

NewStatesman

Spotlight

THE FUTURE OF WORK: AI AND AUTOMATION

Oliver Dowden / Jo Stevens / Carl Benedikt Frey / Stephen Metcalfe



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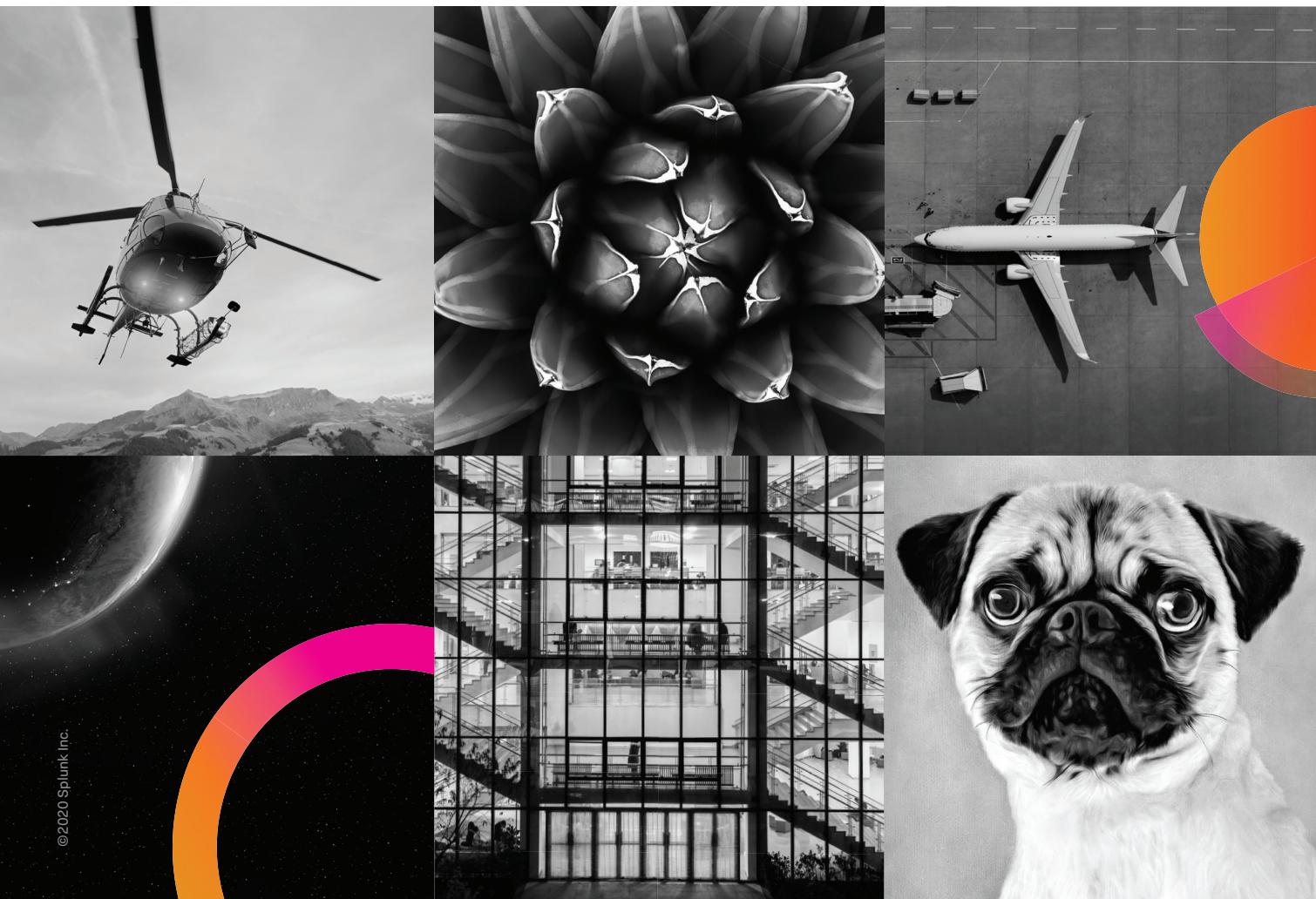
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The lesson to learn from exams failure



Anyone who doesn't think that AI and automation affect their daily lives was proved mistaken last month with the publication of this year's A-level results. A "mutant algorithm", as Boris Johnson has since termed it, used by the exam regulator Ofqual downgraded nearly 40 per cent of teacher-assessed grades. The ensuing debacle – complete with systemic bias, untold stress for students and government U-turns – was a shocking end to a long coronavirus summer.

It was also a sign of the world to come. AI and automation are already changing how we live and work. As Carl Benedikt Frey and Michael Osborne predicted in their widely touted 2013 study (see page 10), as many as 47 per cent of US jobs, and 35 per cent of UK jobs, may be automated by the 2030s.

This government has been keen on automation in the public sector. Under Health Secretary Matt Hancock, for instance, NHSX has been pushing its use in the health service. The body is running a survey to gauge how much robotic process automation is being used to automate GP referrals and to cancel appointments.

But the exam fiasco raised a red flag about the ethics of applying tech and ensuring transparency in its use. Last month it was reported that a number of councils across the UK are stopping their use of algorithms to make decisions on welfare matters and benefit claims, because in some cases systems made mistakes and led to delays.

Research by PEW from 2017 found that 72 per cent of Americans were anxious about "a future where robots and computers can do many human jobs". Three years is a lifetime in tech. But what hasn't changed is the need to ensure it is used in the right way. The review into algorithmic bias by the Centre for Data Ethics and Innovation (CDEI) is, of course, welcome. But if the government is serious about ethics, it will quickly establish the CDEI's independence on a statutory basis. This would help restore its reputation in light of its chair's involvement in the A-level scandal; Roger Taylor is also the chair of Ofqual.

The students who finished school this summer will enter a workforce transformed by automation. Their experience will hopefully shape their generation's, and the government's, use of tech for the better. ●

6 / Oliver Dowden

The Secretary of State for Digital, Culture, Media and Sport on how the UK can become a world leader in AI

10 / Carl Benedikt Frey

The Oxford economist on how automation is impacting the labour market

12 / Jo Stevens

The Shadow Secretary of State for Digital, Culture, Media, and Sport on a skills policy that keeps pace with technological change

14 / The geopolitics of AI

How the rivalry between the US and China could accelerate automation

16 / Tessa Lau

The Robot Whisperer on how robotics could revolutionise construction

22 / Stephen Metcalfe

The chair of the APPG on AI on the new normal of tech-aided and remote work

31 / AI and green jobs

Can automation help the clean energy shift?

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The *New Statesman* is an official media partner of London Tech Week, which runs online from 1-11 September 2020



First published as a supplement to the *New Statesman* of 4 September 2020. ©New Statesman Ltd. All rights reserved.

Registered as a newspaper in the UK and US. The paper in this magazine is sourced

from sustainable forests, responsibly managed to strict environmental, social and economic standards. The manufacturing mills have both FSC and PEFC certification and also ISO9001 and ISO14001 accreditation. This supplement can be downloaded from: newstatesman.com/page/supplements

News



Councils ditch AI in benefits systems

Rohan Banerjee

A number of councils across the United Kingdom are scrapping the use of artificial intelligence-enabled algorithms in their decision-making processes around benefit claims and other welfare schemes. The public fallout from the recent A-level crisis – in which an AI system downgraded close to 40 per cent of students' results – has led experts to warn against such technologies being used.

Many AI systems are implemented without public consultation, critics have pointed out, and are susceptible to having biases programmed into them. The A-level fiasco involved schools'

historical exam performances being used as a factor in determining grades.

Research by the Cardiff Data Justice Lab and the Carnegie UK Trust found that around 20 councils have ceased using an algorithm to flag claims as “high risk” for potential welfare fraud. The cases that were pulled out for staff to double-check, without legitimate cause to, the research said, potentially slowed down people’s claims.

Hackney Council, in east London, has abandoned using data analytics to help predict which children are most vulnerable to abuse.

UK government to launch AI labour market probe

Rohan Banerjee

The UK government is carrying out research into the scope and scale of the artificial intelligence labour market. The Department for Digital, Culture, Media and Sport has commissioned Ipsos Mori and Perspective Economics to survey hundreds of businesses and charities across the UK between September and October.

Questions aim to examine the skills relating to AI and data science that different organisations have and need. DCMS intends to base future policy and strategy around AI, including regulation, taxes and investment decisions, on the findings of the research.

The survey is not technical, DCMS says, and does not require expert knowledge. Rather, it simply aims to gauge to what extent, if at all, AI is being implemented in different sectors, and how open these sectors are to change in the future.

Self-driving cars may be allowed on motorways in 2021

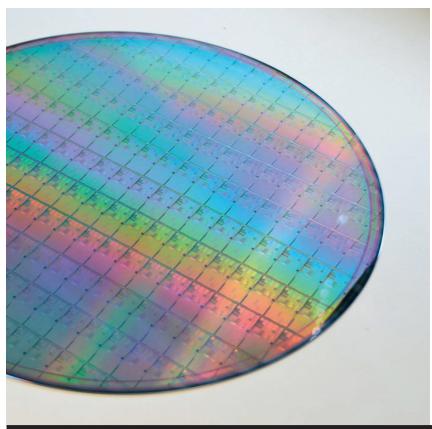
Rohan Banerjee

The UK government is considering proposals from self-driving car manufacturers to allow such vehicles on motorways from next year. Within the proposals are details of the latest collision-avoidance and lane-keeping technology, including AI-enabled alert systems and speed and steering assistance.

While there is confidence that self-driving cars can be developed to navigate small roads at low speed, the

government is still reviewing the case for them to be allowed at speeds of up to 70 mph in slow motorway lanes – where the vehicles would be programmed to automatically slow down for vehicles in front of them.

One of the key questions that will need to be addressed in the government's consultation, which launched last week, is where any legal responsibility for the vehicle will lie: with the driver who must remain prepared to take over if and when prompted, or with the technology provider itself.



UCL “brain” could reduce AI’s carbon footprint

Jonny Ball

University College London researchers have developed an AI system that uses memristor electrical components to create artificial neural networks, mimicking the human brain. These computer systems are generally less accurate than standard transistor-based AI hardware, but the UCL team says it has rapidly improved performance.

Operating AI technology is energy-intensive, but replacing the transistor hardware with the memristors can lead to huge energy savings, improving efficiency up to 1,000 times. The accuracy of the memristor systems were

enhanced when engineers set up the components to work together in sub-groups of so-called neural networks, and finding an average of their calculations.

This “neuromorphic” or “brain-inspired” technology combines processing and memory in the same blocks. Traditional hardware wastes energy in data movement between the processing and memory units.

Using energy-efficient memristors instead of current computing systems could potentially lead to huge amounts of computing power being packed into ever-smaller devices, even removing the need for an internet connection.

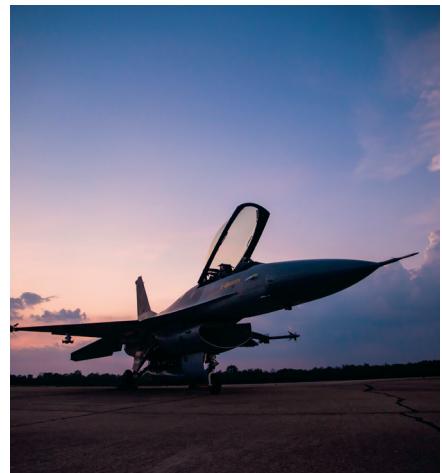
Robots to store energy in “fat reserves”

Jonny Ball

A team of researchers at the University of Michigan has made new breakthroughs in “biomimetic” battery power in humanoid robots. Rechargeable zinc batteries can now be integrated throughout a robot’s structure in a similar way to human fat reserves, allowing up to 72 times the previous battery power. The weight, volume and charge capabilities of traditional lithium-ion batteries has been an obstacle to successful robot development in the past.

“Robot designs are restricted by the need for batteries that often occupy 20 per cent or more of the available space inside a robot, or account for a similar proportion of the robot’s weight,” said Nicholas Kotov, the lead researcher. Like fat reserves, the zinc-based distributed energy sources will act as both energy reserves and as protection for the robot’s internal hardware. This will be particularly useful for robots designed to operate in human environments.

The research was part-funded by the US Department of Defence.



AI system beats US military pilot in F-16 dogfight

Jonny Ball

In a sign that the military applications of artificial intelligence are becoming even more advanced, a US AI system has beaten an experienced F-16 fighter pilot in five out of five simulated aircraft dogfights. The successful simulation is one step towards what developers have called “human-machine symbiosis”, although the system used a Second World War-style scenario with forward-facing guns only, reducing the number of variables and increasing the number of constraints. Modern fighter planes use missiles, which would have made the dogfight far more complex for the AI, developed by Heron Systems.

The trial was conducted by the Defence Advanced Research Projects Agency (Darpa), a US Department of Defence agency that funds specialised research into advanced technologies with military applications. Darpa has previously won the praise of Boris Johnson’s controversial adviser, Dominic Cummings, who has presented it as a model to emulate in the UK. Rishi Sunak’s latest Budget included £800m for a new “blue skies” research agency, thought to be modelled on Darpa.

Digital skills are the foundation of a strong economy, says Oliver Dowden, Secretary of State for Digital, Culture, Media and Sport

Unlocking Britain's tech potential

In just one generation, the world of work has been completely transformed by tech. That was already the case before the coronavirus pandemic. But this year's enforced lockdown has put a rocket booster under that trend, turbocharging the digital transformation of almost every part of our lives. Our workplaces, our businesses, but also how we shop, how we stay in touch with family and the way we use public services, all increasingly require digital skills.

The power of technology is celebrated every year at London Tech Week and it is thanks to our innovative firms that it is taking place at all this year. The events, talks and forums bring together some of the finest entrepreneurs, investors and tech workers from around the world to the tech capital of Europe. It is a time to mark this government's commitment

to the sector and the many firms up and down the country who will help us achieve our aim of a tech-led recovery out of the pandemic.

Take Astrum Wine Cellars, based in Surrey. This small business ordinarily takes most of its revenue from the hospitality sector. When the virus struck, they had to adapt quickly to find new sources of income, including selling goods online directly to consumers. Until this point, Astrum had little experience in the digital marketplace. Thankfully they were able to turn to Digital Boost, a government-backed scheme which provides small firms and charities the skills they need to operate online. The support on offer gave them the confidence to build and refine digital ads and attract new customers, which they said was key for remaining open throughout the pandemic.

Statistics from my department suggest more than 80 per cent of jobs today now require some level of digital ability. People who work in marketing need to be proficient in search engine optimisation and HTML. Even in less specialist roles, workers are expected to be comfortable navigating smartphones or tablets now the workplace is increasingly mobile.

If we want everyone to take advantage of this revolution – and of the UK's booming digital economy – then we need them to have the right skills. The government is working with industry and academia to boost digital skills across the board – from the basics, like booking appointments online or sending emails, to the specialist skills needed to work in data science and other digital sectors that will drive our post-pandemic recovery.

We have worked with educational, business and industry partners to launch





Robots work on the MINI production line at the BMW group plant in Cowley, near Oxford

The Skills Toolkit, a free platform which gives everyone the opportunity to revamp their digital skills, get ahead in their current jobs and boost their employability.

Our Local Digital Skills Partnerships – which bring together public, private and charity organisations to build people's digital skills – continue to operate in six regions across England serving more than ten million people.

They support fantastic organisations such as Teen Tech which has helped give schoolkids in deprived areas days out to learn digital skills. I am delighted to say that this autumn we will be launching a seventh partnership in West Yorkshire. And as part of our wider commitment, the government will invest £3bn over five years in the National Skills Fund to support the retraining of the adult workforce. These schemes are helping individuals and businesses navigate the challenges of remote working and training, and contributing to regional economic recovery.

The UK is a nation of innovators, entrepreneurs and inventors, so it's no surprise our tech industry is already incredibly strong. We rank third globally for investment in the tech sector, only behind the United States and China, and consistently outperform the rest of Europe.

But I want to build on that strength. To do so we need to make sure our workforce keeps pace with the latest technologies – the kind set to revolutionise the way we live and work, such as artificial intelligence.

British firms are working at the cutting edge of this technology. Benevolent AI in London is harnessing deep learning to help doctors make smarter treatment decisions, while construction firm Kier has been partnering with the University of Cambridge and nPlan to explore how machine learning could help stop projects from overrunning.

In Manchester, start-up Upside Energy is using AI to help move our energy system towards net zero by enabling homes and businesses to sell unused power from renewable sources back

to the grid.

If we are to continue on our current trajectory, we need to develop and maintain the best AI workforce in the world – one which makes the most of everyone's potential. That's why in June we announced 2,500 new places on AI and data science conversion courses to boost the diversity and number of people working in AI.

Statistics from Tech Nation and Royal Society reveal women make up only 19 per cent of the tech workforce. Our programme will mean applicants from underrepresented groups such as women, black and disabled people have access to 1,000 scholarships to support the development of ethical technology, make sure data-driven technologies reflect the needs of society and help mitigate the risk of biased technologies being developed.

I want the benefits of these technologies felt right across society and in the world of work at every level.

We have joined the Global Partnership for AI, an international and multi-stakeholder initiative to guide the responsible development and use of this technology. The Global Partnership for AI works with countries including Canada, France, India, Japan, Mexico, New Zealand, Singapore and the United States to investigate how AI can be used to address challenges that require international cooperation. This includes strengthening our response to and recovery from the pandemic, delivering on net zero, and bridging the gap between cutting-edge research and the use of AI to tackle real-world problems.

We must take care that the opportunities it creates are shared fairly across society, and work hard to make sure everyone has access to technology through world-class digital infrastructure such as gigabit-capable broadband speeds. Our new digital strategy is due to be published later this year and will aim to lead the way and form one of the vital building blocks of our recovery – a recovery that will be tech-led, but benefit us all. ●



Post-pandemic recovery will be led by tech

“We’re on the edge of epochal shifts”

Benjamin Pring, managing director of the Centre for the Future of Work at Cognizant discusses how the pandemic will change cities, work, and just about everything

Are cities dead?

I think that question is on a lot of people's minds at the moment. Are our big world cities going to survive as they are now, with this new home-working model? City centres are empty. Businesses are struggling.

But cities aren't dead. It's just that the way we use them is going to change fundamentally. Cities have always been home to three groups of people: the young, the rich and the poor. Think of Dick Whittington, the young man packing a bag and going off to London to make his fortune. Then of course you have the cultural elements, the social life of cities. And young people filling out clubs and gigs, and the cultural element of galleries and theatres that you perhaps don't get in more rural areas. That is why I moved to London when I was 18 and I think the big cities will continue to be a big draw for the young.

Then there are the rich, who in many ways are insulated from the pandemic, so they will continue their lives more or less as before. And the poor will always gravitate towards big cities for work. So for these people cities are very much not dead. I think what has changed is that millions of suburban middle-aged commuters, who, out of habit, were used to commuting and unfamiliar with home-working, have now had a taste of something different. The genie is out of the bottle. People have realised that the commute



is unpleasant and expensive. Senior businesspeople say that their personal productivity and that of their staff has held up well. They now trust their workers more.

Now millions of people who have had this exposure to working remotely have come to the conclusion that working this way is infinitely superior to the daily commute, putting on smart clothes and dragging yourself into the city to work in a cubicle.

That, I think, is dead. Historically, working from home has been synonymous with shirking, but that myth is now shattered. Businesses will be saving huge amounts of money on commercial office space as this becomes the norm. The need for these huge office buildings is going to be dramatically reduced. The financial and economic ripples will be immense for many small businesses that rely on footfall and that change is going to be incredibly significant and difficult for a lot of people.

Covid-19 will kick-start an evolution of offices

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Are offices dead?

No – but the purpose of the office is going to change. If you can work from home easily then you will. But if you want to do creative collaboration, or get people invested in the purpose, the vision, the ethos of the business or organisation, then that's what the office will be for. It will become a much more social space. A space to do things you can't really do effectively from home, like creative, collaborative activities, or cultural transfer from more experienced to newer members of staff.

Just think of many offices now – multiple rows of people working with their heads down and their headphones on. They're not really social, they're not really interacting, sharing or collaborating, so I think those spaces are going to be changed.

It will be for the end of year party, except those parties will become smaller and more regular. They will be about listening to senior leaders, coming together, eating and drinking, socialising and establishing the core values of an organisation collectively. The one shindig at the end of the year will become an on-site work social every few weeks.

What should we focus on as we look to “build back better”?

This moment is the biggest existential challenge since the Second World War. If you are the sandwich shop owner or the dry cleaners it is a huge tragedy, of

course, that your entire business model could be rendered unprofitable through no fault of your own. But this forest fire that's happening will burn out a lot of dead wood, so to speak.

It will expedite the end of a lot of outdated practices that were due a correction. And the forest fire does mean that eventually we will see the green shoots of recovery, and, hopefully, the chance to build a better world. The World Economic Forum in Davos is talking about “The Great Reset”, particularly looking at some of the global iniquities.

There is all this talk of V, U, or L-shaped letter recoveries. But then there is the possibility, unfortunately, of K-shaped recovery – a further bifurcation between rich and poor. The next generation of political and business leadership will have to try and avoid this and not build back the old world, but actually realise there is an opportunity to do things better, to think about multiple stakeholders rather than just shareholders, to think about people who have been “left behind”.

I hope historians look back on this moment as a time when we changed the way we thought about business, about politics, about technology, the role of AI and other very powerful emerging technologies, to use them and share their benefits.

What new technologies are going to be significant in the future of work?

There are two technologies, AI and Virtual Reality, that are going to become central in the next few years.

AI and VR will be normalised in the future of work

Some people are still sceptical about this, but these technologies are going to be a big deal. I have been a tech analyst since the mid-90s. Since then, cloud computing has fundamentally changed business. It has been a big deal. AI is in the next 20 years going to be way bigger than The Cloud.

The impact will be significantly bigger than anything I've seen in the last 20 years. It is hard to really appreciate the scope of how big this change is going to be. Now, as we speak, AI software can teach itself. It can learn, can operate at speeds and at complexity levels that are unprecedented. It is science fiction-type operations that we have speculated about in films and popular culture for many years – and now it has become a reality. The tools are being created that will facilitate the future of work.

Historically, in England, in the US, lots of people used to work on farms. Now not a lot do. Instead we have created all sorts of new jobs. And now, with AI, some jobs will disappear, but we're going to create a huge raft of new jobs and new work. There will be difficulties, but this technology is so fundamental that it will, undoubtedly, happen.

Virtual Reality will also be a very big deal. It's creating a platform, a new dimension, for creatives and artists to build new worlds in. We could be having this conversation in a VR system, a VR platform in a few years' time. Already you can see big rock 'n' roll acts such as John Legend doing VR concerts. In five years, we will be having VR-based staff meetings, very, very routinely.

We are on the edge of a lot of big, epochal shifts, and everyone will have to adapt to these new dispensations. But, on the whole, this is not something to fear but to embrace. It is something that will improve the way things are done, and it makes for an exciting challenge. ●

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How Covid-19 will accelerate automation

Oxford economist Carl Benedikt Frey says millions of lost jobs will never return.
Interview by Oscar Williams

In September 2013, two academics at the University of Oxford made a startling prediction. Writing in a university journal, Carl Benedikt Frey and Michael Osborne claimed that by the 2030s, 47 per cent of American jobs would be at risk of automation. The research became one of the most cited and debated economic studies in recent history. Its methodology was adopted by former US president Barack Obama's Council of Economic Advisers, the Bank of England (35 per cent of UK jobs would be impacted, according to the research) and authors including Yuval Noah Harari, in calls for policymakers to prepare for unprecedented levels of unemployment.

When, in 2017 and 2018, Finland trialled paying select citizens a “universal basic income” each month, Olli Kangas – described as one of the chief architects of the experiment – cited Frey and Osborne’s study. Such a dramatic transformation of the labour market would require an equally radical policy

response, it was argued.

But while the study triggered a frenzy of policy proposals, in the years since its publication other economists have cast doubt on the extent of the disruption Frey and Osborne forecast. The OECD said in 2018 that only 10 and 12 per cent of US and UK jobs respectively were at high risk of automation. Last year, a study by McKinsey, the professional services firm, found that only a third of roles in rich countries such as Germany and the US were at risk. So, seven years after publication, does Frey, director of the Future of Work Programme at the Oxford Martin School, stand by his research?

“I’m confident that it’s the most methodologically solid prediction out there,” he tells *Spotlight*. The OECD, which Frey has advised, used the Oxford training data but then applied a different analytical framework that factored in “within occupation variation”. The concept refers to the idea that variation in the way certain jobs are carried out





affects their exposure to automation. The OECD has not, Frey argues, published enough data to prove that variation could account for the disparities in their predictions.

"They don't show a single plot or figure on that [disparity] and that's the key argument of the paper," says the Swedish-German economist. "We've been in certain conversations with them and pointed it out to them." But Frey says he is yet to hear back from them on that point. "It makes me think the OECD study is not an improvement on our analysis. With the McKinsey analysis, all I can say is that it's a black box. It's

impossible to say anything about it because it's a complete black box." McKinsey said it had provided detailed descriptions of its methodologies in its reports. The OECD did not respond to a request for comment in time for publication.

While Frey is keen to defend his methodology, he is concerned that the study has been misunderstood. There is an important distinction, he says, between jobs that are at higher risk of automation and those that will be automated. The latter depends not just on technology, but on businesses' appetite for automation, as well as a range of social, political and economic factors that are hard to predict.

Nevertheless, as the global economy is plunged into one of the deepest recessions in history, many economists – Frey included – expect the rise of automation to accelerate. With revenues falling, companies seeking to cut costs will automate roles. And as consumers' incomes fall, they will turn to cheaper suppliers who depend on fewer workers.

Furthermore, with US political sentiment turning against China, the White House is introducing increasingly aggressive trade policies. Such interventions could force US companies to reshore manufacturing, but many are sceptical about whether managers facing higher labour costs would hire more US workers or simply turn to machines. "If you move manufacturing to more expensive labour markets, automation rises," Frey notes, adding that lower-paid roles are typically hit hardest.

In his latest book, *The Technology Trap*, Frey warns that in the short term, automation can suppress wages by pushing workers into lower-paid jobs. But, he argues, history has shown that technology ultimately increases prosperity by boosting productivity.

Future gains are unlikely to materialise if the technology underpinning them is resisted by workers, however. In order to secure employees' support, governments must pursue policies which increase competition and empower workers so that they have greater control over the

process, says Frey. "The best way of strengthening bargaining power is by bolstering the labour market. If you have a lot of options, that contributes to your bargaining power."

One of the greatest threats to this, says Frey, is the sharp rise in industrial lobbying. This has had the effect, he argues, of protecting incumbents and making it harder for new businesses to enter existing markets. "It seems to me that a lot can be achieved by trying to combat lobbying, rather than just trying to prop up unions, because much of the shift in lobbying power has also been a consequence of corporations getting larger, getting higher market shares in the industries in which they operate and spending more protecting their position," says Frey.

"We know that businesses that spend more on political lobbying tend to be less innovative. It tends to be those lobbying to protect themselves, which means fewer new businesses can absorb the labour that is being shredded. We need to think very carefully about antitrust competition policy and intellectual property laws, which make it harder for new businesses to get access to technology and enter markets."

And what about universal basic income? "The problem with universal basic income is the U in the UBI. I don't see why we want it to be universal. If you were to take current welfare systems and replace them with UBI what you would do is essentially worsen income inequality. I'm much more in favour of what Milton Friedman proposed in terms of a negative income tax which essentially provides a floor below which people's income cannot fall and people have incentives to go out and top up their incomes."

Frey dismisses the idea that UBI is a panacea. "People attach meaning to their work and like their jobs," he says, "economists tend to think about consumption being the purpose of production, but I think that's actually wrong for a lot of people. Production is an end in itself." ●

Technology boosts productivity

Why AI must put people first

Technology and skills policy are interlinked, says Jo Stevens, Shadow Secretary of State for Digital, Culture, Media and Sport

For a brief period during the Industrial Revolution in France, the machinery that pumped out shoes at a rate faster than any cobbler, group of cobblers or an entire cottage industry of cobblers could ever match with their bare hands, came to a grinding halt. Traditional French wooden shoes, sabots, had been wedged in the mechanism. Clogs in the cogs was the origin of the word sabot-age.

Humans, from the industrial age to the present day, have resisted life-rattling technological change. For the Luddites it was smashing cotton mills, during the Swing Riots it was agricultural labourers destroying threshing machinery, in the postwar period it was infamous industrial battles, such as the Wapping dispute over printing technology, and more recently concern over the rise of the gig economy.

Predicting the future of work can



be a fool's game. The harsh reality is the economy evolves, paradigms shift and change is inevitable. Our older industries are heavily regulated, while our newer ones often nimbly exploit their under-regulation. Sadly, the human cost is too often forgotten; employment rights have been circumvented by classifying employees as "associates" or any number of bizarre terms, often as a means to avoid being responsible for holiday pay or other fundamental workplace rights. New does not always equal better.

Just as automation is not new, neither is the decreasing requirement for human labour to perform production tasks. What is new is the speed of change, the exponential ability of machine learning and the emergence of a new form of Fordism, one with tentacles touching not just manual jobs, but all echelons of employment.

Globalisation means we cannot stop the world and get off, but for many



the world is moving at a frightening pace. Tech companies with turnovers comparable to small nations fill the strategic void left by poor governance.

But the situation does not mean we are powerless. Instead, it is about how we prepare for such rapid change. History has shown that when certain types of jobs disappear, others quickly emerge to fill the void. The jobs of the future require a change of mindset and need not seem like they have fallen from the pages of the dystopian novel. The jobs of today would baffle our great-grandparents. Embracing the future brings with it almost endless possibilities. Yet for technological change to be a positive occurrence, governments must operate within a strategic framework which puts people first; in essence policy must go hand-in-glove with conscience.

We know that most jobs are not for life, we also know that the skills you learn at school and beyond need to be supplemented and updated continually. Lifelong learning is key and incentivising employers to invest in their staff is one of the greatest challenges facing government.

Labour wants people to reap the benefits of technological change, rather than feel that they are being dragged along by it. It is why we have launched a consultation, “Our Digital Future”, to embed values in our collective response to both the challenges and opportunities that lie ahead.

We should be empowering, not just supporting, people through life-long learning opportunities, investing in people alongside research and development and regulating the online space to make it a safer and more pleasant place to be. We need to stem the decade-long decline in in-work training budgets across the private sector, and foster a new culture of updating your skills as you progress through life, with a conscience-led policy of creating jobs that provide dignity to those that occupy them and benefit society as a whole.

During this pandemic Labour has prioritised retaining and creating jobs,

but we fear the situation has only further accelerated changes for a society ill-equipped to respond. Our high streets have been devastated as online shopping has soared – bolstered by some of the biggest firms exploiting the unchecked tax advantages they hold, leaving the very fabric of many localised economies unravelling at the seams. Equally, just because a person’s job can be done from home does not mean that they are immune from these pressures, for in certain cases it could therefore be done from a different, cheaper home somewhere else in the world.

Two years ago the government announced a £1bn Artificial Intelligence Sector Deal, creating an Office for AI, but the significant investment in technology needs to be matched by an investment in people. The pandemic exposed the woeful lack of connectivity for millions of families, with recent research from the Children’s Commissioner pointing out that 9 per cent of families did not even have basic access to the internet or a digital device. A recent Microsoft report found that only 17 per cent of UK employees say they have recently taken part in any re-skilling efforts at their workplace, with just one in three workplaces reporting they feel prepared for a future of machine learning and AI.

Tellingly, the report highlighted that the UK faced a perplexing issue shared by few other nations, namely an overemphasis from firms on getting the latest technology in place, rather than improving the skills of those potentially using it. It does not take a churning supercomputer to work out where the government might want to focus its attention.

The technological world relentlessly spins on but, guided by a clearer strategy that brings people with it, underpinned by a conscience, such changes can improve the lives of all. Oh, and as for the story of sabots and sabotage I was once taught in a history classroom, it turns out it is an apocryphal tale. I just googled it. We are never too old to learn. ●



Innovation should leave no one behind

How the US-China rivalry will accelerate automation.

By Jonny Ball

The geopolitics of AI

Last year, speaking at a visit to a specialist technology training centre in Moscow, the Russian president Vladimir Putin gave his audience an ominous warning. “I have said it before and I will say it now,” he told reporters, “he who can establish a monopoly in artificial intelligence... will rule the world.”

That same year Donald Trump signed Executive Order 13,859, announcing the “American AI Initiative” – a Federal government strategy for advancing AI capabilities by investing in R&D and skills development, and fostering collaboration between the private sector, academia, government and “like-minded international partners”.

Two years before that, China announced the *Next Generation Artificial Intelligence Plan*. This aimed for Chinese AI to reach a “globally advanced level” by 2020, to be “the major driving force for industrial upgrade and economic restructuring” by 2025, and to become the world’s “global AI innovation centre” by 2030.

The context for these initiatives is an escalating “AI arms race” between the world’s pre-eminent economic and military superpowers. As the US-China rivalry intensifies in the wake of Covid-19, leadership in AI has become a major global battleground. Advances in this technology

promise to give the edge in terms of military and economic strength.

As this *Spotlight* report details, AI is changing the world in profound ways. In virtually every sector, automation will revolutionise work practices, improve productivity and drive efficiencies. But this technology is also predicted to cause dislocation in jobs and industries affected by what tech enthusiasts call “disruption”. A 2013 paper by Dr Carl Benedikt Frey and Michael Osborne, experts in machine learning and the future of work at the University of Oxford, estimated that 47 per cent of total US employment was at risk from computerisation. (See our interview with Frey on page 10.)

Data, the raw material on which AI algorithms are trained, has been described as the 21st century’s oil and the world’s “most valuable resource”. AI and the data economy were identified as the first of four “Grand Challenges”

AI has become a major global battleground

that must be met in the UK’s Industrial Strategy, published in 2017.

But it is the US and China who lead in this global race. Their rivalry over AI takes place against the backdrop of the US trade war launched by President Trump against what he describes as China’s unfair trade practices, as well as tensions over China’s treatment of the Uighur Muslim minority and the status of Hong Kong and Taiwan.

In 2019, an interim report from the US’s National Security Commission on Artificial Intelligence, chaired by the former Google chief executive Eric Schmidt, articulated this struggle for hegemony. “AI cannot be separated from emerging strategic competition with China and developments in the broader geopolitical landscape,” the report said.

It went on to detail China’s deployment of AI to “advance an autocratic agenda” and “commit human rights violations”, warning that AI technology could be used to launch disinformation campaigns, wage war and threaten critical national infrastructure. “The future of our national security and economy are at stake,” it said.

Since 2008, China has become the engine of global growth. And now, as part of the Communist Party’s “Made in China 2025” initiative, the country is shedding its former reputation as “the world’s factory” – a source of low-quality



Trump's 2017 visit to Beijing did little to quell increasing tensions between the two superpowers

consumer products and cheap labour for foreign multinationals – and becoming a leader in emerging technology, big data, artificial intelligence and machine learning. This is helped in no small part by the Chinese state's mass collection of data on its citizens. In contrast, US and European big tech is subject to stringent privacy regulation.

In addition to the obvious civilian uses of AI to improve a country's economic competitiveness, part of the appeal of the technology is its military application. The *Financial Times* reports that *Military Science*, a Chinese military journal, predicts a shift from “informationised” warfare – our current model, using hi-tech IT systems – to “intelligentised” war, with belligerents using AI. China's *Next Generation Artificial Intelligence Plan* openly commits to enhancing “AI civil-military integration”, and the so-called “civil-military fusion”.

The effect that the technology will have on both American and Chinese workers and on their respective national economies will be huge. Automation and AI will boost GDP, but millions of lives will be upended. China may be better placed to deal with these coming shifts. The country has a 300-million-strong itinerant workforce and regular population movements between town

and country, along with years of high productivity growth and expanding GDP. This has revolutionised the country's working cultures many times in the last few decades. China's workforce is used to reskilling and transition.

As the world heads towards a predicted “Asian century”, Trump's US, engulfed by culture wars and stymied by comparatively sluggish growth, looks increasingly in decline. Beijing, with its state-managed “socialist market economy”, has channelled vast resources towards productive investment in the technologies, industries and putative “sectors of the future”. In 2008, China's largest company was Petrochina, the state-owned oil and gas giant. But by 2018 it had been overtaken by Alibaba, the publicly traded e-commerce and AI technology company, as well as Tencent holdings, a conglomerate that includes the instant messaging service WeChat;

Who, as Putin put it, will rule the world?

the world's largest music streaming service, Tencent Music Entertainment; and an AI research and development arm, Tencent AI Lab. Baidu, another public company headquartered in China's capital, is the world's second largest search engine, and invests heavily in AI.

While these large, private companies seemingly mirror the US's big tech success stories, the often blurry line between large-scale private enterprise and the Party-state creates the impression in outsiders that they are dealing with a country rather than a company. Associations between government and industry are so widespread that some China observers have dubbed these private companies “state overseen enterprises”. Most notoriously, the supposed links between Huawei and the CPC have been used to justify sanctions against the company in the US and UK.

Those blurred lines also highlight the challenge for the US in keeping up with China, with its strict constitution and separation of powers. Although the US boasts most of the world's top tech companies, including all of the GAFAM firms (Google, Apple, Facebook, Amazon and Microsoft), they are all strictly independent enterprises. In 2016, Apple refused to unlock an iPhone used by a terrorist gunman and rejected cooperation with the FBI and the US government, citing concerns over “civil liberties” – a situation that would be anathema in China.

As the world economy begins on its journey of post-pandemic recovery, the retreat into shorter supply chains, domestic production and even protectionism may create a very different and perhaps more polarised world. AI is sure to play a crucial role in how we rebuild in the decades ahead. What we don't know is whether Washington and Beijing can avoid the so-called Thucydides trap – the observation that war between a rising power and a former hegemon is more likely than not. Nor do we know who will, as Putin put it, come to “rule the world”. ●

Tessa Lau, CEO of Dusty Robotics, wants to fix the building sector's productivity problems.
Interview by Samir Jeraj



A Robot Whisperer takes on construction

When Tessa Lau was eight, she got her first computer, a TRS-80, from Radio Shack. This was before CDs, and before floppy disks the size of your hand that were actually floppy. The TRS-80's computer memory was minuscule compared to any wireless appliance in your home today. "It was all downhill from there," jokes the CEO and founder of Dusty Robotics.

For Lau, that first computer was the start of her journey to becoming a "Robot Whisperer", her chosen title as head of a robotics start-up. Now, with nine years of experience in this field, she is working to revolutionise construction through artificial intelligence.

It was while Lau was remodelling her home that she realised robotics could help the industry. Productivity in construction has been behind other parts of the economy for decades, according to 2017 research from the McKinsey Global Institute. A labour shortage is part of the problem, as is the fact that many building methods have not modernised. "People are still using paper-based projects," says Lau. "That's how businesses work in the construction industry, and so



modernisation is late to come".

Lau's company is one of dozens of US start-ups hoping to change construction through robotics. While others are innovating in roofing or logistics, Dusty Robotics specialises in automated layout services. Lau and her business partner spent six months speaking to people in construction and on building sites. "We bought hard hats and steel-toe boots and learned how to operate the manlifts and how to walk on rebar [reinforcing bar]," she says.

When Lau and her team were clearing

up a construction site at the end of the day, they understood what their robots should be doing. Groups of workers were measuring up and debating where to put features, marking them out on the ground on their hands and knees. The job was physically demanding yet required a high level of skill. It was an ideal task for a robot.

Construction is still dominated by family firms, all with their own ways of doing things, and many people grow up in the industry. In the UK, it is the sector with the highest number of family businesses, according to research by Cynergy Bank. "Few outsiders really understand the scope of what construction is and how complicated it gets," she adds.

The variety of people working on building sites was particularly surprising to Lau. She recalled walking around a project to build student accommodation in the Bay Area, California. More than 2,000 people worked on any given day and behind each builder were suppliers, logistics people, and support staff. "There's this stereotype that says people in construction are reluctant to adopt



Workers stand next to an excavator robot during preliminary work in the Notre-Dame de Paris Cathedral

new technology and they're never going to change," Lau says, "I think that could not be further from the truth".

It was a project called "Robots for Humanity" that first brought Tessa Lau into robotics. She worked with a man called Henry Evans, who had lost use of his limbs following a stroke and was confined to a wheelchair. Lau helped program robots to enable Evans to carry out mundane tasks, like feeding himself or scratching his nose.

At the time, Lau was working on software at IBM, where she had been for 11 years. Seeing how robots could transform a life made her realise that "for all of the work that I was doing in software and tech, none of that could actually touch peoples' lives the way robotics could".

She left IBM and founded a start-up called Savioke, developing robots for the hospitality sector. They would perform routine tasks like delivering room service in hotels and medication in hospitals, and providing support in elderly care. Lau thought of her parents who are "not that young", and of getting to the age where she will need assistance. "I would

much rather preserve my independence and have a robot assist me with my basic needs," she explains.

Savioke was where she became a "Robot Whisperer". "I wanted to have a little bit of fun," she explains. Traditional titles like CEO did not appeal and she wanted to reflect the care and intuition needed to make robots work. "Just as dog whisperers and horse whisperers really understand the creatures under their care, I wanted to do the same for robotics," she says.

For those who still see robots as a thing of the future, the Robot Whisperer thinks they are already with us. "I think of my dishwasher as a robot. Put the dirty dishes in and the clean dishes come out. What is that if not robotic

"Robots can do more with less"

automation?" She believes that specific appliances such as these will be entering our lives in the near future, but the potential beyond that is huge. Robots can be used to "augment" human efforts, she argues, giving people "better power tools" and even promoting equality in jobs that have traditionally been about physical strength. With the right tools, a person like Henry Evans could be as good a construction worker as anyone else.

However, there is always the fear that advances in robotics will automatically lead to fewer humans in work. Lau says this is not an issue in construction, where there is a labour and skills shortage, and her remit is about creating better tools for workers, not replacing them. We are still a long way away from machines like Mr Data in *Star Trek: The Next Generation*, Lau's favourite fictional robot.

Longer-term, however, Lau knows that eventually human jobs will start to be displaced by machines, and her answer is universal basic income, an idea she came across in Andrew Yang's 2018 book *The War on Ordinary People*. "In the US, our philosophy has always been 'if you want to have a decent living, you need to work'", she says. But in a world with widespread automation the only "decent, human" response is to "raise the floor" and provide an income to people. "You shouldn't be dependent on your ability to attract a job in this future where automation is everywhere, and that should not be the condition to eat and have a roof over your heads."

Back on the construction sites, work is starting up again after the coronavirus lockdown. The need to socially distance means fewer workers can be on site at a given time. One solution to that is using robots to augment the workforce, says Lau.

"A lot of these changes from coronavirus are probably going to persist and so there's going to be a continued push to limit numbers of people on job sites and trying to do more with less. That is exactly what robotics is good for." ●

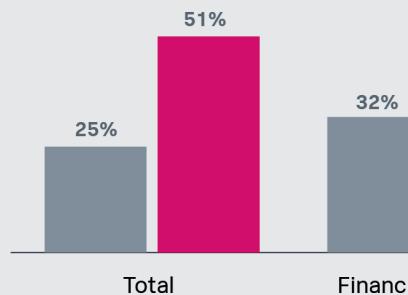
Opportunity and challenge mark the new “Data Age”

Organisations need to prepare themselves for the future, says **James Hodge**, chief technical adviser at Splunk

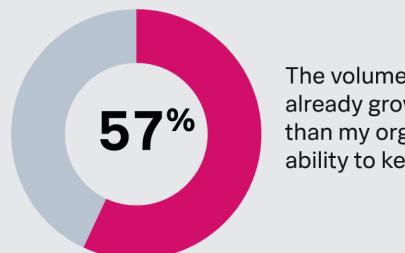
New research shows that the UK, and the world, are not ready for a new era of data-driven technology. Given the speed and magnitude of change, in a world already reeling from economic, political and health crises, organisations that seek an edge now will have an advantage going forward. And in a Data Age driven by artificial intelligence, automation and emerging data-driven technologies, the defining edge will be how we turn our data into quick, decisive action.

New global research commissioned by Splunk found the vast majority of respondents were unprepared for – and sometimes unaware of – the magnitude of data about to multiply their already overwhelming volumes. The research, by TRUE Global Intelligence, provides a snapshot of an interesting intersection of fear and faith. On average, organisations expect their data to increase nearly five times by

Current use of AI/ML is surprisingly limited, and business managers expect to use it more in the future



Organisations are already stretched to capacity, and rapid data growth could push some to breaking point



2025. Realising that, only 14 per cent of respondents expect their organisations to be prepared to handle that wave of data. Yet when considering likely contributors to that stark increase – emerging technologies including 5G, edge computing, augmented reality and artificial intelligence – respondents become optimistic: 63 per cent say they expect their organisations to successfully take full advantage of the opportunities

Leveraging data will provide key insights

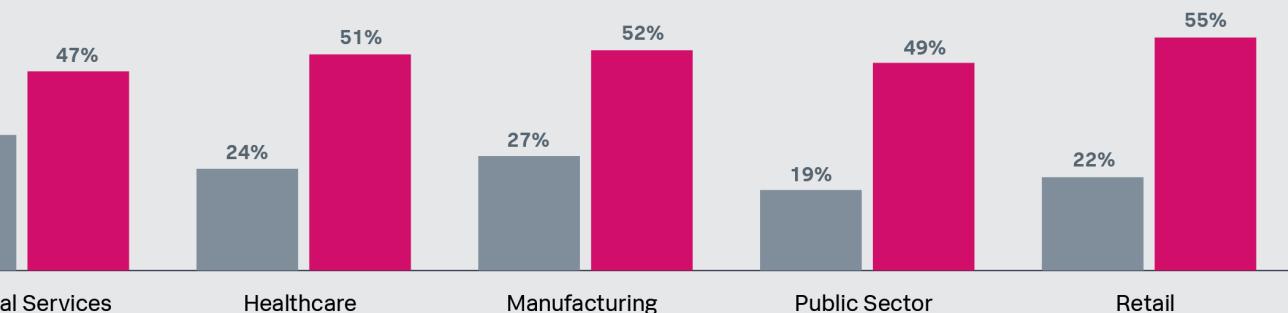
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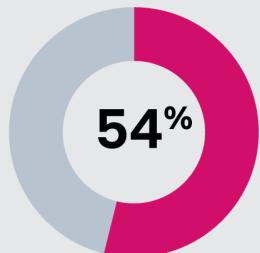
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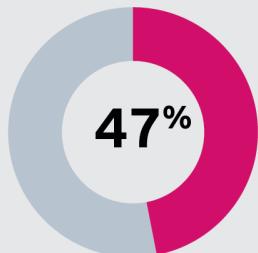


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My organisation
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that these technologies present.

But this is the era of Covid-19. Is a global economic meltdown the right time to be thinking about future horizons? Actually, yes. A chaotic economic downturn is exactly when the next generation of leaders begins to emerge. When both Bain and the *Harvard Business Review* examined business performance after the recession of 2008, the data showed that agile, adaptive organisations that focused investment on key initiatives, rather than burying their heads until the crisis had passed, were more likely to survive and thrive in the upswing.

It will take a new style of data-driven leadership requiring collaboration, curiosity and courage to cross the chasm between underprepared and leading edge, and the research report provides key opportunities to prepare for a new age of data, and to thrive in it.

After 25 years of digital

transformation we are entering a new stage. This Data Age is not the result, simply, of the zettabytes of data we are generating every year. The measure of the Data Age is in how we are capitalising on this information. We are increasingly moving it out of the silos and task-specific applications that characterized initial digital transformation, to take a more holistic and investigative approach.

This interconnectedness is the

Covid-19 has underlined the need for connectivity

essence of the Data Age. We see it in our daily lives: with 5G and smartphones, we hold in one hand vast swaths of the world's cumulative knowledge, the ability to communicate instantly with total strangers and our closest loved ones, access to our work, to healthcare, to entertainment and the arts, to the offices and tools of civic engagement. With laptops, wi-fi and cloud-based servers, whole enterprises shifted overnight from corporate campuses to working from home.

In the Data Age, we see the individual innovations of digital transformation come together to change entirely, not incrementally, the ways in which we work, shop, consume and create. And central to this new phase is the potential of artificial intelligence, to draw unprecedented insight from new waves of data, and to accelerate, through automation, our response to those

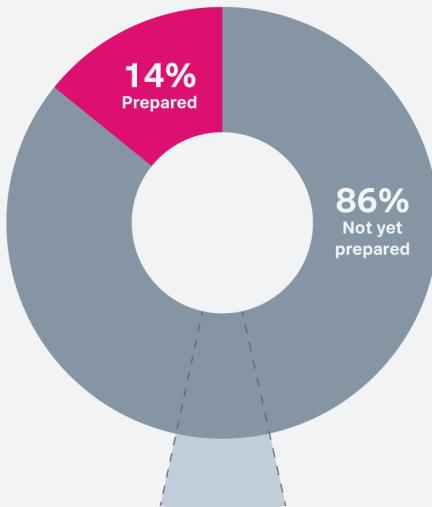
insights. Access to information and knowledge combined with the next wave of technology innovation means businesses are only limited in their imagination in how to bring the next experience to the consumer.

As we have found with previous research, business and IT experts in the United Kingdom place near or above the global average for all things data. Sixty-two per cent of UK respondents expect data to grow over the next five years. They estimate that their data will grow 4.8 times from where it stood in late 2019, exactly the average of the eight countries in our survey. In the United States, the estimate was 5.2 times, and in China, 3.9 times.

UK respondents voice considerable optimism about emerging technologies, though implementation lags. For example, just 19 per cent of UK respondents say they are currently using artificial intelligence and machine learning technologies, but 58 per cent look ahead to future use cases. For another essential Data Age technology, 5G telecommunications, less than half of UK respondents feel ready to go: only 44 per cent rate their own understanding of 5G as “expert” or “high”. But that again exactly tracks the global average, and falls just a point below the US number. Respondents in China, by contrast, scored themselves at 62 per cent.

As interesting as it is to compare the eight countries in the research (which also addressed France, Germany, the Netherlands, Japan and Australia), or compare one industry’s progress against another, the real competitive question is between companies in specific industries. Which logistics firm will solve supply chain problems with AI and Blockchain? Which bank or retailer will automate its responses to a data security threat? Each new technology represents a disruptive threat and a competitive opportunity. And the current disruption will sharpen the divide between leaders and laggards. Customers are no longer loyal to brands but crave

Preparation for the coming data wave



Among those whose organisations are not prepared for the data wave, only 8% are very confident that they will prepare in time

exceptional experiences; industry leaders understand that data is the key to providing this.

Even as organisations cope with the demands of coronavirus mitigation and the fallout of the economic downturn, forward motion remains essential. The Data Age report offers a number of strategic recommendations, but there are two fundamental first steps: to understand your own evolutionary strategy – the strengths and opportunities that must be your focus – and to focus, holistically, on how your organisation works with data. From IT operations to machine

learning engineer to business end-user, each member of your organisation needs appropriate, role-based access to data and the tools to learn from, and act on, it.

And keep your eye on that sharp data growth. One of our survey respondents, a director for a UK manufacturing firm, said this: “Ensure that you discuss accelerated data growth at every meeting. Keep it on your agendas. Ensure that you have people and processes in place to advance your data preparation.”

We are in a new era, in which every challenge and opportunity will revolve around data. A big surprise in our research was that respondents in every industry sounded overwhelmed, even pessimistic about their immediate prospects around data, AI and other technologies. But when we asked which industry – retail, financial services, manufacturing, healthcare or the public sector – was best poised to thrive in the Data Age, most respondents chose their own.

I think they are right. ●

Consumers are craving speed and convenience

The power of information

Data needs to be at the forefront of every CEO's mind, says **Gordon Morrison**, director of EMEA government affairs at Splunk

Since the Covid-19 crisis began, we have seen a considerable amount of technological change and a realisation that data has a huge part to play in dealing with the virus and the economic recovery. This digital transformation and the focus on data will accelerate. Emerging technologies – led in large part by the Internet of Things, artificial reality, virtual reality and Blockchain – will create more data, and others such as 5G, edge computing, artificial intelligence and machine learning will create an environment that facilitates its further growth.

The promise presented by these transformational technologies combined with ongoing societal changes is culminating in the new Data Age. However, organisations are not ready; according to our research on the topic, only 14 per cent of businesses across the world are prepared.

The UK is not any different. In the UK, managers' report a relatively low current usage of emerging technologies but are optimistic about plans to use them in the future. Adoption of these technologies will potentially generate enormous economic opportunity for the UK, and rapid adoption is perhaps critical to the economic recovery from the effects of the pandemic.

We already have many policy initiatives in place to accelerate the

adoption of these technologies which will, in turn, lead to massive growth in data. In the report and in the UK, IT and business managers estimate, on average, that by 2025 their organisations will have 4.8 times the amount of data they currently generate and receive.

This compounds a problematic situation in that many are struggling with the data they already have. Across the world, only 51 per cent reported that their organisation was "very good" at managing its data, and only 47 per cent said the same for their organisation's skill in leveraging its data to drive value for the business. This leaves us with a challenge: a significant proportion of the world's economy is potentially not where it should be in its ability to manage growing amounts of data, nor has the skills to make use of it.

Many of the organisations we surveyed suffered a lack of awareness and urgency, and a failure to appreciate what the new Data Age means and the opportunity it presents. It is clear, the UK economy must become a data-driven economy, with data put to work in ever more productive ways.

Now is the time to prepare, and there is a window for organisations to grapple with these challenges and plan for success. There may be a very high penalty for burying one's

head in the sand, while organisations that proactively address their data challenges today position themselves to flourish as the Data Age matures.

So, what are the policy challenges for the UK government? Firstly, UK industry perhaps needs to understand the competitive and productivity benefits of data, and how managing it better and keeping up with the expected data growth is critical to the economy. We need new data evangelists in the UK, and for data to be at the forefront of every CEO's mind.

We already know in the UK that data skills are scarce and expertise in artificial intelligence machine learning and some other technologies are equally as problematic. Not everyone needs to be a data scientist, but, in the Data Age, everyone in an organisation will need to have appropriate data skills. We have all learned to adopt new technology in the past; in the Data Age those that exploit data quickest will perhaps be the most competitive.

Finally, citizens will benefit significantly from the Data Age. Data analytics have been used to help mitigate some of the effects of the pandemic, but as the Data Age accelerates, citizens will need to trust "Data Age"-related technology. A challenge for all governments is in how to reassure citizens that they are using data to make ethical, proportionate and appropriate decisions with citizens' data. We recently worked with the World Economic Forum and the UK government to develop procurement guidelines for AI, and the UK government should be commended for helping lead the thinking here.

The Data Age presents us with an opportunity to deliver real benefit to the citizen and to support the recovery. To do this, we need to understand the opportunity in our data, improve our skills at all levels and ensure we engender trust in the way we use it. Let us grasp that opportunity and make sure the UK benefits from this new age. ●

Emerging technologies must be matched by progressive policymaking, says Stephen Metcalfe, chair of the APPG on artificial intelligence

Why we need to get AI right from the start

Artificial intelligence technologies have taken on a central importance in our everyday lives during the Covid-19 pandemic. Not only have they been at the heart of public health strategies and pharmaceutical research in the fight against Covid-19, but data-driven tools were also essential to maintaining our professional and private relationships during the lockdown.

Many proponents of new technologies argue that AI has been the main force in creating a “new normal” with the potential to replace the life as we knew it pre-pandemic. However, one could equally argue that it is due to AI that our new normality is in most parts still reminiscent of the lives we lived six months ago. AI-driven applications made it possible to preserve a semblance of normality and routine that helped many of us through months of social distancing and limited access to stores and health services.

Whether the pandemic will fast-track the Fourth Industrial Revolution remains to be seen. However, our dependence on AI technologies in almost every aspect of our lives has been made abundantly clear during the pandemic. Nevertheless, with our increasing reliance on AI-driven applications to manage our day-to-day life, also their challenges and limitations surfaced in many unexpected ways. It became evident what impact skewed data, mismatched algorithms, and technological glitches could have on important areas of our private and professional lives.

Human interactions that were traditionally built on relationships of mutual trust had to be moved into the comparatively anonymous virtual realm. Video calls did not only create, at times, an unnatural distance that was augmented by the delayed response of our conversation partners, but which also deprived us of many of the

nonverbal cues that facilitate social interactions. This has been especially challenging in matters that concern health and education, fields in which we value human expertise and dialogue especially highly.

Even though both sectors had profited immensely from AI technologies long before the current pandemic, the sudden reliance on online education and health services has fuelled the discussion in how far we can allow algorithmic decision-making into areas pertinent to our physical and psychological wellbeing. It might be that the pandemic only served as a catalyst that made us realise how interwoven our lives had already become with AI technologies prior to the onset of the global health crisis. However, under these new circumstances the question for the responsible deployment of AI received new urgency.

Public health and medical research are fields in which AI technologies have





AI could revolutionise the future of public health

GETTY IMAGES / GLYN KIRK

played a pivotal role in recent months. Whereas the discovery of new drugs and diagnostics had been advanced by AI long before the emergence of Covid-19, the contributions that AI technologies made to the speedy determination of the properties and behaviour of the virus and to the discovery of pharmaceutical measures to combat it cannot be overestimated.

AI-based applications have further been helpful in public health measures to help contain the virus. In a recent evidence meeting of the APPG on AI, Professor Tim Spector from King's College London gave evidence of the impressive results of the Covid Symptom Study which was conducted with the help of a symptom tracker application. The successful deployment of this app offers valuable insights for AI-driven methods in public health that will have a significant impact on epidemiological research and the medical community beyond the pandemic.

Many of the most impactful AI-supported methods in the fight against the Covid-19 crisis have profited immensely from the international and interdisciplinary collaboration of experts. Setting structures in place that facilitate these exchanges in the future will be of great benefit to the advancement of more data-driven medical research.

AI-driven apps and digital platforms have also facilitated the sudden shift to online classrooms and e-learning. Applications that enable personalised learning also promise to provide students with support tailored to their individual learning needs. However, to fully reap the benefits of EdTech, a comprehensive introduction to these new tools is necessary.

Many teachers, parents and students faced the challenge of familiarising themselves with new technologies and ways of learning within days as schools shut. During this process, structural inequalities became painfully apparent in the way families were able to realise a smooth shift to online learning for their children. Technical equipment, the

provision of an adequate learning space for the child under lockdown conditions as well as parents' understanding of the EdTech that was entering their home played an important role in the adoption of online education. For this reason, a sound education of AI that reaches all citizens will be indispensable for successful social inclusion and for making sure that every citizen can benefit from these new technologies.

UK businesses have also undoubtedly profited immensely from the introduction of AI technologies, even before the pandemic, as many processes could be made more accurate and reliable with AI-supported automation. However, the impact of Covid-19 has made the importance of a "human-in-the-loop" clear as predictive algorithms, that ran behind e-commerce and marketing failed when confronted with customer needs that did not correlate with the training data gathered before the health crisis.

The new demand that was created by the international health crisis called for experts to fix flawed AI systems that had been trained with now irrelevant data, which now needed to be updated to produce more reliable results.

As more and more businesses expand their AI strategy as a response to the crisis, the lack of in-house talent that is needed to deal with such unexpected events has become painfully obvious. For this reason, the government created a programme to increase the number of highly skilled workers in AI and data science, roles to which students with diverse professional and subject backgrounds can apply.

Above all, the pandemic has brought to the fore the urgent need for international and interdisciplinary collaboration to advance a fair and safe deployment of AI and the importance of making AI technologies relatable to all citizens to create a society in which everybody can benefit from technological advances. AI technologies offer great promises in countless areas of our life, but to realise this full potential, we need to get it right from the start. ●

New skills and diversity can transform the future of work

Collaboration, skills, and diversity will revolutionise the world of work, says **Lauren Kissner**, director of AI at Amazon's development centre in Cambridge

The way we think about work, employment and skills is rapidly evolving in our digital-first world. Technologies like artificial intelligence (AI) and machine learning (ML) are shaping the way we work, learn, shop, socialise and much more. There is a greater need for technical skills than ever before as technology continues to transform careers and every sector of our economy.

From agriculture to zoology, emerging technologies like AI have the potential to revolutionise our efficiency and productivity, improve outcomes, create entirely new jobs and free us up to focus our time and energy on higher impact, more valuable tasks and innovation.

A look at how the workforce has changed over time helps us understand the impact of technology on the labour market, underlining the need for both more technical skills and a "lifelong learning" mindset. Technical skills are a priority on the global stage: according to the World Economic Forum (WEF), around 123 million roles will be generated through data science and AI. The UK's top-three emerging jobs are Artificial Intelligence Specialist, Data Protection Officer and Robotics Engineer according to LinkedIn's Emerging Jobs report for 2020.

This shows how the UK's economy



can unlock the potential of emergent technologies with a healthy pipeline of employees possessing relevant technical skills, knowledge and a hunger to learn.

To understand the transformative nature of AI and ML, let's look at an example from the world of agriculture. They say an apple a day keeps the doctor away. If you apply AI and ML tools to create a "smart" orchard with automated and optimised processes, a farmer can ensure their customers are supplied with the freshest, crispiest British apples. In turn, the farmer has more time to focus on other areas of their business.

On our "smart" orchard, the farmer receives automated and real-time updates on the state of their crop. They are notified when the crop is at the optimal ripeness and can deploy an automated picker at just the right time to harvest the crop and send it

Diversity results in better outcomes

IN ASSOCIATION WITH

amazon



on to market. The apples then arrive at an automated sorting centre, which grades the fruit using ML algorithms to check for colour and freshness, before preparing the apples for distribution. Meanwhile at home, you or I order the fruit to be delivered to our doorstep.

This simple example highlights how AI can transform our productivity in many different sectors, while also creating new demand for skills and new jobs at each stage of the process – in fact data science and AI alone could create 58 million net new jobs according to WEF. The farmer and the sorting centre will need workers who understand the data and can repair the machines, while the grocery store needs ordering applications, sophisticated technology and automated logistics.

Likewise, in the office, automation can shift time away from repetitive tasks to higher-value, creative work that maximises people's potential. Less time spent filing paperwork or entering data to more time spent designing innovative products and learning. In healthcare, automation can give frontline nurses and doctors more time working directly with patients. Ultimately this puts us back in touch with why we love what we do.

While these technologies can be a powerful tool to create new opportunities, as well as societal good,

we must also be realistic about the risks. Building bias into technology, for example, would further the digital divide and impact parts of society that aren't represented in building these technologies. All companies must be mindful of these risks, and be responsible and inclusive as we build and implement AI and ML to ensure that we're not leaving anyone behind.

At Amazon, we believe that cross-industry collaboration, alongside diversity and inclusion, are vitally important as these technologies shape the way we work and think about work. Businesses, policymakers, and researchers must work to build a talent pipeline that reflects the society we're all trying to serve. For example, Amazon, Google/DeepMind, IBM, BBC, The Alan Turing Institute and Microsoft are already working together on AI Partnership, a global programme which aims to develop and share best practices, provide an open platform for discussion and engagement, and to identify and foster aspirational efforts in AI for socially beneficial purposes.

We need to keep working to build a diverse talent pipeline. We've launched initiatives such as Amazon Amplify, AWS Get IT, AWS re/Start, and even our own online Machine Learning University programme to help find tomorrow's data and AI specialists. Launched in the UK last year, Amazon Future Engineer is our comprehensive childhood-to-career programme to inspire, educate and enable children and young adults from lower-income backgrounds to try computer science.

We believe that innovation and

AI and ML can create a better world that works for all

diversity have a powerful relationship. A diverse workforce gives us a better understanding of our customers' needs and is key to unlocking new ideas.

Despite the potential for these technologies to drive economic growth and to create new opportunities for employees from all walks of life, evidence suggests a global skills shortage. In the UK, research from STEM Learning has shown that STEM roles are expected to double in ten years – yet 89 per cent of businesses are struggling to recruit for STEM roles.

We cannot rely solely on business, educational institutes or governments to close this gap by working in isolation – instead we must work together. Amazon's apprenticeship programme in the UK is just one example of such a partnership: last year we announced 1,000 new positions, currently being delivered across 19 apprenticeship standards – providing the participants with diverse work experience.

These apprentices are combining theoretical learning with hands-on training, enabling participants to obtain vocational qualifications and in many cases degrees – while earning annual salaries of up to £30,000 a year at the same time. Our apprentices work across the company – in corporate sites such as our London HQ and Cambridge Development Centre.

At Amazon, I'm proud of our work to find and develop talent from all backgrounds. We are motivated by the opportunity to help build the jobs, skills and opportunities of the future in an economy that is as diverse as our customers. As an organisation, we want to use our credentials in research, development and innovation to enrich the debate on ethical, responsible and socially valuable applications of emergent technology. These initiatives, working in concert with governments, our external stakeholders and partners, can result in a diverse, technically skilled workforce that will help to build the future. When AI and ML live up to their promise, we can create a better world that works for all of us. ●

What does a computer look for in a CV?

Technology may be able to sift through job applications more quickly, but humans still need to make key hiring decisions.

By Rohan Banerjee

Would you trust a robot to conduct a job interview? Talkpush, an American artificial intelligence firm, has designed a chatbot to do just that. Candidates needn't worry about an untucked shirt or having something stuck in their teeth – but how well can a machine really evaluate a potential hire?

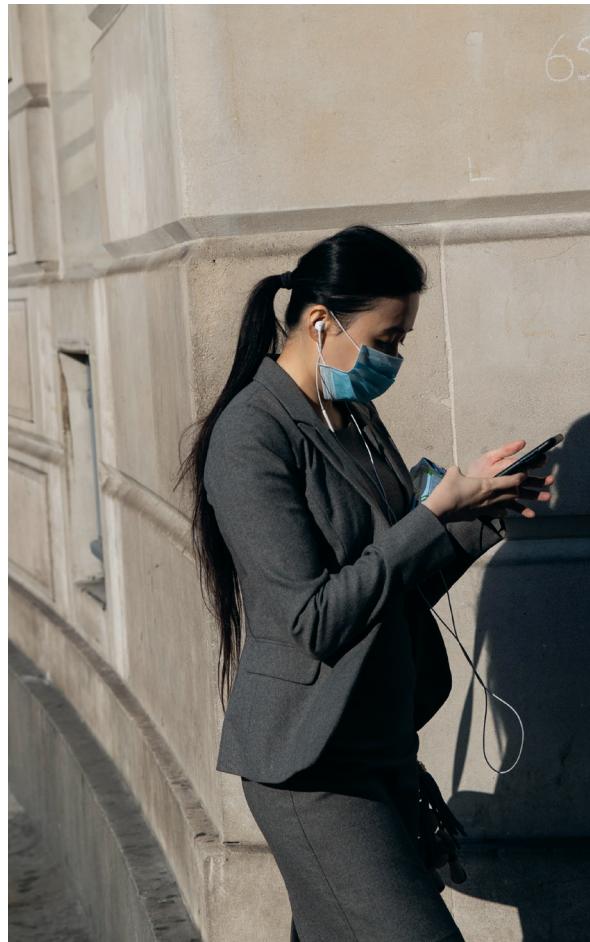
Talkpush's chatbot asks applicants to record information about their personality and relevant work experience, as they might on a WhatsApp voice message.

The chatbot does an initial sift of candidates. It scans the recordings for key words or phrases and then, if the applicant meets a set of criteria, the system forwards the audio content onto a recruiter or hiring manager, who then decides whether or not to invite them for a face-to-face meeting. Talkpush, its website says, aims to "make hiring

conversations faster", and generally to streamline shortlisting processes, rooting out the under or ill-qualified and saving unnecessary travel on behalf of candidates.

The coronavirus pandemic, and the social distancing protocols it has created, has undoubtedly changed the recruitment landscape. Companies across all sectors have had to adjust to the new normal of the virtual office and mass home-working.

And, when it comes to HR, Talkpush is not alone in using AI to try and help that transition along. The programmatic job advertising software used by another American firm, Appcast, runs predictive recruitment algorithms to analyse market data to determine how job ads will perform. The software decides when and where to place ads with, the Appcast website suggests, the ability to put them in front of "the most applicable





Some AI technologies have made it possible for candidates to complete interviews from their smartphones

of 200 million candidates." Appcast has over 10,000 recruiter partners, including job sites Glassdoor and Adzuna, and can, the company says, place an ad based on where a certain kind of candidate is statistically most likely to see it.

Recruiters are also using AI to scan CVs. Sifting through CVs, the Canadian technology firm Ideal estimates, can take up 24 hours per individual hire. Ideal's cloud-based software allows employers to upload large numbers of CVs and cover letters, ranking them

AI cannot manufacture diversity

GETTY IMAGES/DAN KITWOOD

according to suitability. Ideal's software looks for key words, length of time in previous employment, and other criteria that may have been specified by the employer using the technology.

Meanwhile, HireWand, a recruitment tech firm founded and based in India but also operating in the US, allows businesses to use an AI-powered headhunter of sorts. Collating candidate data from sources including career sites, publicly available LinkedIn profiles and CVs and applications directly sent to employers, HireWand builds a "talent pool" of potential employees. Similar to Ideal, the HireWand software screens and ranks candidates according to their suitability, but it goes one step further and contacts them on the employer's behalf. HireWand produces an automated message that it sends to candidates who match a certain profile, explaining why they are a good fit for a role available with the employer. It then gauges their interest in the position by asking a series of questions.

Inefficient processes are far from the only problem facing recruiters, however. The growing momentum of the Black Lives Matter movement in 2020 has highlighted structural inequalities and lack of diversity. HR departments have a big role to play in changing that picture when it comes to their organisations.

Unconscious bias – implicit, learned stereotypes that are able to influence behaviour – is the scourge of the hiring process. And within that, there are different types of bias. Confirmation bias is the tendency to interpret new evidence as a confirmation of a recruiter's existing beliefs; personal similarity bias leads to recruiters gravitating towards candidates who remind them of themselves.

Could AI help address these issues? Dr Lewis Paton, a research fellow at the Department of Health Sciences at the University of York, points out that AI technologies are "only as effective as the data put into them." Paton, who has previously worked on the application of AI to medical school selection, and studies aiming to diversify medical student backgrounds, explains that

machines "learn from the data being fed to them, and if that data reflects human biases, then machines can learn them as well."

Paton adds: "If there are systemic reasons as to why individuals from underrepresented backgrounds aren't applying for certain jobs or university courses, then it makes very little difference whether it is a robot or a human making the decision on each application... If there is no diversity in the applicant pool, there will be no diversity in the selected applicants."

James Targett, a consultant at Velocity Recruitment, a London-based firm specialising in construction, admits that unconscious bias is one of the key challenges of his profession. His firm, he says, conducts regular training to overcome this, but he notes that this is not standardised across the sector. "No amount of training can entirely remove it [bias]," he says, "but more regular sessions, or making it mandatory [across all companies in recruitment] would be a good start."

Targett is not convinced by a computer's capacity to make particularly insightful decisions on someone's personality. "The human touch is still necessary when looking for personal characteristics... there are many qualities that a person cannot easily translate to a CV." But he sees the merit in AI for streamlining some of the hiring process. "In some cases," he explains, "we can have applicants for a job who don't even meet the basic qualification requirements, so it would be good to be able to remove those from the outset. It would save time."

For Paton, there is "possibly a line to be drawn" between what AI can currently do in the hiring process and where human reasoning skills will still be needed. "Having an application rejected because an automated AI system found a number of spelling mistakes in your CV," he says, "is perhaps easier to understand than having an application rejected because an AI system, through a highly complex formula, predicted you wouldn't be very good at a job." ●

AI can spur real change in the legal sector

Professor Katie Atkinson, Dean of the School of Electrical Engineering, Electronics and Computer Science at the University of Liverpool, on how AI and automation technologies can streamline administration, cut costs and drive efficiencies

From technology giants to innovative start-ups, AI and automation are disrupting the way we live, work and even think, across a range of sectors. And the legal profession is no exception. To remain competitive, law firms must view technology and an increasingly digitised world as an opportunity, rather than a challenge.

The coronavirus pandemic has undoubtedly catalysed the fourth industrial revolution. As courts moved online and office-based law professionals worked remotely, the legal sector began to accelerate the power of this digital disruption.

Traditionally, legal professionals process vast quantities of lengthy official documents in order to conduct everyday legal work, taking up a lot of their time and consequently forming a large proportion of the costs associated with a legal case. But what if AI rather than a human could process these documents instead and, further, advise on decisions in legal cases based on previous precedents? Automation is not about the full replacement of jobs with technology but it will shift the focus of roles within the legal sector.

Research in AI and law

At the University of Liverpool, we have



been producing innovative research in the field of AI and law since the 1980s. Over the past decade we have developed innovative ways to extract and reason with relevant pieces of knowledge and data contained within complex legal documents, cases and laws. Our researchers build this legal knowledge into a “computational model of argument” to develop decision-support tools that can enable more consistent and faster decision making than manual human processing delivers.

These modelling tools have been demonstrated to be highly accurate in replicating the actual outcomes of closed court cases in a variety of well-studied areas, reaching a 100 per cent success rate in certain scoped legal fields. Thus, the AI tools that we have developed at Liverpool provide decision support that can advise on outcomes while displaying the arguments and justification process, assisting legal professionals to take informed actions.

We have also applied our work in industrial settings. A tool we developed in collaboration with a partner from the

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legal industry applies AI techniques such as natural language processing, data mining and machine learning to provide a fast, flexible and scalable system for extracting information from legal documents related to commercial law.

The ANGELIC methodology is the framework developed by Liverpool academics that enables AI programs to be designed to capture knowledge about a body of case law and advise legal professionals on the acceptable arguments in a case. This methodology can even assist in flagging inconsistencies between new and precedent cases, and accommodate changes in the law within the computer model as law-makers evolve the law. The methodology has been applied to real world domains in collaboration with an industrial partner from the legal sector.

Developing explainable AI

Currently, there is a lot of interest in AI from across the UK's legal sector and we are already seeing established technologies being successfully applied to the law. One strand of research

that we undertake at Liverpool is specifically focused on "explainable AI", meaning that the legal judgements our technologies make can be understood by humans. This is a very important ethical issue that we must address head on in order to foster trust and confidence in the use of AI from legal professionals, their clients and the public. Rather than our AI systems being seen as a black box, in which data inputs are converted into a verdict without any transparency, we need to remain accountable by being able to explain how our decision was reached, and why other options were rejected.

Our models of legal decision making use computational models of argument and hence they are able to explain their decisions akin to how a lawyer does. Humans use argumentation to debate and discuss what to believe and what to do, so we are building formal models that can be turned into computer programs for automated argumentation. These programs can take a set of arguments about a legal case and determine which are the acceptable ones and why, accounting for precedent cases, as is done in the common law system used in the UK.

Deploying AI technologies

To transfer our research into practice, we've collaborated with a number of law firms to deploy our AI technologies in their business operations. Working with top UK law firm Weightmans and tech company Kira Systems, we have developed an AI solution that is able to extract data to power a decision engine capable of carrying out legal reasoning. The solution can identify arguments for settling cases and speeds up decisions to deliver case handling improvements for Weightmans and its clients.

Through a Knowledge Transfer Partnership funded by Innovate UK, we've been working with another personal injury claimant law firm to develop support tools for their specialist area of law using our AI research. This has allowed the law firm to embed a culture of innovation through further

investments, generating significant benefits in terms of both efficiency and accuracy of case processing, thus boosting their profitability.

AI technology development takes time and resources but the positive impact on efficiency, accuracy and reduced case processing time has been found by our partners to significantly outweigh the initial expenses. We aim to help the firms make faster, more consistent decisions with the support of transparent AI tools, and ultimately deliver swifter justice for their clients. In addition, time savings enable earlier risk mitigation that can lead to better outcomes for businesses and customers.

The future of legal work

The widespread adoption of AI technology is set to transform the legal sector and disrupt the future of legal work. Through the use of automation, repetitive legal tasks will be carried out by AI technologies with increased speed and accuracy, allowing paralegals and lawyers to focus on cognitively challenging tasks. As a result, some job profiles within the legal sector are likely to shift away from traditional skill sets, as law firms look to recruit in-house data scientists and innovation managers to help them horizon scan and drive technological R&D within a competitive market.

Driving UK competitive advantage

The UK's legal services sector is a key segment of our economy. According to the Law Society, the legal sector added more than £60bn GVA to our economy in 2018 and employed over 350,000 people. In the uncertain economic era that we are finding ourselves in, it is vital that the UK legal sector remains globally competitive. To sustain their competitive advantage, UK lawyers are increasingly embracing productivity-enhancing legal technology, such as the innovative AI technologies that we've been developing at Liverpool. ●

For more information, please visit:
www.liverpool.ac.uk/digital

Regulate tech to realise the benefits

Policymakers must keep pace with the advancement of artificial intelligence, says **Elliot Wellsteed-Crook**, head of partnerships and public relations at London Tech Week

When it comes to industry regulation, the story normally goes that after years of self-regulation or no regulation there is a scandal that kicks regulators into shape. When it comes to artificial intelligence, that is not an option. So far regulators have been caught between a rock and a hard place. Act too soon, and ill-formed policies stifle innovation. Act too late, and you fail to protect society and industry. The choice for citizens globally is split: look to the state to regulate AI or to business?

No country has a coherent approach to regulating AI, and regulations quickly morph into principles and investment strategies. Take the 2019 OECD Principles on Artificial Intelligence, the first universal standards agreed to by major nations to promote AI technologies that respect human rights and democracy. In July, the European Commission published its AI High-Level Expert Group Assessment List to provide a checklist for businesses to self-assess the trustworthiness of their AI systems. While such voluntary

non-binding guidelines encourage the responsible development of AI, they hold no regulatory clout.

Setting standards is an important first step, what is next is to translate these principles into national and international law. Much of the talk about regulating AI is also positioned alongside driving inward investment. Singapore's AI Governance framework lists out AI policy principles alongside investment targets. This is a sign of how global competition for AI, and the promise of economic reward, has pushed AI regulation to the sidelines. Rather, effective regulation will do more to support AI reaching its full economic potential than suppress it.

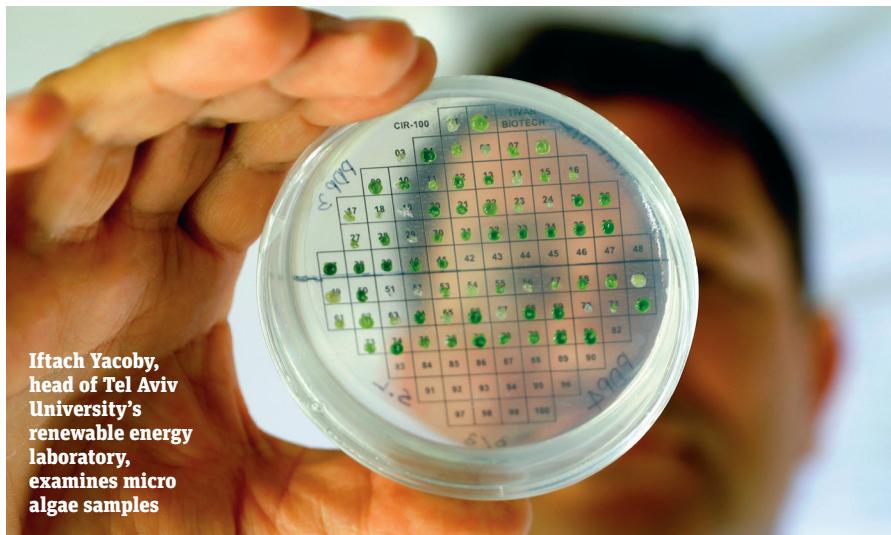
If you look at the top three tech hubs – the United States, China and the United Kingdom – each one is taking a very different approach. The US free market model has championed corporates focused on self-regulation. China's authoritarian approach, outlined in the 2017 initiative New Generation AI Development Plan, promotes a national push to become the world's "leading AI power by 2030" and sets itself in competition with the rest of the world. The UK is taking the middle ground, working with the public and private sector.

When it comes to the responsible and ethical development of AI, the UK leads the pack. The UK is uniquely placed to capitalise on this and develop policies and laws with a pragmatic understanding of how the technology works, and what the implications are. The 2018 AI Sector deal and the flurry of new-formed bodies since – the Centre for Data Ethics and Innovation, Regulatory Horizons Council and the UK government's AI Council – show immense promise to bridge the gap between industry and government, and advocate for AI regulation that serves to support, not stifle innovation. ●

London Tech Week will take place online between 1-11 September. The New Statesman is an official media partner. www.londontechweek.com

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Iftach Yacoby,
head of Tel Aviv
University's
renewable energy
laboratory,
examines micro
algae samples

How AI can create green jobs

Automation will lead to a “re-shifting” of roles in the move to clean energy, says Philippa Nuttall Jones, editor in chief of Energy Monitor

Certain regions, particularly those with a heavy reliance on one industry such as coal mining, will see job losses in the move away from fossil fuels. But overall employment figures related to the green transition are bullish. The move to clean energy will mean a net gain in jobs globally of 18 million by 2030, according to the International Labour Organisation (ILO), a UN agency. The Abu Dhabi-headquartered International Renewable Energy Agency estimates that as many as 42 million jobs will be created in the renewables sector by 2050.

Digitisation, and indeed automation, will be an important enabler of this shift. When it comes to concerns that an increased role for artificial intelligence (AI) will mean fewer opportunities for human brains, most experts are sceptical. Rather than putting predictions of job

creation at risk, “digitalisation can be a net job creator, including in the context of rapid technological change towards a zero-emission economy”, says Marta Wieczorek, spokesperson for economic affairs, jobs and social rights at the European Commission.

AI is already used to produce parts of solar panels and wind turbines, and is expected to play an increasing role in managing the production, transmission and consumption of variable renewable energy in electricity grids. Engineers are also exploring how AI can help repair offshore wind turbines, or how it can work with drones to inspect power facilities and identify potential faults.

Ensuring AI helps solve the “complex problems of climate change and does not leave humans without employment, while producing positive social

gains, means having the right policy frameworks”, says Camilla Roman, policy specialist at the ILO.

“We also need large investment in retraining and re-skilling workers,” she adds. Data on skills gaps globally is scarce, admits Roman, but the information available suggests these gaps are “widespread, especially in less developed countries”. Science, technology, engineering and mathematics skills are especially lacking, she says, and these voids could “act as a constraint to sustainability”.

Many issues relating to AI, jobs and the green transition are “being ignored or not reflected properly”, says her colleague Ekkehard Ernst, chief macroeconomist at the ILO. “Governments are aware lots more skills are needed. This does not mean everyone has to be an engineer, but people need basic digital skills.” If countries don’t invest in these skills, “the private sector may simply move production to where these skills exist, and this could slow the energy transition in some regions”, he warns.

Economists disagree about how many jobs will be displaced by AI and whether work that will be automated will be replaced by new or alternative work, says Devashree Saha, senior associate at the World Resource Institute, a US-based think tank. She believes that rather than net job losses there will be a “re-shifting of jobs”. In the energy industry, AI will generate more roles for humans and machines, says Saha, with AI leaving space for “human creativity and judgement, and machines doing routine, iterative tasks and jobs where they outperform humans such as in predictive analytics”. She also envisages hybrid roles, where humans and machines “augment each other’s capabilities”.

Saha recognises AI, like the energy transition, will cause “significant job displacement in certain sectors, geographies and even socio-economic groups, raising concerns about exacerbating existing inequalities”. Ultimately, though, she is confident “that AI is likely to create more jobs than it destroys”.



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