struggle in more familiar domains, such as language translation. While Google has successfully used deep learning approaches to improve the performance of its translation engine, it continues to falter with simple requests. Its 'neural machine translation' (NMT) model can only make sense of a limited amount of information, meaning it works well in translating individual sentences but struggles with long passages of text.[57]

Critics say these failures are not isolated cases but reflect deep seated

47. Mitchell, M. (2018) *Artificial intelligence hits the barrier of meaning* [article] The New York Times, 5 November 2018.

48. Lynch, S. (2017) *Andrew Ng: Why AI is the new electricity* [article] Insights by Stanford Business, 11 March 2017.

49. Vincent, J. (2018) *DeepMind's AI can detect over 50 eye diseases as accurately as a trained doctor* [article] The Verge, 13 August 2018.

50. Lee, D. (2018) *IBM's machine argues, pretty convincingly, with humans* [article] BBC News, 19 June 2018.

51. Marcus, G. (2018) *The deepest problem with deep learning* [article] Medium, 1 December 2018.

52. Mitchell, M. (2018) Op cit.

53. Hao, K. (2018) *AI can't just play video games all day if it's ever going to grow up* [article] MIT Tech Review, 21 November 2018.

54. Quach, K. (2018) *IBM Watson dishes out 'dodgy cancer advice', Google Translate isn't better than humans yet, and other AI tidbits* [article] The Register, 28 July 2018.

55. Ibid.

56. Ibid.

57. Ibid.

engineering challenges that will limit the long-term applications of AI. One of these is a lack of reliable data upon which algorithms can be trained. Supervised learning, a method used to develop many AI systems, involves feeding algorithms with large quantities of 'labelled' data until a common pattern can be found (eg an algorithm may identify similar characteristics in a series of MRI scan images labelled as cancerous). According to McKinsey, a supervised deep learning algorithm will achieve acceptable performance with around 5,000 labelled examples per category, but will require as many as 10m labelled examples to reach human level performance.[58] Alongside data issues, critics point to a lack of innovation in algorithmic design. Deep learning models may have ratcheted up the capability of AI in the last five years, but some worry they are now running out of steam. Critic Andrew Fentem says deep learning systems are based on a technique of 'backpropagation' that hasn't changed much since its invention in the 1960s.[59]

There are, however, still reasons to believe AI will be a game-changing technology in the years ahead. Excitement has grown in a new AI architecture called capsule networks, which many believe will outperform traditional approaches to deep learning. As explained by technology investor group CB Insights, a major advantage of capsule networks is that they can spot patterns in datasets with fewer data points, while being able to deal with messier inputs.[60] They are less likely, for example, to be fooled into answering that an image is a face when its features have been rearranged.[61] A recent development from DeepMind also shows that AI may be less brittle than some believe. Last year its research team created a computer programme called a generative query network (GQN), which can build a mental picture of the world by itself. By showing it a scene from several angles, it can predict what the scene may look like from another angle, much in the way a human does. The implication is that AI may one day be able to reason about the world with sophistication.[62]

Robotics

What about robotics? This field of technology has made significant progress in the last two decades. For much of the 20th century, robots came in the form of articulated machines that had limited degrees of movement and which were confined to fixed spots on factory floors. However, the new millennium saw several breakthroughs that freed robots from their cages. In 2000, Honda unveiled Asimo, a humanoid robot that walked on two legs, could recognise gestures and understand voice commands. In 2003, the robotics company Kiva (since taken over by Amazon), introduced a machine that could seamlessly shuttle goods around warehouses. Developments have continued to follow thick and fast, from robots used in farming to spot blight on crops, to robots used in supermarkets to scan

58. McKinsey Global Institute (2018) *Notes from the AI frontier: Applications and value of deep learning*. MGI.

59. Fentem, A. (2018) *Mything the point: The AI renaissance is simply expensive hardware and PR thrown at an old idea* [article] The Register.

60. CB Insights (2018) *Top AI trends to watch in 2018*.

61. Ibid.

62. Knight, W. (2018) *A computer program that learns to "imagine" the world shows how AI can think more like us* [article] MIT Tech Review, 14 June 2018.

shelves and keep a track of inventory.

The growth of robotic applications has been driven by parallel improvements in underlying hardware and software. Cloud computing has allowed robots to pool data and continually learn from the experiences of others. Better sensors have enabled robots to more precisely understand and monitor their environments. Improvements in hydraulic pumps have reduced friction and allowed more precise control. Silicone and spider silk have made for sharper looks, while 'ferrofluids', a type of liquid that can be magnetised, has enabled robots to bend, contract and twist more easily. Artificial intelligence lies behind many of these improvements, a symbiosis that could push the field of robotics still further forward. Researchers at OpenAI recently used AI to train a robot hand to rotate and orient a cube, an impressive feat given the machine has nearly as many degrees of freedom as a human hand.[63]

But just as with AI, there are reasons to question whether robotics will deliver on the promises of its evangelists. In a sign the industry may be losing its momentum, several robotics companies have folded or been sold off in the last few years. Rethink Robotics, a maker of 'cobots' designed to work alongside humans, shut its doors last year after expected orders did not materialise. Likewise, Alphabet terminated a bipedal robot programme called Schaft, stating that it wants to prioritise non-humanoid robots in future. It may be that the market was not yet ready for the machines these companies were creating. But technical stumbling blocks were also a likely factor in their demise. Manual dexterity, in particular, remains elusive (the robotic hand mentioned above is far from as agile as its human counterpart). While machines may be able to roam warehouses, hospitals and supermarkets, few can perform nimble-fingered tasks like turning the page of a book or handling a bag of oranges.[64]

None of this, however, has slowed down the commercial applications of robots. The International Federation of Robotics (IFR) found that global sales of industrial robots soared by 30 percent from 2016 to 2017.[65] Between 2011 and 2017, the average annual sales of robots stood at 236,000 units, double what it was between 2005 and 2008 (the period between 2008 and 2011 was a blackout period for investment caused by the economic crash). The IFR points to several innovations that could further drive up demand in the coming years, including robots that are easier to programme and therefore more appealing to smaller businesses, and robots that are easier to integrate into existing manufacturing systems. Moreover, research labs continue to brim with promising experiments. Researchers at Queen Mary University are trying to teach robots the skills of manipulation using a system of virtual reality and smart wearable devices, which enable machines to mimic human demonstrators.[66] If proven effective, this training innovation could pave the way for more dexterous robots able to handle more types of objects.

63. Quach, K. (2018) Relax, Amazon workers – OpenAI-trained robo hand isn't much use (well, not right now) [article] The Register, 30 July 2018.

64. Vincent, J. (2018) *Welcome to the automated warehouse of the future* [article] The Verge, 8 May 2018.

65. International Federation of Robotics (2018) *Executive summary: World robotics 2018 industrial robots*.

66. Knight, H. (2018) *Robots to mimic human dexterity for better grasp of objects* [article] The Engineer, 19 September 2018.

Other technologies

While AI and robotics may be the two most hotly anticipated technologies, there are others that could shape the world of work in profound ways, and whose trajectories are just as uncertain:

- **Autonomous vehicles (AV):** Nearly every major car manufacturer has an AV programme underway, as do tech giants including Alphabet (with Waymo) and Uber (with Otto). Their cars can now be found traversing the roads of several willing cities, including Phoenix and Pittsburgh in the US. Otto, which specialises in autonomous trucks, completed its first autonomous delivery in 2016, covering 120 miles of ground unaided.[67] In a sign the technology is maturing, Waymo has said that later this year it will open the world's first factory dedicated to making AVs.[68] Many, however, continue to doubt whether self-driving cars or trucks will ever become a regular sight on our roads. A cause for concern is the high number of crashes and fatalities in AVs relative to miles travelled. AV specialist Sam Schwartz says that in California, cars in autonomous mode are crashing nine or 10 times more frequently than conventional vehicles.[69] Based on its technical tests of AVs, the IIHS, a nonprofit in the US, declared in 2018 that an AV which can "go anywhere, anytime" will not be market ready for "quite some time".[70]
- **Distributed ledgers:** Few technologies divide opinion more than distributed ledgers. Proponents say blockchain and other ledgers like it will upend every industry where transactions need to be verified en masse, removing the need, for example, for back-end staff to facilitate property dealings, remittance transfers and interbank trading in the financial sector. Hundreds of startups have sprung up offering blockchain as a solution to X or Y problem. One such company is Provenance, which uses blockchain technology to verify the authenticity of a company's goods and their treatment of supply chain partners. Corporates are also beginning to experiment with distributed ledgers. Walmart is reportedly using blockchain to keep tabs on its distribution network for fresh produce, while Facebook says it is launching a cryptocurrency that will let users transfer money via WhatsApp.[71] Yet distributed ledgers have some way to go before we can be convinced of their significance. A recent study of blockchain's supposed benefits for international development is a cause for concern.[72] Of the 43 'solutions' analysed by researchers, including a Fellow at USAID, none were able to demonstrate that blockchain added any value, even after the researchers

67. Davies, A. (2016) *Uber's self-driving truck makes its first delivery: 50,000 beers* [article] Wired, 25 October 2016.

68. Jee, C. (2019) *Waymo plans to open the world's first self-driving car factory this year* [article] MIT Tech Review, 23 January 2019.

69. Gross, T. (2018) ***The Revolution Will Be Driverless: Autonomous Cars Usher In Big Changes*** [article] NPR, 10 December 2018

70. Guo, K. (2018) *Driven to safety - it's time to pool our data* [article] Tech Crunch, 21 November 2018.

71. Orcutt, M. (2018) *With Walmart's veggie tracker, blockchain for supply chains will finally get real* [article] MIT Tech Review, 25 September 2018.

72. Orlowski, A. (2018) *Blockchain study finds 0.00% success rate and vendors don't call back when asked for evidence* [article] The Register, 30 November 2018.

contacted the vendors directly.

- **Additive manufacturing:** Additive manufacturing, or 3D printing, as some know it, has proven its worth in several industries. High end manufacturers like Jaguar Landrover use the technology to produce intricate parts for its engines, while the NHS has deployed it to create replicas of organs that can aid transplant surgery. 2018 was an important year for the technology, with the completion of the world's first 3D printed steel bridge and the first 3D printed concrete house (the latter taking just 24 hours to construct).[73] Advocates say further breakthroughs are likely as larger printers and better materials (eg plastics embedded with carbon fibre) come on the market.[74] However, several barriers stand in the way of additive manufacturing becoming a mainstream technology. One of these is the difficulty of making, let alone disassembling, objects that consist of multiple materials. Another is the challenge of ensuring that printed objects have structural integrity, given additive processes can alter the inherent properties of a substance.
- **Internet of Things:** The Internet of Things (IoT) refers to the now vast network of objects that are connected to the internet, allowing novel data to be captured, shared and analysed. The number of internet-enabled devices has ballooned in the last decade, reaching nearly 30bn objects that together generate 5 quintillion bytes of data every day.[75] IoT has already left its mark on many sectors. In transportation, the US railway company Union Pacific uses sensors on rail tracks to monitor the integrity of train wheels and prevent derailments.[76] In insurance, several companies are using the data collected by internet-enabled cars to offer personalised insurance, based for example on average speed and frequency of braking.[77] Cheerleaders say this is just the beginning of the IoT revolution. Sensors may one day be so small and cheap that they become ubiquitous, meaning everything from what we eat, to the way we work, to how we shop can be monitored and analysed. None of this can happen, however, without greater interoperability, standardisation and cybersecurity defences. The march of IoT could also be swiftly halted should consumers have concerns that their privacy is at risk (more on this below).
- **Immersive technologies:** Immersive technologies include augmented and virtual reality. The former consists of screens that add more information to objects when viewed through a camera, and the latter involves headsets that display a fictional virtual world to their wearers. Both technologies appear to have made great strides of late, as shown by their commercialisation

73. For more details see www.mx3d.com/projects/bridge-2/ and www.iconbuild.com/

74. Miller, J. (2018) *3D printing: What's the hype and hope about?* [article] Forbes, 25 July 2018.

75. Stack, T. (2018) Internet of Things (IoT) Data Continues to Explode Exponentially. Who Is Using That Data and How? [article] Cisco, 5 February 2018.

76. DHL *Internet of Things in Logistics*. Available: https://discover.dhl.com/content/dam/dhl/downloads/interim/full/dhl-trend-report-internet-of-things.pdf

77. Juang, M. (2018) *A new kind of auto insurance technology can lead to lower premiums, but it tracks your every move* [article] CNBC, 6 October 2018.

and growing list of use cases. Last year, Walmart filed a patent for a 'virtual showroom' that would see customers donning VR headsets and sensor-clad gloves to shop in a virtual replica of a store.[78] Microsoft recently secured a $480m contract with the US military to provide prototypes of its augmented reality headset, Hololens, which would help soldiers "detect, decide and engage before the enemy".[79] One could imagine AR and VR being used across every industry to train staff, aid maintenance operations, allow for virtual meetings, and open up new avenues for interacting with customers. But as with the other technologies discussed so far, there are still many creases to iron out before immersive technologies can reach maturity, particularly VR headsets.[80] Virtual worlds can be incredibly time consuming to create, while the headsets have been criticised for causing eye strain and sound disorientation.

Adoption and integration

Whether it is AI or robotics, distributed ledgers or autonomous vehicles, there are few technologies whose development is guaranteed. These uncertainties are enough on their own to make predicting the future of work enormously difficult. But to complicate matters further, we cannot be sure of which technologies will be commercialised and adopted, and at what pace and scale, even if they have proven effective behind the closed doors of research labs.

On the one hand, we can see that a raft of new companies have emerged in recent years to sell and deploy new innovations. Some of them we have already heard in this report, such as Percolata (workforce scheduling software), Iron Ox (robotic farming equipment), Provenance (blockchain for supply chain management) and MX3D (additive manufacturing of metal infrastructure). We can also see corporates making use of new technologies in day to day operations. McDonald's say it is installing 1,000 self-ordering kiosks in its restaurants every quarter, while Amazon reportedly has plans to launch 3,000 cashier-less grocery stores.81 Other signs, however, suggests that the adoption of some technologies may be achingly slow and confined to a narrow group of firms. Previous RSA research found that only one in seven UK business leaders were investing in AI and/or robotics or soon planned to.[82] Elsewhere, the ONS found that just 19 percent of Britons believe their job has changed as a result of new software being introduced to their workplace in the last 12 months.[83]

Whether future adoption of technology will be high or low, broad or narrow, will depend on several factors. One of these is the **public's attitude towards technology**. Sometimes, as was the case with smart phones and now with AI powered voice assistants like Amazon's Alexa, new

78. O'Shea, D. (2018) *Walmart patent filings hint at VR shopping experience* [article] Retail Dive, 20 August 2018.

79. Binder, M. (2018) ***Microsoft signs $480 million HoloLens contract with U.S. military to 'increase lethality'*** **[article] Mashable UK, 29 November 2018.**

80. Pettey, C. (2018) *3 reasons why VR and AR are slow to take off* [article] Gartner, 6 September 2018.

81. Thomas, L. (2018) *Amazon is considering opening as many as 3,000 cashierless stores by 2021, report says* [article] CNBC, 19 Sep 2018.

82. Dellot, B. and Wallace-Stephens, F. (2017) *The Age of Automation*. London: RSA.

83. Corfield, G. (2018) *Almost 1 in 3 Brits think they lack computer skills to do their jobs well* [article] The Register, 7 August 2018.

innovations can be enthusiastically embraced by consumers and diffuse rapidly throughout the economy. But there is always the chance that people will find no use for a technology or, worse, actively move against it. Waymo's self-driving cars, for example, have been vandalised numerous times in the city of Phoenix where it is being tested.[84] According to local newspaper Arizona Central, cars have had rocks hurled at them, had their tyres slashed, and been forced off the road by other drivers. Similarly, a security guard robot in San Francisco was allegedly harassed by locals who thought its real purpose was to target homeless people.[85] How much the public pushes against technology will depend partly on their innate values but also on whether they think they will win or lose from technological change. Recent drone incidents at airports, for instance, are unlikely to have warmed the public to these machines.

Another factor affecting the adoption of technology is the attitude of workers and their ability to shape the investment strategies of their employers. Workers may accept the introduction of new technologies in their workplace, believing that it will make their jobs more interesting, enhance pay and improve working conditions. On the other hand, workers may fear for their jobs, their wages or their privacy, depending on the technology in question. Last year in Las Vegas, the Culinary Workers Union threatened to put 50,000 of its members on strike unless employers signed up to a deal that creates new protections against automation, including six months' severance pay for anyone who loses their job to a machine.[86] Closer to home, the ASLEF union for train drivers threatened "all out war" if Transport for London sought to introduce driverless trains on the Underground.[87] Workers within tech companies may also stymie the roll out of technologies. Last year, 650 staff at Salesforce protested against the company's contracts with the US Customs and Border Protection Agency, while Google's employees criticised the company for its dealings with the Pentagon.[88]

A third factor to consider is regulation, which may be influenced by worker and consumer attitudes to technology. The EU's General Data Protection Regulation (GDPR) has already introduced several measures that may hinder the take up of AI and other data driven technologies. Among the protections it establishes is a right for individuals to know the 'logic' behind any significant decision that affects them and which has been automated. Some say this rule will cause problems for organisations that deploy 'black box' algorithms, where it is difficult to determine how a decision has been arrived at. So far, GDPR's implementation has been relatively painless, and over time may even increase the public's trust in digital technologies. But further regulation may be on the cards if the government sees new risks or deems self-regulation to be insufficient. 3D printers may come under closer scrutiny if they are seen to compromise IP rights, while self-driving cars could be banned outright to prevent

84. Randazzo, R. (2018) *A slashed tire, a pointed gun, bullies on the road: Why do Waymo self-driving vans get so much hate?* [article] AZ Central, 14 December 2018.

85. Marx, P. (2018) *Learning to love robots* [article] The New Yorker, 26 November 2018.

86. Merchant, B. (2018) *This was the year the robot takeover of service jobs began* [article] Gizmodo, 20 December 2018.

87. BBC News (2014) *Driverless tube trains: Unions vow 'war' over plan* [article] 28 February, 2014.

88. Conger, K. and Wakabayashi, D. (2018) *Google Employees Protest Secret Work on Censored Search Engine for China* [article] The New York Times, 16 August 2018.

widespread job losses. Platforms, too, may find that regulation curtails their expansion. New York City last year introduced a minimum wage for ride hailing drivers, undermining the financial viability of Uber and other platforms.[89]

The depth and breadth of technological adoption will also be conditioned by business models and organisational readiness. It may be that the cost of some technologies falls rapidly as time passes, such that they become available to the smallest of firms as well as the largest. Moreover, if real wages in the UK continue to rise, high labour costs may create an incentive to invest in new software and hardware. Although the UK has experienced almost a decade of stagnant real wage growth, earnings have recently picked up pace and are growing at their fastest rate since 2008.[90] Competitive instincts may also speed up tech integration, as firms worry about losing out to rivals. Yet organisations will have to battle with inertia and the natural instinct to prioritise today's challenges over tomorrow's potential, what Clayton Christensen calls the 'innovator's dilemma'. Even when organisations commit to adopting new technologies, they may find it takes time to upskill staff in how to use them, or to bring in outside expertise. One estimate puts the number of people who can solve 'serious' AI problems at fewer than 10,000 globally.[91]

2. Non-tech uncertainties

Technology will alter the workplace in one way or another over the coming years, but to what extent is unknown. Even if machines develop at break neck speed, there is no guarantee they will be adopted far and wide. Some technologies could be blocked by hands-on regulators, overlooked by indifferent consumers or ignored by harried business leaders distracted with short-term concerns. Yet as noted as the outset of this report, technology is not the only force that will shape the future workplace. Also important will be the health of the global economy, the extent of union power and the level of net migration to the UK. Among the non-tech related uncertainties are:

- **The global economy:** It is barely a decade since the 2008 financial crisis, but pundits are already pointing to dark clouds on the horizon. An economic slowdown in China, a protectionist regime in the US, the UK's disorderly exit of the EU – all are potential causes of a recession. With global debt levels at new highs, a small downturn could easily turn into a deep crash as firms go under and Western governments tighten already squeezed public budgets. Still, the IMF claims the financial system is better and more intensively supervised than before the 2008 crisis.
- **Regional imbalances:** Another uncertainty is the degree to which

89. Ghaffray, S. (2018) *New York City has set the nation's first minimum pay rate for Uber and Lyft drivers* [article] Recode, 4 December 2018.

90. Inman, P. (2019) *UK pay growth surges as employment hits record high* [article] The Guardian, 22 January 2019.

91. McKinsey Global Institute (2018) *The promise and challenge of the age of artificial intelligence.*

growth will be concentrated in London and the South East, which would in turn influence the distribution of good jobs across the country. As it stands, all but two core cities outside London are below the national average in output per head.[92] It is difficult to imagine London being toppled from the top of the regional league table. However, its relative dominance may slide. Recent data shows Londoners are moving away from the city at their fastest rate since 2007.[93] The devolution of powers to regional governments is also starting to bear fruit, with northern unitary authorities like Greater Manchester seeing a surge in outside investment.

- **Net migration:** Will net migration to the UK rise or fall in the years ahead? Many expect the UK's departure from the EU to stem the flow of workers arriving from overseas, especially as the government's new immigration policy would introduce stricter entry requirements for low-skilled workers.[94] Other forces, however, may counteract the impact of Brexit, for example climate change, which may result in higher migration if people's livelihoods elsewhere are put in jeopardy by natural disasters. Either way, migration will have consequences for our domestic workforce. High levels of migration could lead to more competition for jobs and thus keep a lid on wages, or it could raise consumer demand and spur economic growth.[95]
- **Market concentration:** Where sectors are dominated by a handful of firms, workers may find themselves with less bargaining power to seek higher wages.[96] There appears to have been a trend of market concentration in many sectors. Amazon, for example, now accounts for a third of online sales in the UK.[97] But as difficult as it is to believe, today's Goliaths may eventually be toppled. Of the top 1 percent of superstar firms today, two thirds were not in the top 1 percent a decade ago.[98] Whether behemoths will be replaced with other behemoths, or have their market share distributed among smaller rivals, is an open question.
- **Worker voice:** The fate of workers is intimately tied to their capacity to bargain for fairer terms. But for the past four decades, union membership has been in free fall. In the 1970s, half of UK workers were signed up to a union. Today the figure is just a fifth.[99] Yet while traditional unions may never relive their heyday of the 1970s, some are beginning to experiment with new approaches. Community, for example, has reoriented itself as a union for the self-employed, and in partnership with

92. Jones, R. (2017) *The UK has the most regionally unbalanced economy in Europe. Time for change.* [article] The Guardian, 1 November 2017.

93. Press Association (2018) *Londoners buy £30bn worth of property outside capital, the most since 2007* [article] The Guardian, 26 December 2018.

94. Warrell, H. (2018) *How UK's post-Brexit immigration regime would work* [article] The Financial Times, 2 October 2018.

95. Ruhs, M. and Vargas-Silva, C. (2018) *The labour market effects of immigration*. The Migration Observatory a the University of Oxford.

96. The Economist (2018) *Companies appear to be gaining market share* [article] 7 July 2018.

97. Harris, J. (2018) *Amazon v the high street* [article] The Guardian, 11 October 2018.

98. Manyika, J. et al. (2018) *What's driving superstar companies, industries, and cities* [article] Harvard Business Review, 25 October 2018.

99. Kelly, G. (2017) *Rebooting the rank and file: why there's still hope for the unions* [article] Prospect, 9 November 2017.

the coworking space IndyCube now offers affordable invoice factoring to its members.[100] Alternative vehicles for worker voice are also emerging, for instance Organise, a digital platform that orchestrates single-issue campaigns.

- **Attitudes to work:** In a sign that society may be shedding its protestant work ethic, there have been growing calls in recent months for a four day working week, with the TUC making the idea a major goal for the 21st century.[101] 'Post workists' like Nick Srnicek and David Graeber claim people are becoming more resistant to work, which in their view lacks meaning and purpose.[102] However, there is a danger of overstating the backlash against work. Indeed, a British Social Attitudes Survey found that twice as many people in 2015 as in 1989 strongly agreed they would enjoy having a job even if their financial circumstances did not require it.[103]
- **Workforce strategies:** A final uncertainty is how employers will engage with their workers. Will we see the continued atomisation of the organisation, or will firms rein in their use of contingent contracts? Many believe the rise of atypical work like zero-hour contracts is guaranteed, an inevitable consequence of firms looking for any way to drive up profits. Last year, Uber announced plans to launch a new platform called UberWorks, which will allow businesses to hire short-term staff, from security guards to waiters and waitresses.[104] But these trends could equally fizzle out in time, particularly if their roots lie in the last economic downturn. The number of workers on zero hours is, in fact, beginning to fall, while at the same time the number of workers in full time employment is growing.

In this chapter, we have seen that the future of work will be determined by more factors than the technical progress of artificial intelligence or robotics. Will regulators clamp down on technology, or will they let it develop unbridled? Will trade unions continue to dwindle in size and stature, or will they see a renaissance? Will people deepen their moral attachment to work, or will they seek out a different way of life that prizes leisure time over virtuous toil? All of these are open questions, contrary to what some pundits would have us believe.

In the next chapter, we weave these critical uncertainties together into four overarching scenarios: The Big Tech Economy, the Precision Economy, the Exodus Economy and the Empathy Economy.

100. For more information see www.indycube.community

101. Kentish, B. (2018) *Give workers four-day week and more pay, unions urge businesses* [article] The Independent, 9 September 2018.

102. Graeber, D. (2018) *Bullshit Jobs*. Penguin; and Srnicek, N. and Williams, A. (2015) *Inventing the Future*. Verso Books.

103. NatCen (2016) British Social Attitudes Survey 33.

104. O'Kane, S. (2018) *Uber is testing an on-demand staffing business called Uber Works* [article] The Verge, 18 October 2018.

The four futures

Choosing our scenarios

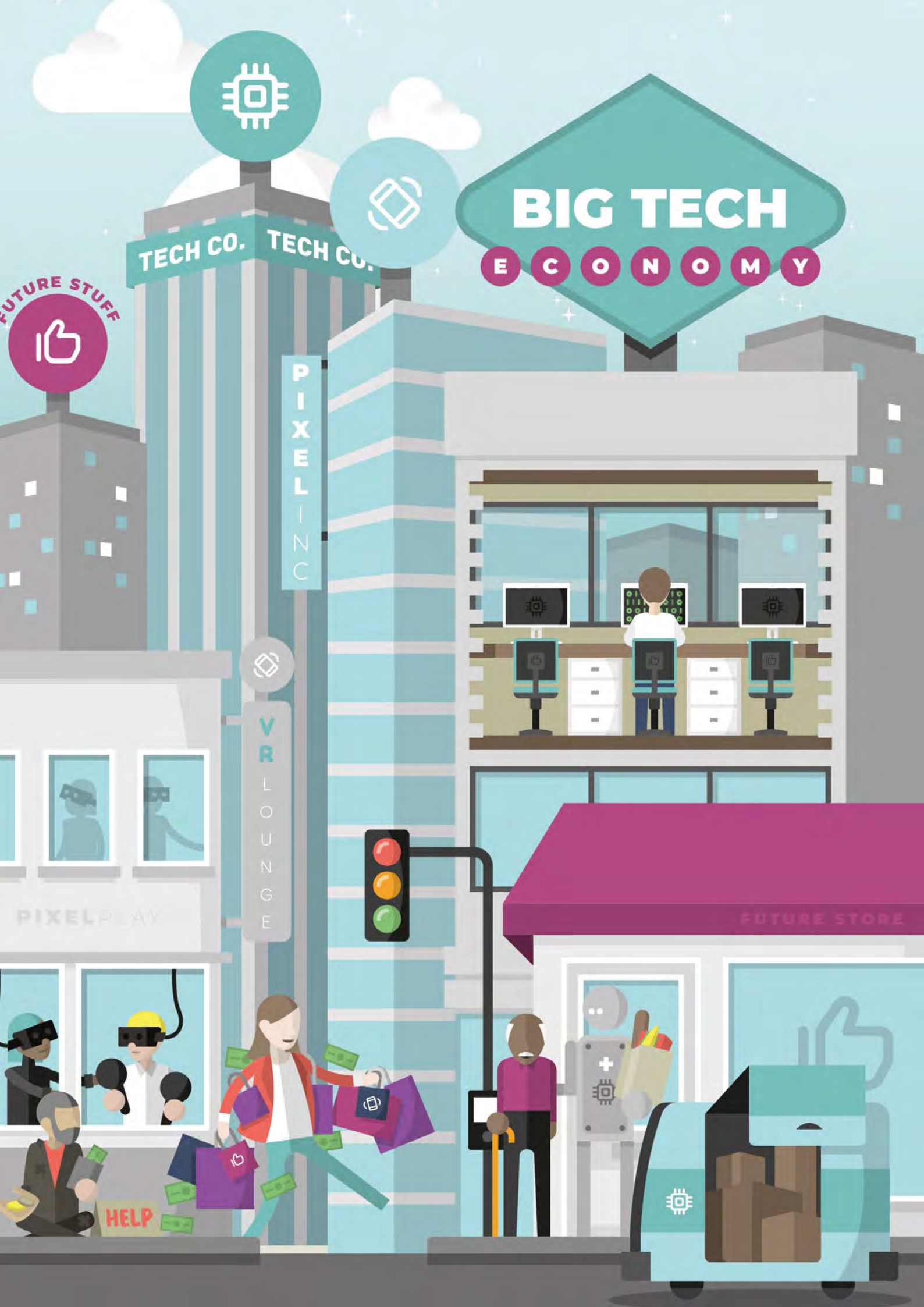
Having identified the critical uncertainties for the future of work, our next task was to create a range of projections against each, to inform the construction of our scenarios; and then to identify which combinations of these could underpin each narrative. One can think of each uncertainty as a dial, and a projection as the level at which it is set. One dial, for example, may point to economic stagnation while another may refer to a slowdown in technological adoption. In isolation, these dials and the levels at which they are set mean very little. However, when combined they create a distinct and detailed narrative for the future of work. Experimenting with several combinations of dial settings led us to 12 initial scenarios, which were then whittled down to the four most compelling: the Big Tech, Precision, Exodus and Empathy Economies.

In drafting these scenarios, we have extrapolated on some trends that are already in development today. However, we have also sought to push the boundaries of people's imaginations and include novel possibilities, new occupations, new business models, new applications of technology, new threats and new opportunities. The rest of this chapter gives a detailed account of each scenario, its promises and its perils, its winners and its losers. As we shall see in the next chapter, how workers ultimately fare in each scenario is not set in stone but rather can be shaped with the right policies and practices.

The Big Tech Economy

2035 is the Age of the Giants. Breakthroughs in computing power and machine learning techniques, in combination with an unfathomable amount of data produced by a worldwide network of IoT devices have provided the conditions for stunning leaps ahead in integrated technologies. Increasing computing power is the technological trend that powers all others. Though some doubted that Moore's law of exponential growth could continue, breakthroughs such as the quantum chip ensured it did; the pocket devices of the 2030s outmatch the supercomputers of the 2010s. Over time, even the trickiest technical problems yield to the sheer strength of computers, and the promises of the techno-dreamers all come to pass. Self-driving buses, vans and bin lorries have reserved lanes in major cities. Versatile robots, capable of complex tasks and human interaction, are ubiquitous, particularly in retail, service and healthcare environments.

The technology powering this transformation is proprietary and highly concentrated. In the 2020s the giants of Silicon Valley, along with a new cohort of Chinese tech behemoths, complete their capture of the technological arena. New technologies and would-be competitors are either


BIG TECH
ECONOMY
TECH CO.
TECH CO.
FUTURE STUFF
PIXEL INC
VR LOUNGE
PIXELPLAY
FUTURE STORE
HELP

crushed or acquired, in a winner-takes-all global economy now beyond the control of national regulatory action. The Giants steadily enter new sectors. Apple is the second biggest provider in a largely privatised health service. For small civil cases, Google Lawyer represents as many clients as do traditional solicitors. The UK economy enjoys unprecedented productivity. However less and less of the wealth generated remains in the UK, as multinational companies continue to stay comfortably ahead of national tax regimes.

Even the sectors where the Giants don't actively compete still experience massive technological disruption, as businesses of all sizes find themselves able to deploy radical technologies (under license) relatively cheaply. Labour-displacing tech sweeps through the economy, displacing blue- and white-collar work alike. This time, the robots really did take our jobs. Workers clock on average 20 hours a week, though stability is hard to come by for some. In the main, an increasingly atomised workforce competes for piecemeal work which cannot be automated or offshored.

However, a minority of workers have never had it so good. Those with the most in-demand technical capabilities command excellent pay and working conditions, as do soft-skilled professionals in and around the hyper-productive tech sector. The demand for skilled software developers and engineers has risen steadily (though not nearly enough to replace the jobs lost). The rapid pace of technology means that for this group in particular, reskilling is key to staying at the top of the pile. The other winners are a similarly small number of talented scrum-masters, coaches and transformation specialists, trading on their '4th industrial revolution' skillsets. Flexible schedules, self-organising practices and remote working, enhanced by VR communication, are the norm for the Big Tech Economy's winners.

As the demand for labour evaporates, the traditional protestant value of dignity through work cannot sustain, and the question of meaning and purpose takes centre stage. However, this manifests from the bottom and the top in very different ways. Highly-skilled workers are more invested than ever in their work, and increasingly expect to find fulfilment and purpose in their working lives. This luxury feels a long way away for the large swathes of low-skilled and insecure workers, who conversely feel ever less invested in work and look to find purpose in their time outside the workplace. Community, voluntary and civic movements see a sharp increase in participation.

The decades-long trend of a steadily urbanising workforce levels off. Communication capabilities unlocked by nationwide 5G coverage, virtual and augmented reality mean that remote, virtual teams are commonplace. Many knowledge workers take this opportunity to escape the city for quieter, cheaper surroundings, and small town and village communities feel the effect of young, affluent arrivals. Local economies rarely manage to keep this wealth local, however; local high streets have all but disappeared to online retail and fully-automated delivery systems (delivery drones serving the most remote areas).

Escaping the city isn't an option for those still trading physical work on ad-hoc task platforms, where being in close physical proximity to sources of work is essential. Wealth inequality, in cities especially, is stark. The cost of living is eased, at least, by a technological revolution in

construction, where a combination of additive manufacturing, modular construction and building robots enable high density housing to be built quickly and cheaply, finally pushing down UK property and rental costs.

The 2020s sees a rear-guard action for workers' rights as the vast majority realised they may be on the losing side of the emerging trends. However neither unions, nor a considerable political will can cut through. Collective strike action is rendered toothless by the ease of automation and consequent reduction in the value of most labour. Eventually, unions pivot their offer to predominantly providing services and support for members, rather than adversarial collective action. Economic insecurity translates into a broad political will to action, and some major wins are delivered for workers: 'uberization' of work is curtailed and eventually rolled back, and the minimum wage raised significantly. But the brutal reality remains that many are simply left without enough work. Public opinion towards tech and tech companies remains fairly upbeat, however. Public backlash against the Giants in particular is kept in check by well-funded lobbying and public relations operations (including acquisition of major media outlets) alongside high-visibility social programmes.

One group of technologies fail to live up to expectations: the block-chain, and other distributive, decentralising technologies, deployed only in as far as they can be used to automate sections of the finance and legal systems. Beyond this, the tech Giants, highly incentivised to maintain their hold on user data, fiercely resist the rise of alternative, decentralised digital goods and services. Such ideologically-driven alternatives spring up from time to time but with limited interest, completely outmatched for technical superiority and user experience. Faced with the offer of ever-better goods and services in exchange for ceding data and power, consumers overwhelmingly do so.

Society finds an equilibrium. Extreme inequality and economic insecurity is tempered by obvious and widely-felt lifts in living standards: people spend their considerable leisure time pursuing purposeful projects, or else taking advantage of the huge advances in consumer goods, entertainment, and free-to-use everyday services. And there is no sign of slowing in the race to the next dazzling technological leap.

Recap of The Big Tech Economy

- Technological breakthroughs come thick and fast.
- Automation eliminates cognitive and non-cognitive, routine and non-routine roles.
- Tech giants reap the greatest rewards, hoovering up profits and transferring them overseas.
- Jobs are in short supply, with a 20 hour working week the norm.
- Workers are too weakened to take a stand, while tech giants stifle dissent with well-oiled PR machines.
- Tech developments hold out the promise of keeping everybody suitably fed, sheltered and entertained.

The Precision Economy

In the years leading up to 2035, billions of Internet of Things (IoT) devices are gradually installed across society. Virtually every aspect of the economy is now monitored with precision and this has enabled businesses to hyper-efficiently allocate resources.

Machine learning plays a critical role in helping organisations to make decisions on their increasingly large pools of data. But there has been little in the way of significant improvements in this technology. Deep learning reached an impasse early in the 2020s, while other experiments in Artificial Intelligence (AI) programming failed to bear fruit. This has stymied the development of other technologies, including robotics, which is limited to manufacturing and other predictable environments. Ambitions to develop fully autonomous vehicles have been abandoned after several failed attempts to meet road safety standards, while additive manufacturing proved incapable of producing at scale anything beyond single material items.

Blockchain and smart contracts, on the other hand, have become more useful thanks to the prevalence of connected devices. Distributed ledger technology is now used to facilitate transactions and maintain records in many sectors. And its development has proven crucial in addressing cybersecurity risks relating to IoT, especially after a series of high-profile breaches in the early 2020s that some expected to leave the technology dead in the water.

In some ways, The Precision Economy does not appear markedly different to 2019. Like then, IoT sensors are contained within the things people buy and the buildings they work in, and the extraordinary technologies promised to us by 20th century science fiction are still out of reach. But our towns and cities have become much 'smarter' and this has made life more convenient. Homes connected to e-commerce accounts automatically replenish household essentials. Transport authorities deliver personalized bus services based on GPS data from smartphones. And the quantified-self movement goes mainstream. Wearables used to determine life insurance policy premiums are now widely adopted.

A relatively buoyant UK economy has meant that businesses across different sectors of the economy have been able to invest in these technologies. From supermarkets to energy companies, banks to clothing chains, businesses have installed sensors across their supply chains, enabling them to spot the potential for vast efficiency improvements. This in turn has enabled them to fend off competition from the tech giants of Silicon Valley and Shenzhen. With IoT sensors costing token amounts, and there being little in the way of expensive hardware to purchase, tech behemoths have few outlets for the piles of cash they have built up over the years. There remains an overall trend towards market concentration, albeit one where incumbent large firms are the 'winners who take most'. Meanwhile the Chinese hardware firms developing this infrastructure have seen their valuations skyrocket.

The impacts of automation are modest and mostly contained to routine occupations. Administrative roles have experienced the greatest decline, with blockchain and smart contracts eliminating many back-office jobs in sectors like finance, insurance and real estate. Manual workers in industries such as warehousing now handle only the most dexterous of


PRECISION
ECONOMY

tasks, assisted by robots that are responsible for the bulk of picking and packing. Jobs that involve creativity, caring or complex problem solving remain mostly untouched in their task composition. Managerial roles continue to experience growth, alongside newer occupations such as big data analysts, behavioural scientists, gamification experts and online reputation managers.

However, jobs are increasingly subject to algorithmic management and workplace monitoring. In retail and hospitality, in-store sensors are widely used to collect information on footfall while wearables are used to track staff activity, including time spent inactive and sales conversions. Manager-analysts review metrics following shift completion and ratings are assigned based on a combination of hard data and subjective appraisals (1 to 5 stars). In the Precision Economy ratings are pervasive, and this system is supported by many workers who believe they will benefit from performance related pay, enhanced opportunities for progression and a crackdown on their freeriding co-workers.

Equipped with predictive algorithms and real time organisational data, employers embrace on-demand labour strategies. Waves of 'uberisation' ripple across the economy as gig working patterns become the norm in sectors such as healthcare and retail. As the gig economy grows, more types of platform emerge, many with entry requirements and an air of exclusivity. At one end is Finest, with gigs only for the brightest minds whose performance and empathy metrics pass a high threshold. At the other is Worka, where work is available to anyone desperate enough to do mucky and miserable tasks such as content moderation on social media.

The winners of the Precision Economy are those with 'in demand' talents who can more optimally allocate their labour. Work-life balance and pay are improved for some professionals, as doctors and nurses are now able to charge surge prices for anti-social hours. And even in low paid sectors, workers with high ratings and the right mix of digital badges – credentials acquired on-the-job that demonstrate excellence in customer service and other relevant skills – get priority shift scheduling and command a modest pay premium. Younger workers find it easier to navigate this environment, and in some cases, climb more quickly up the rungs of the career ladder. This comes at the expense of their older co-workers who have struggled to adapt. Under the intense gaze of their employers, many workers turn to cognitive enhancing drugs to improve their performance and demonstrate their worth.

Relatively low unemployment rates mask hidden slack in the labour market. Average hours worked have fallen to 25 per week with as many as one in three workers reporting that they want to work more hours in their current job, across any of the handful of employers they usually work for. In large segments of the labour market, workers are left to battle it out for piecemeal work that doesn't pay well, offers little control over working hours and gives minimal discretion over how to carry out tasks. Competition for shifts via apps has reduced workers' bargaining power, placed downward pressure on wages and created a culture of fear and subordination. Clever UX, gamification and the promise of upward mobility keeps many people logged on.

Society becomes increasingly divided. While some remain critical of what they regard as 'surveillance capitalism', others embrace technology,

believing that the gains exceed the risks. Consumers happily trade their data for cheaper prices, greater convenience and more tailored products and services. And big data has proven to have wider positive social and environment impacts. People are provided with insights on how to nudge themselves towards healthier lifestyles, based on their unique physiology. Air quality improves, with cities more able to identify and sanction major contributors to pollution. And more efficient resource use has gone some way to mitigate climate change risks for future generations. The Precision Economy may have squeezed more out of workers, but so too has it reined in waste and excess.

Recap of The Precision Economy

- Technology advances at a steady pace, but the most ambitious projects are abandoned.
- Businesses turn to IoT sensors and big data to create value and spot opportunities for efficiency gains.
- Automation is modest, with most jobs that involve creativity or dexterity secure for the time being.
- But workers are subject to a new level of algorithmic oversight, with ratings systems now pervasive.
- On demand labour grows as firms have a better picture of who they need, at what times and at what skill level.
- Extensive monitoring of people and objects brings about improvements in healthcare, policing and environmental management.

The Exodus Economy

A severe economic recession on the scale of the 2008 crash takes the world by surprise. Growing household debt, a slowdown in China, rising protectionism and an oil shock stemming from political unrest in the Middle East combine to send the global economy into a tailspin. With interest rates already at rock bottom, there is little scope for using monetary policy to keep consumer spending stable. With national political agendas increasingly focussed inwards, political will is lacking to mount an ambitious international response to the crisis. The relationship between China and the US remains tense, while the UK is slow to rebuild bridges with the rest of Europe. Sub-Saharan African economies see record growth rates, but not enough to counter the dip in Chinese production and keep Western economies afloat.

Unemployment soars, reaching nearly one in ten workers. Most of the job losses are felt in sectors underpinned by disposable spending and in industries where margins are already wafer thin (eg retail and hospitality). The government, faced with plummeting tax receipts, seeks to balance the books through a further round of austerity in the public sector, leading many middle-skilled workers to lose their jobs in healthcare, policing, education and central government. Contingent working practices, which had dissipated in the tight labour market of the early 2020s, make a comeback as firms try to save costs and keep their heads above the water. Agency work, zero-hour contracts and self-employment all edge upwards.


EXODUS
ECONOMY
CO-OP CENTRE
!
CLOSED
FOR SALE
FOR SALE
£££££ CRASH
ZHC
ZHC
OPEN

With the bargaining power of workers weakened by high unemployment, firms begin to ask more of their staff: higher workloads, weekend working, wage freezes and, occasionally, wage cuts.

The economic rupture causes technological progress to falter. Firms have little incentive to invest in automation given that wages have flatlined, and even if they did, many would struggle to find the funds to bring in new technology. The much vaunted fourth industrial revolution envisaged by the Silicon Valley gadflies of 2019 is contained to a handful of the most gilded professions and sectors. Most firms have only meagre technology budgets, which they spend on tried and tested innovations, avoiding high risk hardware (eg robotics, drones and autonomous vehicles) in favour of low risk software (eg machine learning) that can be rented on demand. 'Fauxtomation' becomes an increasingly popular term, as businesses seek to retain a veneer of innovation while behind the scenes making extensive use of cheap human labour.

Domestic, middle-sized firms struggle to weather the economic storm. Many household names, once captains of industry in the 20th century, go under or are subsumed and taken over in the flurry of mergers and acquisitions that often follow recessions. Markets become increasingly concentrated, with sectors including retail, energy, logistics and entertainment morphing into oligopolies and duopolies. Tech giants seize the opportunity to enter new markets by buying out weakened rivals. Apple becomes a major player in healthcare, Google in transport, Facebook in banking and Amazon in what is left of bricks and mortar retail. Chinese behemoths similarly make an entrance into UK markets, with Alibaba, TenCent and Bank of China becoming household names. To make matters worse, domestic firms must cope with a barrage of increasingly sophisticated cybersecurity attacks from overseas.

These changes conspire to trap UK workers in a low-skilled, low paid and low productivity paradigm. Although many are given a reprieve from the threat of automation, the quality and nature of work take a turn for the worse. Wage growth stalls, contracts become more contingent, and work is increasingly commoditised. Having only just left a decade of dearth from 2008 to 2018, people's patience with the prevailing economic system starts to wear thin. This is the age of resentment. Resentment at tech companies for sitting on enormous wealth as the rest of world scrapes by. Resentment at national leaders for cutting back on public services when waiting lists are already stretched from a burgeoning and ageing population. Resentment at Chinese investors who are buying up the UK's once prestigious businesses. And resentment at technology itself for being the source of oppression, surveillance and cyber threats.

Some channel this anger into protest. Strikes become more common, aided by a new breed of alternative union with a mission to represent the interests of low paid workers. Mass walkouts and road blockages bring many industries grinding to a halt, while collective 'log offs' by gig workers and endless battles in the courts frustrate the ambitions of tech platforms. Several platforms including Uber and Deliveroo fold in the UK, unable to find a viable long-term business model after their drivers and riders have their employment status reclassified. A second Occupy movement emerges, demanding a debt jubilee, job guarantees for all and an end to ubiquitous data collection. However, this time its ranks contain an

eclectic mix of protestors alongside the usual anti-capitalist ideologues: middle class professionals, low paid millennials, and older workers whose pensions have plummeted in value.

Not everyone, however, chooses to protest. Some plough their energy into creating alternative economic institutions, from platform cooperatives to consumer owned banks to community-owned energy companies. More people leave the big cities in search of a different lifestyle, one more rooted in self-sufficiency and shaped by an awareness of our environmental limits. Some view this as a journey they have been forced to take against their will. Others, however, view the economic downturn as the push they needed to break free from jobs they rarely enjoyed, living a lifestyle that in the words of economist Tim Jackson saw them spending 'money [they] don't have, on things [they] don't need, to create impressions that won't last, on people [they] don't care about'.[105] Those who join this exodus, in both the literal and figurative senses, find themselves materially poorer but spiritually richer, with more time for leisure and caring for loved ones. The exodus also breathes new life into UK regions outside of London and the South East, as an educated and talented workforce sets out for a more enriching and meaningful life elsewhere.

Recap of The Exodus Economy

- A severe economic crisis raises unemployment and leads to a new round of austerity measures.
- Contingent working practices become commonplace as firms try to cut costs and stave off bankruptcy.
- Investment in innovation drops off a cliff as businesses prioritise short-term concerns.
- Automation is therefore limited, but this keeps the UK economy uncompetitive and unproductive.
- Weakened domestic firms merge in a bid to find economies of scale, or are bought out from overseas investors.
- Disgruntled with ebbing living standards, many workers take to the streets, bringing the economy to a standstill.
- Others seek out a different way of living, leaving the cities in droves for a better life in rural areas.
- Those who take part in this exodus find themselves materially worse off but richer in other ways.

The Empathy Economy

Technological progress advances at a clip. Every year sees another breakthrough in machine learning and quantum computing, the general-purpose technologies that underpin many others. The promises made by Silicon Valley cheerleaders are duly delivered: autonomous vehicles begin to ferry passengers and goods on dedicated motorway lanes, algorithms deployed in healthcare lead to new treatments for previously intractable conditions, cashier-less stores pop up in every corner of the country,

105. Jackson, T. (2010) *An economic reality check* [TED talk] TEDGlobal. See: www.ted.com/talks/tim_jackson_s_economic_reality_check/transcript?language=en


EMPATHY
ECONOMY
OSTEO
OSCAR'S
HEIDI HUGS
MARTHA'S
BOUTIQUE

delivery drones operate in all but the most built up urban environments, and virtual reality seamlessly integrates into most workplaces, altering what it means to communicate and to entertain. Chinese and US tech companies lead the pack, but other nations find their industry niche, including the UK. Several influential tech companies emerge from our universities, which are now more attuned to the potential of turning raw innovation into viable commercial ventures.

During the early 2020s, these breakthroughs are welcomed as a sign of social and economic progress. Consumers are promised an abundance of cheap goods, while workers are told that a life of leisure is around the corner. But by the middle of the decade, feelings of excitement turn into trepidation as the threats posed by new technology become more apparent. Cyber-attacks on financial institutions compromise people's savings. Past transgressions exposed on social media undermine people's search for work. And the spread of platforms into more sectors further undermines job security. As the pain of a new machine age spreads, including among the middle classes, so public resentment grows. Acts of vandalism on technology become more commonplace, while populist parties offer assurances to outlaw the trading of US and Chinese firms in the UK. Tech companies face their own internal challenges, as employees participate in frequent walkouts and whistleblowing.

Faced with deepening public hostility, tech companies and their investors embark on a journey of soul-searching. Self-regulate or be regulated, is the ultimatum issued by the government. A series of public announcements and promises follow suit: to pay more in tax, to end contracts with military departments and political parties, to shelve the development of 'black box' algorithms, and to share valuable pools of training data with upstart competitors. Gig platforms commit to funding a suite of new protections for their workers and their service providers. Progressive investors, meanwhile, use their muscle to cajole any tech firm still reluctant to change their ways. Non-tech firms follow suit with similar commitments to steward technology responsibly. Business leaders outdo each other to claim their ethical tech credentials, including by allowing external audits of their datasets.

Technology continues to be deployed at scale. It automates, brokers, manages and digitises. But the worst effects are contained. Workers retain their privacy, hold onto their autonomy and continue to see real wage growth. Regular breakthroughs lead to extensive automation, including within cognitive and creative roles such as journalism, law, finance and govenment services. However, employers now work hand in hand with unions to deploy innovations on mutually beneficial terms, helping workers to navigate the tremors of technological disruption with retraining and unemployment insurance. Rather than squeeze, pressure and scrutinise workers, today's technology is applied to augment their capabilities, from VR being used by retail workers to role play customer interactions, to personal trainers using wearables to create bespoke training regimes for their clients.

A prosperous domestic tech industry ensures that the lion's share of innovation's spoils is retained in the UK. This, combined with a Fordist effort on the part of firms to keep workers employed, helps to stabilise consumer demand. Disposable income flows into sectors and services that

still retain strong interpersonal connections: care, education, entertainment, hospitality, tourism and other sectors underpinned by empathy, attention and a personal touch. While much of the job growth is seen in traditional occupations (eg care workers, teaching assistants, therapists and travel operators), several new job types emerge to meet consumer demand. Personal PR assistants, narrative specialists, friend strategists, digital detox planners, and social media infomoters become highly sought-after careers. Independent businesses thrive in this new economy by serving people's desire for the authentic and the artisan. Consumers do not struggle to find new outlets for their income.

Yet there is a dark underbelly to an economy driven by the empathic and the personal. Outside of care work, few empathy industries thrive in small towns and cities, which do not have the demand to support niche occupations, and whose tradeable industries (eg agriculture and manufacturing) have been gradually automated. Moreover, work can at times be emotionally exhausting, with empathy and emotion becoming increasingly commodified, and workers judged not only on their abilities but their personal brand. The need to be forever on message and attuned to other people's needs can be a struggle, especially when there is a disconnect between people's internal feelings and the external expressions expected of them. The Empathy Economy, it transpires, has many ominous features, including a glut of jobs that exist only to make other people feel good. Come 2035, there is no shortage of empathy. But whether it is genuine or manufactured is another question.

Recap of The Empathy Economy

- Technological breakthroughs are a regular occurrence, often coming from the UK's own tech scene.
- The public's attitude towards technology steadily turns sour as the risks become more apparent.
- Faced with a looming regulatory crackdown, tech companies decide to mend their ways and self-regulate.
- Automation is moderate as firms work with staff and unions to adopt technology on mutually beneficial terms.
- Profits in the main are retained in the UK, preventing consumer spending from dipping.
- People's disposable income flows into empathy sectors of care and education that are most resistant to automation.
- But this work can be emotionally demanding, with people required to manage one's emotions in service of boosting the feelings of others.

Table 1: Summary of the Four Futures of Work[106]

	The Big Tech Economy	The Precision Economy	The Exodus Economy	The Empathy Economy
Technological progress/adoption	High	Medium	Low	Medium
Job availability	Low	Medium	Low	High
Job fracturing	Medium	High	Medium	Low
Productivity growth	High	Medium	Low	Medium
Inequality	High	High	High	Medium
Economic growth	Medium	High	Low	Medium
Regional inequality	High	Medium	Medium	Medium
Market concentration	High	Medium	Medium	Low
Political unrest	Low	Medium	High	Low

106. By fracturing we mean the extent to which jobs are broken down into smaller chunks of work, or 'gigs'.

Good work, come what may

Readying for the reckoning(s)

At the outset of this report, we made the case that predictions are a flawed method for preparing for the future of work. Instead, we must look to scenario planning to help us ready workers for multiple eventualities. The last chapter outlined the results of our own exercise. We heard about the Big Tech Economy, where game-changing technological advances lead to mass automation but an abundance of cheap goods and services; the Precision Economy, where a proliferation of sensors and big data analysis cranks up the level of surveillance and gig work; the Exodus Economy, where an economic slowdown ushers in another prolonged period of austerity, leading people to seek out alternative ways of living; and the Empathy Economy, where self-regulation by the creators and users of technology results in a more harmonious labour market, with the greatest jobs growth coming from the hi-touch sectors of health care, education and entertainment.

But how can these scenarios be used to prepare us for the actual future that awaits? In this chapter, we look at the different interventions that could shield workers from the worst effects of each scenario, without diminishing the opportunities they present. Preparing for the Big Tech Economy, for example, could mean strengthening our competition policy to rein in the power of large companies, as well as scrutinising mergers and acquisitions more closely. Protecting workers from the Precision Economy, meanwhile, could require tighter controls on data collection and more rights for workers that use gig platforms. While many interventions will be relevant for each scenario, the urgency of applying them will vary. Giving workers a greater stake in assets will be helpful regardless of how the future plays out, but it will be essential if we find ourselves travelling down the route of the Big Tech Economy, where jobs are few and far between and people need other sources of income to get by. Table 2 highlights the most urgent interventions for each scenario.

If we continue to ignore the possibility of alternative futures, and talk only of mass automation versus business as usual, we risk putting the livelihoods of workers in jeopardy. Rising inequality, growing suppression in the workplace, stagnant wages, heightened discrimination and bias, and deepening geographic division could all come to pass if we do not become more responsible custodians of technology. Experience tells us we cannot be complacent. Globalisation, another major force to rock our labour market, was badly managed from the 1980s onwards. Just as today, we were told that a tremendous force was coming, that its effects

were inevitable, and that it would leave us all better off in the long run. Yet the reality was something else. Deindustrialisation wreaked havoc in manufacturing heartlands and whole communities were left behind, with the scars still on show today. Against this backdrop, it is little wonder people have limited faith that technological change will serve them well. A 2018 RSA/Populus survey found that just 6 percent of workers felt that as a group they would gain the most from the introduction of new technologies in the workplace.[107]

Yet we do have the power to steward technology in a more benevolent direction. Those who reject that technology can be anything but a force for destruction overlook the experience of our European neighbours. Germany is one of the most automated countries in the world, with industrial robot sales reaching 21,400 in 2017 compared to 2,300 in the UK.[108] But thanks to an impressive vocational education system and formidable industrial relations, it has managed to keep unemployment under 4 percent while maintaining strong real wage growth. A similar situation exists in Sweden, where powerful Job Security Councils retrain workers who are at risk of losing their job to machines. A survey undertaken by the EU Commission found that 80 percent of Swedes take a positive view of AI and robotics, compared with just 60 percent of UK citizens.[109]

The rest of this chapter looks at what it would take for the UK to become a country more confident in its use of technology, with a range of interventions at its disposal to pre-empt technological change and secure good work, come what may. In doing so, we look at the potential for policy and practice changes across the technological lifecycle, from the point where technology is created to the time it is deployed in a work setting. Our recommendations can be grouped into six broad categories, or 'conditions', each of which we explore in turn:

- **Richer debates:** How can we have a higher quality of conversation about what technology is capable of and what it could mean for workers?
- **Ethical technology:** How can we steward the creation of new technologies so that problems are nipped in the bud in the developing stages?
- **Robust lifelong learning:** How can we upskill the workforce on an ongoing basis, enabling them to evolve as their jobs evolve?
- **A 21st century safety net**: How can we renew our tax and welfare institutions so that the spoils of technological change are shared as widely as possible?
- **Strong worker voice:** How can we give workers greater say over how technology is deployed in their workplace and the wider economy?
- **Agile regulation:** How can regulation and regulators keep pace with a changing labour market and technological developments?

107. RSA/Populus survey of 1,114 UK workers (part time and full time). Field work undertaken 27-28 June 2018. Full results available in Dellot, B. and Wallace-Stephens, F. (2018) *Good work in an age of radical technologies*. London: RSA.

108. International Federation of Robotics (2018) *Executive summary: World robotics 2018 industrial robots*. IFR.

109. EU Commission (2017) *Attitudes towards the impact of digitisation and automation on daily life*.

Table 2: Pressing questions and priority interventions for each scenario

	Questions to address	Priority interventions
Big Tech Economy	▪ How can the power of tech giants be contained? ▪ How can we prevent unemployment from soaring? ▪ Can and should certain technologies be outlawed? ▪ How should we manage future mergers and acquisitions?	▪ Introduce a comprehensive technology sentry system. ▪ Give every worker a 'technological inheritance' through a UK sovereign wealth fund. ▪ Update competition law to reflect the needs of workers as well as consumers.
Precision Economy	▪ How can the contingent workforce (including the self-employed) be protected? ▪ How do we ensure worker monitoring is proportionate? ▪ How can we improve the collection, storage and use of worker data? ▪ How can worker rating systems be fair and transparent?	▪ Pilot Personal Learning Accounts (available to all workers). ▪ Establish a new welfare settlement for the self-employed. ▪ Clarify employment status law and strengthen the enforcement of worker rights. ▪ Introduce a new right to data portability (critical for platform work).
Exodus Economy	▪ How can the pace of technology development and adoption be accelerated? ▪ How can the migration of workers in search of jobs be facilitated? ▪ How can we promote alternative economic institutions and new union models? ▪ How can the unemployed and underemployed be supported?	▪ Address the flaws of Universal Credit and scale trials of Universal Basic Income. ▪ Amend legislation to make it easier to join a union (eg digital ballots). ▪ Promote alt union models built on 'new power' principles.
Empathy Economy	▪ How do we promote self-regulation among tech giants and firms using their technology? ▪ How can the growth of empathy sectors be facilitated? ▪ How do we prevent jobs in the empathy sectors from being commoditised? ▪ How can the emotional demands of labour be contained?	▪ Modernise recruitment practices in the tech sector. ▪ Introduce a Charter for Ethical Technology Investments. ▪ Establish a prize challenge for technology vetting tools. ▪ Establish a union dedicated to tech workers.

Richer debates

To make the right calls, decision makers need accurate information on what technology is capable of and how fast it is progressing. Yet today's media and thinktank coverage lacks depth and accuracy, being driven more by a desire to attract clicks than inform readers. A University of Oxford study looking at media articles on AI found that 60 percent of stories were focused on new industry products, while 12 percent referenced the technology entrepreneur, Elon Musk.[110] Just 16 percent of articles cited academic research. Without a richer public debate underpinned by robust research and high-quality journalism, the danger is that scarce resources will be misdirected to solving problems that are not pressing, while mounting challenges elsewhere are overlooked. We can already see that automation receives undue attention by policymakers, at the expense of other concerns such as bias in recruitment and scheduling algorithms. To promote more accurate intelligence, we propose:

- **Establish a Centre for Data Journalism**: Journalists hold significant sway over what the public and decision makers think about technology. However, cutbacks to specialist reporting mean that tech journalists are more stretched than ever. A new Centre for Data Journalism would offer free training to tech journalists, keeping them abreast of new innovations and upskilling them in investigative methods such as black box testing of algorithms. The Centre could offer bursaries to ex tech workers considering a career move into journalism, as well as coordinate an annual award for the best writing on different topics, including the future of work. the Centre would be a new independent body, though working closely with the BBC, as well as other relevant bodies such as the Alan Turing Institute, techUK and media platforms.
- **Launch a Future of Work Research Alliance between thinktanks and academics:** It is little use having diligent journalists if they themselves have limited access to high quality research. Several academic institutions and think tanks are exploring the impact of technology on the UK labour market, including the RSA's Future Work Centre. However, collaboration is rare, leading to a disjointed research field where studies are often duplicated. The ESRC should launch a Future of Work Research Alliance, which would: align the work programmes of universities and think-tanks, share baseline data (eg raw survey data from thinktank polling), promote common definitions and taxonomies, support the creation of core research tools (eg a UK version of O*Net to map the skills required for different occupations), and provide a forum for researchers to meet with journalists.
- **Upgrade measurements to track good work** – The government, in its response to Matthew Taylor's Review of Modern Employment, recently accepted responsibility for improving the quality of work. However, insufficient measurements exist

110. Brennen, J. S. and Nielsen, R. K. (2018) *An Industry-Led Debate: How UK Media Cover Artificial Intelligence*. Oxford Martin School.

for understanding whether this is being achieved. As a result, the media tends to report only on levels of unemployment and wages, and occasionally the size of the contingent workforce. In partnership with Carnegie UK, the RSA has proposed a suite of new measurements that would paint a richer a picture of the modern world of work and help decision-makers channel limited resources to the right places.[111] Among our 18 recommended measurements are satisfaction with pay, relationships with line managers, and employee involvement in decision-making. While the government has muted its interest in these measurements, we would urge them to commit to our proposals without delay.

Ethical technology

Much of the public commentary on managing technological change focuses on how to resolve problems after technology has been deployed. Yet we can also intervene prior to and during the formation of technology, possibly even by halting the development of certain innovations. This requires us to distinguish between technologies that expand the capability of workers (eg machines that help healthcare workers to lift and carry patients) and those that merely extract from them without increasing their potential (eg monitoring devices that keep tabs on the movement of warehouse staff). Technology is more likely to be benevolent if the workers creating it are representative of the wider population, which they are currently not. Technology can also be steered in a more ethical direction by investors, who can choose to hold back cash or demand that rigorous tests are undertaken on machines before they are used 'in the wild'. While new tools have emerged for auditing technologies, more could be done to ensure they are used systematically across our economy. To promote more benevolent technology, we propose:

- **Modernise recruitment practices in the tech sector:** RSA analysis of government survey data shows that women make up just one in 20 new programmers and software developers.[112] The Royal Society, meanwhile, estimates that BAME groups are underrepresented at senior levels in the 'digital/IT sector'.[113] Improving diversity within tech firms would bring dividends not just for the public (since a workforce that mirrors society is more likely to create appropriate products for the whole of society), but also for the firm itself (with diversity improving business performance). One way to increase recruitment from marginalised groups is to implement blind testing of applicants and to partner with advocacy organisations like UKBlackTech. On a wider note, tech companies could give preference to applicants who have enrolled on ethical modules during their studies, which are now available at universities including Harvard, MIT and Cornell. A further step would be for tech companies to publicly

111. Carnegie UK and the RSA (2018) *Measuring good work*.

112. RSA analysis of Labour Force Survey data. 'New programmers and software developers' refers to the increase in jobs in this occupation type between 2010 and 2018. For more data see The RSA (2018) A Field Guide to the Future of Work. London: RSA.

113. House of Commons Science and Technology Committee (2016) Digital Skills Crisis.

disclose the make-up of their workforce, including demographic details and places of study.

- **Introduce a Charter for Ethical Technology Investments:** Investors are increasingly active in shaping the behaviour of tech firms. The head of New York City's Pension Fund, which controls a $1bn stake in Facebook, called on Mark Zuckerberg to step down because of the company's mishandling of user privacy. Similarly, Amazon shareholders recently called on the company to stop selling its facial recognition software to law enforcement agencies until the technology is proven safe. A Charter for Ethical Technology Investments would seek to mainstream this behaviour by setting out principles for how digital technology should be created and deployed, for example that rigorous tests are done prior to rollout and that regular audits are undertaken to assess the potential risks of technology on workers. These principles could then be woven into existing Environmental, Social and Governance (ESG) criteria, which socially minded investors use to screen potential investments. The PRI (Principles for Responsible Investment) group could take responsibility for orchestrating these reforms.
- **Establish a prize challenge for technology vetting tools:** We cannot have ethical technology if we do not have the tools to gauge its impact on workers. The good news is that academics, consultancies and tech companies are working on new auditing techniques, particularly for AI. Accenture, for example, has produced a new 'fairness tool' to help its customers identify and remove bias in algorithms.[114] Others have focused on making algorithms 'explainable', such that it is possible to understand why they arrive at the decisions they do.[115] Yet many of these tools are still nascent and underdeveloped. We recommend a consortium of partners – government, think tanks and tech companies – come together to establish a challenge prize that would spur more innovation in this space, particularly in under-served domains. The emphasis should be on creating tools that are easy to use and readily accessible to businesses of all sizes.

Robust lifelong learning

To the extent that technology eliminates, creates and transforms jobs, workers will need to find a way of reskilling themselves. In some cases, this will mean moving into hi-tech roles that involve creating, maintaining or explaining machines (eg machine learning engineers or cybersecurity professionals). In other cases, workers will be drawn into hi-touch positions, such as in caring and education. Equally, workers may not need to move roles but rather evolve as their current job takes on a different form.

114. Lomas, N. (2018) *Accenture wants to beat unfair AI with a professional toolkit* [article] TechCrunch, 6 September 2018.

115. See for example Wachter, S. (2018) *Making algorithms accountable and explainable: the need for a legal framework*. The University of Oxford.

Either way, a more robust lifelong learning programme will be necessary to help workers keep pace with changes wrought by technology. Personal Learning Accounts would give every worker, self-employed and employed alike, the funds they need to reskill. Yet we should be under no illusion that everyone will be able to enter a highly skilled profession. Low-skilled work is likely to persist in different forms, and we must therefore help workers to build careers without necessarily rising through the ranks. To promote robust lifelong learning, we propose:

- **Pilot Personal Learning Accounts:** Research by the Learning and Work Institute found that 40 percent of adults had not participated in learning in the three years prior to 2016.[116] One reason is likely to be a lack of funding, another the inflexibility of training support offered by employers. Personal Learning Accounts (PLAs) present a solution to these challenges. Already in operation in France, Singapore and several US states, PLAs give every worker a modest budget to spend on training courses, typically accredited by the government or trade unions. A UK system could be founded on the existing architecture of the Apprenticeship Levy, drawing on the same funding sources. Unlike the Levy, however, PLAs would put the onus on workers rather than employers to decide on training needs, and would be open to the self-employed as well as employees.
- **Professionalise low-skilled jobs through occupational licensing:** While many economic pundits comment on the need to re-skill workers, few acknowledge there will only ever be so many high-skilled jobs to go around. The reality is that low-skilled work will always be present, from care work to bar work. We therefore need to think about how we can craft a career around such roles, such that these workers see themselves as being in a profession. One way of doing this is by establishing a framework of digital badges that recognise soft skill development. Another is to introduce occupational licensing, which would require workers to prove their acumen through regular testing. This would bestow more status to jobs (as the taxi licence has done with London's black cab drivers) and potentially allow workers to charge more for their services. A study looking at the introduction of occupational licenses for security guards and nursery assistants found they have the potential to raise workers' earning power.[117]

A 21st century safety net

Technological change will have a material impact on the economic security of workers. Those with the skills to complement technology can expect higher wages in the future, while those in direct competition with machines should be prepared for wage stagnation. Some workers may

116. Learning and Work Institute (2016) *Power to the People: The case for personal learning accounts*. LWI.

117. Humphris, A. and Koumenta, M. (2015) *The effects of occupational licensing on employment, skills and quality: a case study of two occupations in the UK*.

be pushed out of work altogether, leading to financial penury during the period in which they are searching for alternative employment. To protect workers against these risks, we will need to strengthen our safety net and find a way of sharing the spoils of technological change more widely. In the short term, this will mean ironing out the faults of Universal Credit (UC), while in the medium term, we should continue to explore the potential of Universal Basic Income (UBI) through rigorous pilots. A modern safety net should also feature a special settlement for the self-employed (including gig workers), which would see them pay higher rates of National Insurance in return for more protections. To the extent that capital becomes more important as a source of income in our economy, we will also need to give workers a stake in the businesses and technology that are becoming more profitable, potentially through a Sovereign Wealth Fund. To create a 21st century safety net, we propose:

- **Scale trials of Universal Basic Income:** The UK is in the process of moving from Working Tax Credits to a new UC system of managing welfare payments. While we should continue to push for reforms to UC to ensure it is fit for purpose, we must also explore the potential for UBI as a long term replacement. Unlike UC, UBI creates few disincentives to work, with every citizen receiving the same benefit regardless of how much they earn. Nor does UBI come with a harsh conditionality regime that forces people into work of any kind, regardless of its suitability. The UK government in partnership with local authorities should roll out UBI pilots to test its impact on people's propensity to work, their wider wellbeing and other activities such as caring and volunteering.
- **Establish a new settlement for the self-employed:** one in seven UK workers are now self-employed, and this number may grow over the coming years, particularly if gig platforms become more prominent. A 21st century safety net will remain incomplete until it offers sufficient protections to this group. The government should, as far as possible, aim to give the self-employed the same protections as employees, for example full Statutory Maternity and Paternity Pay, and a fairer deal under UC. This will require the self-employed to pay a higher level of National Insurance in return. However, this would still leave the self-employed without Statutory Sick Pay, which is currently paid for by employers. To plug this remaining benefit gap, the government should consider a consumer transaction charge, which would levy a modest fee on every transaction between a consumer or business and a self-employed worker, with the funds being used to cover the costs of sick pay. For example, passengers using the services of a self-employed cab driver could be required to pay a 2 percent fee on every journey, totalling 30 pence for a £15 fare. Multiply this figure by 100 fares a week means £30 going into

a sick pay fund. This money could either be pooled among all workers or go into individual accounts. Washington State in the US is considering a similar charge under the moniker of 'portable benefits', with a legislative bill that is supported by Uber and the SEIU, a major union.[118]

- **Rebalance the burden of the UK's tax system:** A modern safety net must be financed through a fair and sustainable tax system. Some have called for a 'robot tax' to pay for new policies like UBI. But this is an impractical idea, not least because it is impossible to distinguish between machines that substitute for workers and those that augment them. Still, the underlying principle that capital should bear more of the burden for taxation over labour is a reasonable one. We recommend a consortium of partners – including the Institute for Fiscal Studies, thinktanks like the RSA, and consumer groups like Citizens Advice - commence a review of the UK's tax system to ensure it is fit for a digital age. One outcome could be to increase taxes on unearned income (eg Capital Gains Tax) to pay for a reduction of taxes on earned income (eg Income Tax). The review should also explore the potential for replacing Business Rates, which struggles to tax e-commerce activity and places an unreasonable burden on physical retail stores, as well as Stamp Duty, which creates a disincentive for people to move to new locations in search of work. The last major review on taxation, the Mirrlees Review, saw few of its significant proposals enacted because it lacked political legitimacy and broad public support. We therefore recommend hosting deliberative events with members of the public to better understand their views on fairness and taxation, whilst building a mandate for the review's recommendations.
- **Give every worker a 'technological inheritance' through a UK sovereign wealth fund:** If firms automate and digitise more extensively, we can expect a greater share of national income to flow into the hands of those who create and own machines. At some point, it may no longer be enough for people to have a job to get by. They may also need to own assets (eg company shares), which would top up their income through dividends. The Labour Party has suggested creating an Inclusive Ownership Fund, formed by taking 10 percent of the shares from the largest UK companies. However, the dividends would be capped at £500 and made available only to workers employed by the same companies. We recommend the government explore other options for creating a sovereign wealth fund, which could be formed from a windfall tax or by investing in the fastest growing firms, domestic and international. The RSA has outlined one option in the form of a Universal Basic Opportunity Fund (UBOF), which would pay out a £5,000 dividend over two years to every citizen under the age of 55.[119]

118. Fitzpayne, A. and Greenberg, H. (2018) *Portable benefits leglisation reintroduced in Washington State: Uber and SEIU commit to work together*. The Aspen Institute.

119. Painter, A., Cooke, J. and Thorold, J. (2018) *Pathways to Universal Basic Income*. London: RSA.

Strong worker voice

While the government can offer a broad buffer against economic shocks resulting from technological change, it has limited power to shape firm-level behaviour regarding which technologies are adopted and on what terms. This task must fall to workers themselves, backed by trade unions. Traditional unions, however, have seen membership numbers plummet in recent years. In the 1970s, half of all UK workers carried a union card, but today the figure is just one in five. Changes to legislation could help to reverse this trend, for example by enabling digital balloting as they do in Denmark. But unions must also modernise to stay relevant in an ever-changing labour market. This could mean prioritising technology agreements that create minimum standards for the introduction of new machines in the workplace, or providing services directly to workers, rather than solely lobbying on their behalf. We also call for a union dedicated to supporting UK tech workers, giving them greater say over which technologies are developed and who they are sold to (see the 'Ethical Technology' theme above for more context). To strengthen worker voice, we propose:

- **Promote a union model built on 'new power' principles:** The traditional union model is outdated. Few adequately support private sector workers, and even fewer serve the needs of atypical workers like the self-employed. Moreover, many see their primary role as arbiters of disputes, being reactive to events (eg staff layoffs) rather than proactive in anticipating future challenges. We need a new union model to help workers manage the challenges thrown up by technology. Unions should begin by forming technology agreements with employers, as the Communication and Workers Union recently did with Royal Mail, ensuring that surveillance technology would not be used to inform staff appraisals. Unions should also consider partnering with, and potentially funding, smaller outfits promoting worker voice. An example is Community Union's partnership with the co-working space IndyCube to boost its self-employed member numbers. Unions could even begin offering financial services directly to their members. The National Domestic Workers Alliance in the US, for example, created the Alia app to give domestic workers access to sick pay.
- **Amend legislation to make it easier to join a union:** Even reformed unions will struggle to attract members if current restrictions on union practice remain in place. Many of the legislative changes enacted from the 1980s onwards were warranted, such as ending closed shop rules that obliged workers to join a union. Yet some restrictions are difficult to justify. One of these is the ban on digital ballots, which means unions must rely on an archaic postal voting system to canvass the views of their members. Given digital voting is already used for elections within many political parties, there is no reason for it to be outlawed among trade unions. The government should review constraints like these and ensure workers have ample opportunity to join a union and have their opinions heard.

- **Establish a union dedicated to tech workers:** In December 2018, Wired published an article entitled 'The Year Tech Workers Realised They Were Workers'.[120] It documented several instances where tech workers in the US had lobbied their employers to terminate or postpone controversial contracts. Google employees voiced their discontent with an agreement to sell AI technology to the Pentagon, while Microsoft staff called out the firm's decision to sell cloud computing services to agencies separating families at the Mexico border. Although these disputes centred on the use of technology in law enforcement and military warfare, there is no reason why tech workers could not be more vocal about limiting harmful uses of technology in the workplace. A union for the UK's tech workers could, for example, coordinate strategic responses to influence which technology is prioritised by developers and who it is sold to.

Agile regulation

As the world of work changes, so must the regulatory regime that underpins it. While self-regulation should be the default approach to managing the creation and deployment of new technologies, from time to time the government will need to step in with fresh laws and regulations to protect workers. If gig platforms become more prominent in our economy, for example, we will need clearer regulations for determining the employment status and rights of workers, as well as more effective enforcement of those rights. Data protection regulation may also need to be strengthened, including through a new right for workers to transfer their data from one platform to another. In time, we may wish to compel firms to explain the automated decision-making systems they use and how they function, so long as this is technically feasible and does not compromise intellectual property. At a macro level, meanwhile, we may need to revise competition regulation so that regulators are obliged to put the interests of workers on an equal footing with consumers. In every case, regulators should aim to address problems by working hand in hand with employers, tech companies and other stakeholders, a collaborative approach the RSA has called 'shared regulation'.[121] A modern regulatory system would involve:

- **Clarify employment status law and strengthen enforcement of worker rights**: Recent months have seen a spate of court rulings on the employment status of workers, implicating firms like Uber, Pimlico Plumbers and Addison Lee. Such legal battles will become increasingly common if the gig economy continues to grow. As argued by the RSA in previous research, the government could minimise disputes and prevent the misclassification of workers by providing a clearer definition of the main types of employment: 'employee', 'worker', 'agency

120. Tiku, N. (2018) *The year tech workers realised they were workers* [article] Wired, 24 December 2018.
121. Balaram, B. (2016) *Fair Share – Reclaiming power in the sharing economy*. London: RSA.

worker', and 'self-employed' (see the footnote below for further explanation).[122] However, alongside guidelines, there also needs to be robust enforcement of the rights to which all worker types are entitled (eg the national minimum wage and holiday pay for 'workers'). According to Jason Lee-Moyer of the Independent Workers of Great Britain, the UK has half as many employment inspectors as advised by the International Labour Organisation.[123] The government must increase resources for the enforcement of labour law and ensure that relevant agencies can issue significant fines for wrongdoing.

- **Boost data protection law for workers including through a new right to data portability:** The introduction of GDPR last year brought in several new protections for workers, including a right to know when a significant decision that affects them has been automated (eg if their CV were to be screened by an algorithm). However, there is more to be done to ensure workers are treated fairly in an age of big data, including ironing out loopholes. The right of people to know about an automated decision, for example, is currently only valid when the decision is *fully* automated with no human involvement, a very rare circumstance. Moreover, while there is a new right to move one's personal data from one platform to another, it seems unlikely that this will extend to third party reviews. As Gavin Kelly argues, this means workers using gig platforms may not be able to transfer their customer ratings, in turn diminishing their ability to seek out better conditions on different platforms.[124] The government must ensure data rights for workers are fit for purpose, including through a new right to data portability.
- **Update competition law to reflect the needs of workers as well as consumers:** In recent years, the Competition and Markets Authority (CMA) has been relatively relaxed about the growing dominance of large firms in our economy. The reason is that they and the politicians to which they answer have prioritised the needs of consumers above all else. Mergers and acquisitions are judged primarily on whether they will lead to lower prices and better products. The potential for job losses and wage freezes is a secondary concern. This approach may have been sensible at a time when workers were adequately represented elsewhere by trade unions, but that time has long since passed. As called for elsewhere by the RSA, including in our *Good Gigs* report, we recommend the CMA reviews its policies so that outcomes for workers are given reasonable weighting in major decisions. The government may also wish to update the Competition Act so that worker interests are inscribed in law.

122. Balaram, B., Warden, J. and Wallace-Stephens, F. (2018) *Good Gigs: A fairer future for the UK's gig economy*. London: RSA.

N.B. Rather confusingly, as well as being a catch-all term to describe those in work, 'worker' is of the four main types of employment status along 'agency worker', 'employee' and 'self-employed'. As described by our colleague Brhmie Balaram in the RSA's *Good Gigs* report, 'a worker is registered as self-employed but provides a service as part of someone else's business… their contract is not with their own client or customer, but with another party (ie a gig platform).'

123. Moyer-Lee, J. (2018) *Uber is getting away with breaking the law. Why doesn't the state intervene?* [article] The Guardian, 20 December 2018.

124. Kelly, G. (2017) *Give me my reputation back* [article] Medium, 12 October 2017.

Conclusion

Despite all the perils highlighted in this report, we should not forget that technology is fundamentally a force for wealth creation. It makes, eases and allows. It is the reason why we no longer do backbreaking work in the fields, why child mortality rates have plummeted, why debilitating diseases are close to being eradicated, why we have more leisure time than ever before, and why most people (in the West at least) are surrounded by an abundance of life enhancing goods and entertainment. In the words of businessman and financier Adair Turner, modern economies like the UK's enjoy an "embarrassment of technological riches".[125]

The argument made in this report is that we can marshal technology for the betterment of workers and wider society, but that this first requires us to acknowledge the multiple uncertainties surrounding its development and adoption. The last 5 years have seen a spate of confident predictions about how technology will shape the future workplace. It seems that every week brings a new automation estimate. But the reality is that no one, not even those in the leading laboratories of the tech giants or the highest echelons of government science and technology teams, know how the future will play out.

Rather than make neat forecasts, we have argued that those in positions of power should consider multiple scenarios of the future and prepare workers for a wide range of possible outcomes. The four scenarios we have presented are not exhaustive in their portrayal of how the world of work may change, but they are intended to be insightful and provocative. The Big Tech Economy envisages mass automation, the Precision Economy a world of hyper surveillance, the Exodus Economy an economic crash combined with a flight from urban areas, and the Empathy Economy a reformed tech ecosystem where self-regulation becomes the watchword of the day.

No scenario should be viewed as more desirable than another. Each has a silver lining and a dark underbelly, winners as well as losers. The Big Tech Economy, which many will view as the most catastrophic scenario, could result in a radical reduction of the cost of goods like energy, transport, housing and food. The Empathy Economy, meanwhile, which many would view as the most attractive, comes with subtle dangers. Jobs may be plentiful, but they could also be emotionally exhausting. The need to craft a personal brand, to maintain appearances at all times, and to continually respond to other people's feelings will take its toll.

Those in positions of responsibility – policymakers, educators and employers – must recognise these alternative futures and ready workers for the risks and opportunities they present. In the last chapter we outlined

125. Turner, A. (2018) *Capitalism in the age of robots: work, income and wealth in the 21st century. Available: www.ineteconomics.org/uploads/papers/Paper-Turner-Capitalism-in-the-Age-of-Robots.pdf*

several interventions to aid this task, from updating competition policy to reviewing the tax system to introducing an ethical charter for technology investors. In drawing up these recommendations we have sought opportunities to intervene early in the technology lifecycle, nipping problems in the bud before they worsen. Establishing a Centre for Data Journalism, a Future of Work Research Alliance and a comprehensive technology sentry system would help to identify what, in fact, we should be devoting our attention to.

The reality is that most of these interventions would be worthy of consideration regardless of which scenario prevails. However, the urgency of applying them will vary. The Precision Economy, which would result in an expansion of gig work and self-employment, would add pressure on the government to equalise tax and benefits between employees and the self-employed. The Exodus Economy, where unemployment and underemployment would shoot upwards, would add weight to calls for Universal Basic Income pilots. And in the Empathy Economy, where jobs growth in strong in sectors like healthcare, hospitality and tourism, new occupational licensing rules would help to improve the status and pay of hi-touch jobs that are typically viewed as low-skilled.

2035 feels a long way from today. But there is plenty to gain and little to lose from preparing for tomorrow's workplace. Over the coming months, the RSA Future Work Centre will unpack these early ideas in more detail, bringing them together under the banner of a new social contract, which not only sets out concrete policy and practice proposals but establishes the overarching principles on which they should rest.

To find out more about our research, please contact Asheem Singh, Director of the RSA Economy team, at asheem.singh@rsa.org.uk

Appendix

Methodology: Morphological analysis

Our method for formulating the four futures of work involved a combination of desk research, a scenario planning workshop with experts, and a roundtable to refine our draft scenarios.

A note on definitions

- A critical uncertainty is a driver of change that is both high impact (or rather, potential impact), and high uncertainty, in terms of whether that impact will be realised
- Projections are the different ways a critical uncertainty may play out. For example, if a critical uncertainty is the health of the global economy, one projection could be a severe recession, while another could be stable growth.
- A critical certainty is a driver of change that is high impact and nearly assured to take place.

We began our research by drawing up a longlist of drivers of change, both technological and non-technological, with the goal being to capture as many influential trends as possible. We then convened a workshop with external experts to determine which of these drivers were critical uncertainties and certainties under the above definitions. Participants were encouraged to reflect on the four-part tech taxonomy set out in Chapter 4, and to think about which demographic groups, occupations and sectors could be most affected.

Workshop participants were drawn from three key stakeholder groups: **technologists who make or develop technologies, industry leaders who make decisions on whether to buy and deploy such technologies in practice; and researchers (drawn from academic, think tank and civil society institutions) who are concerned with researching and theorising the impacts of technology on work.**

Following this workshop, we settled on a final list of critical uncertainties, and for the latter we formulated their different projections for 2035. Three projections were chosen for each critical uncertainty, reflecting severe, moderate and minimal impacts/disruption (see Table 3 below). We also agreed on a small number of critical certainties that would appear in

every scenario, for example an ageing society and a rebalance of global economic power (see Box 1 below).

An example of a critical uncertainty is attitudes towards technology. One of our projections is that the public embraces innovation and regulators take a laisse faire stance; another that the public become concerned about specific risks and regulators therefore intervene only in high stakes domains; and a final projection that the public become hostile to a range of digital technologies, leading to strict regulatory standards across the board.

Having finalised the critical uncertainties and their projections, we then moved on to forming our scenarios. This process involved experimentation and iteration. We found that many of our critical uncertainties exert complex causal relationships on each other, in ways that are not always immediately obvious. However, it was possible to clarify causal relationships and work towards thematic and logical consistency within each future. To begin with, we created 12 draft scenarios, which were whittled down to four for maximal internal consistency and distinctiveness.

We then convened an expert roundtable to critically interrogate our draft four futures, probing for sense, consistency, and consideration of all relevant drivers and modes of impact. This encouraged us to rework different elements of our scenarios and add further detail where necessary.

Critical certainties

Unlike uncertainties whose projections are different across all scenarios, the more certain drivers will be fairly constant or uniform across all visions of the future. Nothing is entirely assured, of course, but the following trends are broadly certain, barring an unforeseen turn of events:

- The rebalance of global economic power: China, India, Indonesia and other non-Western countries will continue to grow in economic importance relative to the US and Europe. Some may stutter along the way, but the overall trend of industrialisation in these states will be unrelenting. Economies in Africa, meanwhile, are likely to see high rates of growth as investors seek out cheaper sources of labour. As these non-Western economies mature, so competition for business and jobs will rise up the value chain. The same pressures that affected UK manufacturing workers during the 1980s and 90s may soon be felt by UK professionals in law, finance and accountancy.
- An ageing society: The UK population is ageing. Around 18 percent of the population were aged 65 and over in mid-2017, compared to 16 percent in 2007.[1] This figure is expected to grow further to 20.7 percent by 2027. Birth rates could plausibly increase and life expectancy fall over the coming years. However, these changes would need to be very significant to stem the gradual ageing of the UK population. Pressure will grow on an increasingly small workforce to care for an increasingly large retired population, both in a financial sense (ie paying higher taxes to cover the state pension) but also literally, with care work taking up a larger share of job growth.
- Climate change: Recent years have seen an unprecedented rise in global temperatures. The past four years have been the hottest on

1. Office for National Statistics (2018) Overview of the UK population: November 2018. ONS.

record, while the 20 warmest have all occurred in the last 22 years.[2] There is still time to mitigate disastrous climate change in the long-run, yet global temperatures are set to rise one way or another in the immediate years. Indeed, while global leaders have pledged to keep temperatures from rising 2C above pre-industrial levels, that would still result in extreme weather events, making some regions uninhabitable. One obvious consequence will be an uptick in migration to the UK, as well as more expensive food imports as climate change devastates agriculture.

- The development and take-up of prosaic technologies: While the development of AI, robotics, autonomous vehicles and similar technologies is highly uncertain, other innovations are almost guaranteed to impact workers in the coming years. This includes 5G, cloud computing, gig platforms, and search engines, all of which are either widely adopted already or on track to be. These technologies garner little media attention but will have a meaningful impact on workers. 5G will strengthen communication channels, allowing for more remote working and virtual service provision (eg in healthcare). Search engines, meanwhile, will become increasingly sophisticated at finding the right information, improving the productivity and effectiveness of knowledge workers everywhere.

2. Harvey, F. (2018) Past four years hottest on record, data shows [article] The Guardian, 29 November 2018.

Table 3: The critical uncertainties and their projections

	Critical uncertainties	Projections		
SEEP Drivers	Global economic conditions	The global economy is weakened by a severe recession and an escalating trade war between the US and China.	The global economy experiences sluggish growth punctuated with mild recessions that are contained to a handful of sectors and regions.	The global economy sees an uptick in annual growth rates, driven by a boom in South Asian and African output and a thawing of frosty trade relations.
	Access to labour	Net migration to the UK plummets following our departure from the EU. Educators struggle to respond in time, with skills shortgages felt across the economy.	Net migration to the UK falls marginally following our departure from the EU. But a drive for upskilling and retraining allows domestic workers to plug most gaps.	Net migration to the UK returns to historically high levels, aided by bespoke agreements that allow migrant workers to access jobs in specific sectors (e.g. agriculture and social care)
	Workforce strategies	Employers radically expand their use of on-demand labour (e.g. ZHCs) in a bid to cut costs. Gig platforms break into service sectors like healthcare and education.	Employers hit the limits of an on-demand workforce. However, talent management in traditional recruitment becomes more sophisticated, with widespread rating of workers and better skills matching.	Employers reduce their use of on-demand labour in a bid to improve service quality and business performance. The use of ZHC and temp workers dips, while gig platforms remain confined to existing sectors.
	Attitudes to work	Work and leisure time become closely assimilated as jobs increasingly define people's identities. Meaning overtakes pay as the most desirable characeristic of a job.	Work remains largely a means to an end, although people continue to value jobs for offering purpose. Work-life balance is a goal but economic security continues to be paramount.	Work is increasingly seen as a burden that prevents people from leading rich and fulfilling lives. A movement arises against meaningless jobs and the campaign for a 4 day working week gathers strength.
	Attitudes to technology	The public embrace digital technology, believing that the gains from AI, robotics and other innovations far exceed the risks. Automation is viewed as a force for prosperity and widespread data collection goes unnoticed.	The public become increasingly concerned about the use of digital technology, but make a distinction between the behaviour of tech companies and the opportunities of the tech itself. Regulators limit their interventions to high stakes domains.	The public begin to view digital technologies in the same negative light as GM crops and nuclear fission. A series of cybersecurity breaches and technology failures prompt regulators to step in and introduce strict standards.
	Worker voice	Unions fail to arrest their decline in size and power. An atomised workforce proves too disparate to organise and unions struggle to make a connection with young people.	Unions stabilise in size but remain focused on the public sector. Experiments with new service offerings remain limited, and the alternative workertech movement appeals only to existing activists.	Unions stabilise in size but a handful of the most innovative grow significantly (e.g. Community). Unions come to see themselves as service providers (e.g. of IP insurance), and join forces with workertech to expand their reach.
	Urbanisation	Major cities including London, Birmingham and Manchester are powerhouses of economic growth. A successful house building drive keeps a lid on house prices, spurring more workers to migrate to urban areas.	House prices edge upwards causing more workers to leave the biggest cities in search for a better standard of life. Improved transport infrastructure (e.g. HS2) allows for easier commuting. London in particular experiences a high turnover of workers.	A combination of rising house prices, severe air pollution and growing interest in alternative ways of living leads to an exodus of workers from major cities. Small towns and villages see population growth for the first time in years.
	Market concentration	Tech giants in both the West and East become more dominant in their core markets and expand into new ones (e.g. Apple into healthcare). An international response proves impossible to coordinate. Mergers and acquisitions are commonplace.	The power of tech giants is contained but the overall trend in the economy is towards market concentration. A 'winner takes most' dynamic plays out in retail, entertainment, banking, airlines, energy and many other sectors.	Aided by the growing consumer desire for authenticity and locally made goods, SMEs and the self-employed see their market share rise, particularly in B2C sectors (e.g. retail, hospitality and some forms of manufacturing).

Technology Drivers	Machine learning / big data	Machine learning is limited to undertaking or aiding repetitive tasks, both non-cognitive and cognitive (e.g. in accountancy and legal case work). Modest improvements are made in natural language processing/generation, image recognition and predictive analytics.	Machine learning becomes capable of undertaking or aiding cognitive tasks that involve creativity, communication or empathy (e.g. in design, therapy and journalism). Significant improvements are made in NLP/G, image recognition and predictive analytics.	Major breakthroughs see the power of machine learning rise several notches. New systems including spatial awareness capability create the possibility for physical machines to be used in low cognitive but non-repetitive work (e.g. social care).
	Distributed ledgers	Distributed ledgers have few practical applications beyond alternative currencies and interbank trading. The energy demands of DLT make it unsustainable, while intermediaries remain in place because of their extensive branding and marketing clout.	Distributed ledgers are used to facilitate transactions and record checking in many sectors, for example to verify property ownership, send remittances, track foreign aid and ensure the integrity of supply chains. DLT is also trialled by the government to secure voting and welfare payments.	Distributed ledgers begin to remove intermediary organisations that once acted as third party verifiers. Smart contracts negate the need for Kickstarter, Airbnb and Uber. Decentralised autonomous organisations emerge in pockets to challenge traditional organisational hierarchy.
	Autonomous vehicles	After a series of unsuccessful attempts at meeting road safety standards, businesses abandon their ambition to develop fully autonomous vehicles. AV functionality is introduced to most vehicles but a human driver remains behind the wheel.	Autonomous vehicles are allowed in safe zones only (e.g. industrial parks, isolated lanes on motorways and farms), while drones and micro-vehicles are used for some last-mile deliveries. Its impact is mostly confined to the B2B transport sector.	Autonomous vehicles (inc. buses and trucks) begin to operate side by side traditional vehicles, aided by smart city infrastructure that intelligently controls the flow of traffic. AVs reduce the cost of private consumer transport.
	AR and VR	AR and VR technology is limited to gaming and selective forms of entertainment, art and tourism. Immersive technologies struggle to replicate the detail or atmosphere of real world settings.	AR and VR technology is used extensively in high value and high risk industries (e.g. manufacturing, healthcare and engineering), for example to train staff and help in day to day activities (e.g. AR supporting maintenance jobs)	AR and VR is adopted across different sectors and business sizes to enhance workplace activities, for example through VR meetings and training exercises. Retail in particular is transformed by immersive technologies, including the first holograms.
	IoT and wearables	Security concerns and problems with standardisation limit the number and range of IoT devices. Their use is restricted to a handful of industrial activities (e.g. monitoring the integrity of physical infrastructure and machinery).	IoT devices are installed across many sectors to collect data on the natural environment, the integrity of infrastructure, the location of goods and assets and people's health. IoT extends into workplace performance monitoring, improving performance assessments and health and safety.	IoT devices are pervasive. Virtually every aspect of our economy, society and environment is monitored and analysed. Businesses and public services become hyper efficient with precise targeting of resources. Telepathy wearables (that allow devices to operated with thoughts) gain ground.
	Robotics	Robots are limited to manufacturing facilities and other predictable environments (e.g. moving goods around warehouses). Improvements in sensorimotor functionality allow robots to handle more goods while software developments mean they can be repurposed for multiple uses.	Robots become commonplace in variable and non routine environments (e.g. for picking fruit and stacking shelves). Exo skeletons extend the capacity of workers to lift objects and travel long distances. Specialised robots like serpentine machines become more common (used e.g. in search and rescue)	Robots make headway in highly complex environments undertaking highly complex tasks. Powered by AI, humanoid robots are deployed in service industries like social care and hospitality, and begin to interact directly with humans (listening, communicating and making physical contact).

The RSA (Royal Society for the encouragement of Arts, Manufactures and Commerce) believes that everyone should have the freedom and power to turn their ideas into reality – we call this the Power to Create. Through our ideas, research and 29,000-strong Fellowship, we seek to realise a society where creative power is distributed, where concentrations of power are confronted, and where creative values are nurtured.

RSA
Action and Research Centre

8 John Adam Street
London WC2N 6EZ
+44 (0)20 7930 5115

www.thersa.org

ISBN 978-1-911532-31-6