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# The Future of Work Guide

#NCW2022 #NCW2022 #NCW2022

National Careers Week



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# Introduction

Navigating the future of work can be daunting and overwhelming, especially when there is so much uncertainty about it and there are a number of resources out there. This guide has mainly been created to help careers advisers and teachers to better navigate and understand the future of work, so in turn they can help students to better prepare for it. It can also be used by anyone else interested in understanding the future of work. The guide will focus on the changes to the world of work which are expected to happen due to the Fourth Industrial Revolution and resulting automation.

The guide has been created by Mark Preen who has ten years of experience as an A-Level Economics teacher, and a strong interest in careers and the future of work. If you have any questions or feedback then you can contact him at [mark\\_preen@hotmail.com](mailto:mark_preen@hotmail.com).



# The Fourth Industrial Revolution

The world is currently going through a Fourth Industrial Revolution, which is the ongoing automation of traditional manufacturing and industrial practices, using modern smart technology. Types of modern smart technology include artificial intelligence, autonomous vehicles, biotechnology, the Internet of Things (IoT), nanotechnology, quantum computing, robotics, 5G wireless technology and 3D printing. This technology is merging more with humans and their lives, and therefore the distinction between the natural and artificial worlds is becoming less clear. The speed of change and innovation is also happening faster than ever before.

**The Fourth Industrial Revolution builds on the other three industrial revolutions:**


- First Industrial Revolution (around mid-18th century to the mid-19th century) which brought mechanical innovations, such as the steam engine, cotton spinning and railroads.
- Second Industrial Revolution (around the late-19th century to early-20th century) which brought mass production through assembly lines and electrification.
- Third Industrial Revolution (around the second half of the 20th century) which brought mainframe computers, personal computing and the internet.



This [video](#) from the World Economic Forum and this [video](#) from CNBC explain the fourth industrial revolution. This [video](#) from the World Economic Forum explains the revolution in even more detail.



# Automation

The Fourth Industrial Revolution will lead to more automation, which is the use of machines or computers to do tasks once performed by humans. The below summarises some key points on how automation is expected to affect the future of work. These points mainly come from Daniel Susskind's book "A World Without Work: Technology, Automation and How We Should Respond" and his TED Talk "**3 myths about the future of work (and why they're not true)**". 

- Where machines displace (or substitute for) workers, automation is viewed as harmful to jobs. However, it should be highlighted that this displacement tends to be in particular tasks rather than whole jobs.
- As well as substituting for workers, machines also complement workers with certain tasks. This benefits workers and makes their work more valuable.
- Sometimes machines complement workers more directly, which makes them more productive. For example, a taxi driver can use a sat nav to

navigate unfamiliar roads, and an architect can use computer-assisted design (CAD) software to design better buildings.

- Technological progress also complements workers indirectly. Firstly, technological progress makes the economic pie bigger (i.e. economic growth) due to increased productivity. People's income and demand will also increase. Despite old bits of the economic pie disappearing and there being displacement, workers will be able to find work in the new bits of the economic pie. Secondly, as well as making the economic pie bigger, technological progress will lead to new industries and new goods in the economic pie, and therefore new work for workers to do.
- Machines normally displace workers from routine tasks and workers continue to do non-routine tasks. Routine tasks are easier to automate because they are rules-based and repetitive whereas non-routine tasks require creativity, judgement and intuition. Workers who do more routine tasks are therefore more vulnerable to automation. However, with developments in



artificial intelligence, more non-routine tasks will become routine tasks, and with this task-encroachment machines will displace more workers. Further to this, even if the economic pie gets bigger, it is likely machines rather than humans will take on the additional tasks. Therefore, technology will complement machines rather than humans.

- In the past, the substituting force was weaker than the complementing force, and therefore overall workers benefitted from automation. However, as machines become more intelligent in the future, this will likely be the opposite. Therefore, workers are likely to be harmed from automation and automation anxieties will be more founded than in the past.
- If the substituting force becomes stronger than the complementing force, more workers are likely to be unemployed due to automation, and therefore they will not have an income from work. This is most likely to affect those workers who do routine tasks and are therefore at greater risk of automation. In contrast, those workers who are skilled and do non-routine tasks may be able to command higher incomes. In addition to this, the owners of the machines (or physical capital), such as the Big Tech companies, will have higher incomes due to more automation. The world is therefore moving more into a "winner takes all economy", and subsequently income and wealth inequality is likely to increase. With this, one of the big questions for the future will be "how should

the bigger economic pie be distributed?". This is a question that will need to be answered on the level of government and society as a whole. One of the main suggestions for solving this problem is a universal basic income (UBI).

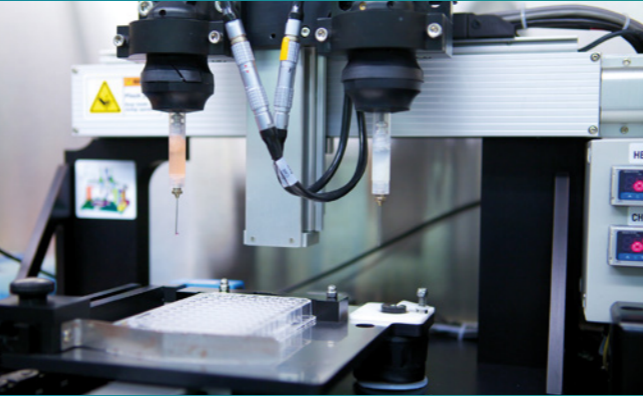
Other changes: As well as changes due to the Fourth Industrial Revolution and automation, there is also expected to be the below future changes:

- More of a gig economy, such as freelance work and self-employment, where there are less security, more flexibility and no jobs for life.
- More project-based teams rather than traditional organisational structures. This will also mean that leadership will be less formal and be more through influence and persuasion.
- A more decentralised workforce where workers can work online and therefore live and work anywhere.
- Ageing populations as health improvements mean that people live longer. This will lead to more opportunities for workers in the care industry.
- Continued challenges from climate change. This will also present opportunities in green industries.
- A more globalised labour market- a "global village".



# Examples of Fourth Industrial Revolution technologies

1 Companies, including Tesla and Google's Waymo, are developing self-driving cars. However, despite the hype and some technological progress, there are still safety concerns and we have a long way to go before we see driverless cars on our roads.



4 A 3D bioprinter has been developed which can produce organs, tissue and bones using plastic materials and living cells. These were then successfully transplanted into rodents. In the future, doctors may be able to do the same with a human patient using the patient's own cells.

5 In 1997 IBM's supercomputer Deep Blue beat world chess champion, Garry Kasparov, at a game of chess.



2 Amazon Go has opened convenience stores in the United States which are partly automated. Customers can walk out of the stores without having to check out with a cashier or self-checkout.



6 Apple's Siri uses speech recognition to answer questions, make recommendations and perform actions, such as writing messages and giving directions. Amazon has used similar speech recognition technology in its Alexa smart speaker.



3 Stanford University has developed an artificial intelligence algorithm which can identify skin cancer in humans with the same accuracy as dermatologists.



7 Boston Dynamics has created Spot the dog which is a semi-autonomous robotic dog. There is potential for Spot to be used in construction sites and other environments where it is unsafe for humans to go.



# Key Facts & Figures

Labour Market Information (LMI) can be used to better understand the future of work and then help students to prepare. For example, students might want to focus on jobs where demand is increasing and avoid those jobs that are expected to experience a decrease in demand. The below summarises some key facts and figures from a December 2017 report **“Jobs lost, jobs gained: Workforce transitions in a time of automation”** by the McKinsey Global Institute. The report looks at the effects of automation up to the year 2030, and it examines 46 countries accounting for about 90 percent of global GDP.

- 60 percent of occupations have at least 30 percent of constituent work activities that could be automated.
- As high as one-third of work activities could be displaced by automation by 2030. This is as high as 800 million workers. However, how high this is will depend upon the rate at which automation is adopted, which is affected by technical, economic and social factors.
- As well as displacing workers, automation will also create new occupations that do not exist today.
- By 2030, 75 million to 375 million workers (3 to 14 percent of the global workforce) will need to switch occupational categories.
- The proportion of work tasks automated varies widely across countries, with advanced economies more affected by automation than developing ones. Reasons for this include differences in economic structures and wage rates between countries. Where wage rates are higher there is more of an incentive to automate tasks.

The below table shows how different occupations in advanced economies and developing economies will be affected up to 2030. Some occupations will experience a decline, some will experience stability and some will experience growth. Those occupations experiencing decline tend to be occupations that are more routine and therefore more vulnerable to automation. Occupations will also experience changes for other reasons. For example, care providers will experience growth due to ageing populations.

Jobs of the future		
Occupation	Advanced economies	Developing economies
Unpredictable physical	Decline	Growth
Customer interaction	Stable	High growth
Predictable physical	High decline	Stable
Office support	Decline	Growth
Professionals	High growth	Growth
Care providers	High growth	High growth
Builders	Growth	High growth
Managers and executives	High growth	Growth
Educators	Growth	High growth
Tech professionals	Growth	Growth
Creatives	Growth	Growth

# Preparing for the future of work

The previous sections of this guide have mainly focused on how the future of work is expected to change due to the Fourth Industrial Revolution and automation. Although having this awareness is useful in itself, it is better to go further by considering what can be done to prepare students for the future, so that they are more future proof and even able to thrive. Developing important skills and traits are two of the main things that can be done. As well as preparing students for the Fourth Industrial Revolution and automation, these skills will also put students in a stronger position when it comes to coping with other challenges, such as competing in a more globalised labour market and against global talent.

Important skills and traits mainly relate to those required to work with machines due to more collaboration with machines, and those skills and traits which are harder to automate. Soft-skills are one category of skills that will be important. They are non-technical skills and influence how well the individual can work with others.

Skills and traits which will be important in the future include:

- Computer or “tech-savvy” skills, such as coding. These will become even more important as machines become increasingly capable.

- Data literacy to use and understand the “big data” which machines produce.
- Emotional intelligence required to effectively collaborate with and lead others.
- Cultural and global awareness as it is likely that people will increasingly be working with people from around the world due to increased globalisation and technological progress. Speaking other languages will also help with this.
- Resilience and adaptability in a world where change is the only certainty. For example, the ability to cope with change by developing new skills for a new job or task, which will help to ensure that the worker can more smoothly transition from one job or task to another.
- The individual taking responsibility for their own learning so that they can develop the necessary skills. This will require a process of life-long learning, so in this respect school never ends. One of the reasons this is important is because people will have longer working lives, and different jobs rather than a job for life. Another reason is because the half-life of a skill is significantly decreasing. Indranil Roy, the head of the Future of Work Centre of Excellence, says “a generation ago, the half-life of a skill was about



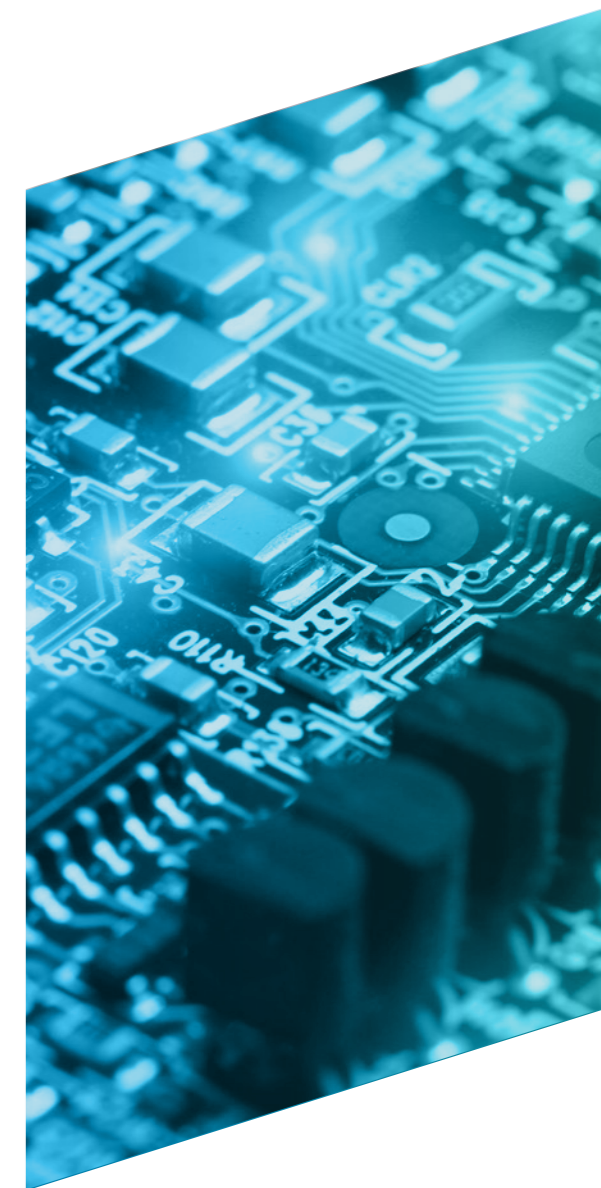
26 years, and that was the model for a career. Today, it's four and half years and dropping”<sup>1</sup>.

- Networking. One of the benefits of this is that connections can help the individual with change and transitions.
- Other skills: communication, creativity & innovation, critical thinking, entrepreneurship, growth mindset, problem-solving, self-awareness and teamwork.

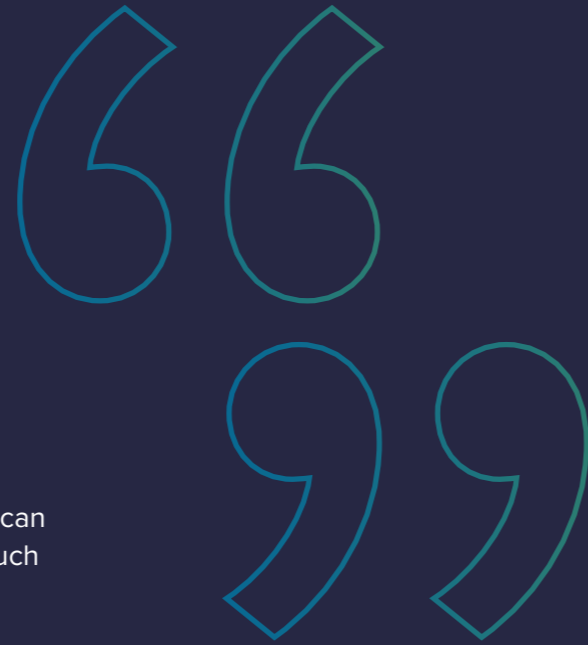
These skills and traits can be developed by educational institutions and students through various initiatives, such as The Extended Project Qualification (EPQ), PSHE<sup>2</sup>, Young Enterprise, work experience, volunteering, trips, problem-based learning (PBL) and leadership programmes. Many educational institutions already offer these. Students can also take advantage of other initiatives independently, such as massive open online courses (MOOCs). However, there is still potential for these initiatives to be further extended and for the education system to be further developed and even reformed. If this happens then the education provided will be more relevant to the 21st century with students having the necessary skills and traits for the future. For more information on the future of education and future skills, it is worth checking out Dr Tony Wagner who is a Senior Research Fellow at the Learning Policy Institute.

<sup>1</sup> Quote taken from this article: <https://www.bbc.com/worklife/article/20190127-humanics-a-way-to-robot-proof-your-career>

<sup>2</sup> Personal, Social, Health and Economic education.



# Future of Work Quotes



Below are some quotes relating to the future of work. These can be used to inspire students and even generate discussion, such as whether students agree or disagree with the quote.

*The best way to predict the future is to create it*

- Abraham Lincoln.

*I fear the day that technology will surpass our human interaction. The world will have a generation of idiots*

- Albert Einstein.

*The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn*

- Alvin Toffler, Futurist.

*As more and more artificial intelligence is entering into the world, more and more emotional intelligence must enter into leadership*

- Amit Ray, AI Scientist.

*A breakthrough in machine learning would be worth ten Microsofts*

- Bill Gates.

*Future strong is being focused enough and mindful enough and courageous enough to search for patterns and order when all others see chaos and noise*

- Bill Jensen, Author.

*Artificial intelligence could be the most disruptive human innovation in history- are we ready?*

- Darrell M West, Author.

*AI doesn't have to be evil to destroy humanity – if AI has a goal and humanity just happens to come in the way, it will destroy humanity as a matter of course without even thinking about it, no hard feelings*

- Elon Musk.

*If we teach today's students as we taught yesterday's, we rob them of tomorrow*

- John Dewey, Educational reformer.

*Imagination allows us to conceive of delightful future possibilities, pick the most amazing one, and pull the present forward to meet it*

- Jason Silva, Futurist.

*For time and the world do not standstill. Change is the law of life. And those who look only to the past or the present are certain to miss the future*

- John F Kennedy.

*How will all keep busy when we only have to work 15 hours per week?*

- John Maynard Keynes, Economist.

*The biggest change in the world today is that the young don't learn from the old, they teach the old about the world today*

- Klaus Schwab, Executive Chairman of the World Economic Forum.

*The future of work consists of learning a living*

- Marshall McLuhan, Philosopher.

*Machine intelligence is the last invention that humanity will ever need to make*

- Nick Bostrom, Philosopher.

*The deeper issue here is that any changes in the work that people do tend to originate at the level of particular tasks involved, and not with the job in general terms*

- Richard Susskind, Author.

*Evolution never looks to the future*

- Richard Dawkins, Evolutionary biologist.

*The challenge of the unknown future is so much more exciting than the stories of the accomplished past*

- Simon Sinek, Author and Motivational Speaker.

*Everyone can enjoy a life of luxurious leisure if the machine-produced wealth is shared, or most people can end up miserably poor if the machine owners successfully lobby against wealth redistribution. So far, the trend seems to be toward the second option, with technology driving ever-increasing inequality*

- Stephen Hawking.

*You can't connect the dots looking forward; you can only connect them looking backwards. So you have to trust that the dots will somehow connect in your future*

- Steve Jobs.

*Today knowledge is free. It's like air, it's like water. There's no competitive advantage to knowing more than the person next to you. The world doesn't care what you know. What the world cares about is what you can do with what you know*

- Tony Wagner, Education specialist.

*Making high earners feel better in just about every part of their lives will be a major source of job growth in the future*

- Tyler Cowen, Economist.

*Whoever becomes the leader in this sphere (- Artificial Intelligence) will become the ruler of the world*

- Vladimir Putin, President of Russia.

*The human worker will go the way of the horse*

- Wassily Leontief, Economist.

*Questions you cannot answer are usually far better for you than answers you cannot question*

- Wassily Leontief, Economist.



# Additional Resources

## Books:

**After Shock: The World's Foremost Futurists Reflect on 50 Years of Future Shock-and Look Ahead to the Next,** by Ray Kurzweil et al.

**An Optimist's Tour of the Future,** by Mark Stevenson.

**A World Without Work: Technology, Automation and How We Should Respond,** by Daniel Susskind.

**Bullsh\*t Jobs: The Rise of Pointless Work, and What We Can Do About It,** by David Graeber.

**Future Proof: Reinventing Work in the Age of Acceleration,** by Diana Wu-David.

**Future Proof Your Career: From the Inside Out,** by John Fitzgerald.

**Futureproof: 9 Rules for Humans in the Age of Automation,** by Kevin Roose (publication January 2021).

**Future Smart: Managing the Game-Changing Trends that Will Transform Your World,** by James Canton.

**Gigged: The Gig Economy, the End of the Job and the Future of Work,** by Sarah Kessler.

**Humankind- A Hopeful History,** by Rutger Bergman.

**Shapers: Reinvent the Way You Work and Change the Future,** by Jonas Altman.

**Shaping the Future of the Fourth Industrial Revolution: A guide to building a better world,** by Klaus Schwab and Nicholas Davies.

**Superintelligence: Paths, Dangers, Strategies,** by Nick Bostrom.

**The Future Is Faster Than You Think: How Converging Technologies Are Transforming Business, Industries, and Our Lives,** by Peter H Diamandis and Steven Kotler.  
**The Future of Humanity: Terraforming Mars, Interstellar Travel, Immortality, and Our Destiny Beyond,** by Michio Kaku.

**The Future of the Professions: How Technology Will Transform the Work of Human Expert,** by Richard Susskind, Daniel Susskind et al.

**The Future of Work: Robots, AI, and Automation,** by Darrell M West.

**The Shift: The Future of Work is Already Here,** by Lynda Gratton.

**The 100-Year Life: Living and Working in an Age of Longevity,** by Lynda Gratton and Andrew Scott.

**Uncharted: How to Map the Future,** by Margaret Heffernan.

**21 Lessons for the 21st Century,** by Yuval Noah Harari.

## TED Talks:

**Future of work: Hiding in plain sight,** by Kelly Monahan.

**How to Future Proof Your Career,** by Jacob Morgan.

**How to Future-Proof Your Career,** by Dorie Clark.

**Play, passion, purpose,** by Tony Wagner.

**The human skills we need in an unpredictable world,** by Margaret Heffernan.

**What explains the rise of humans?** by Yuval Noah Harari.

**What happens when our computers get smarter than we are?** by Nick Bostrom.

**3 myths about the future of work (and why they're not true),** by Daniel Susskind.



## Twitter hashtags and accounts to follow

#AI	@FHIOxford	@lyndagrattton	@richardsusskind
#Futureofwork	@futureguru	@michiokaku	@SarahFKessler
#Futurist	@_futureofwork	@M_Heffernan	@simpletonbill
@danielsusskind	@harari_yuval	@PeterDiamandis	@simonsinek
@dorieclark	@jacobm	@ProfAndrewScott	@steven_kotler
@darrwest	@Kevinroose	@rcbregman	@singularityhub

## Websites:

- BBC Future and BBC Worklife
- Future Ready Schools
- Future of Humanity Institute (Oxford University)
- Future of Work Hub
- Futurism
- Institute for Global Futures
- RSA Future Work Centre
- School of International Futures
- The Futurist Institute
- The Future of Life Institute



## Key Concepts A - Z

**Age of labour:** a time in which workers have generally benefited from technological progress rather than being harmed by it.

**Age of leisure:** a time in which humans will have lots of leisure time due to automation and the end of the age of labour. Humans will therefore have to think about how they spend their leisure time, and how they find meaning without a paid job.

**Algorithm:** a series of commands used by a computer (or artificial intelligence) along with data to solve problems, and therefore complete tasks.

**Artificial intelligence (AI):** intelligence demonstrated by machines, which is in contrast to the natural intelligence displayed by humans. It can be divided into Artificial Natural Intelligence (ANI), Artificial General Intelligence (AGI) and Artificial Super Intelligence (ASI) with intelligence increasing from the former to the latter:

**Artificial Natural Intelligence (ANI):** artificial intelligence that focuses primarily on one single narrow task, with a limited range of abilities.

**Artificial General Intelligence (AGI):** artificial intelligence that would be on the level of a human mind and would allow machines to perform a wide range of tasks. It has yet to be achieved.

**Artificial Super Intelligence (ASI):** artificial intelligence that surpasses the human mind, and therefore machines become superior to humans.

**Automation anxiety:** the fear that machines will replace workers and take their jobs away. During the first industrial revolution “Luddites” smashed and vandalised machines due to their concerns about losing their jobs.

**Automation risk:** the risk of a task or job being automated. Some tasks or jobs are more at risk than others.

Some countries are also at more risk of automation than others due to differences in economic structures.

**Economic inequality:** the difference in how assets/wealth or income are distributed among individuals. It can be measured by the Gini Index, which gives a number between 0 and 1. The higher the number, the greater the degree of inequality. Unless there is a redistribution of wealth and/or income, it is expected that inequality will increase due to the Fourth Industrial Revolution and automation.

**Data:** facts and statistics which are normally numerical. Large sets of data are important because they are fed into artificial intelligence to recognise patterns.

**Digital nomad:** a person who uses technology to earn a living and work in a nomadic manner.

**Disruptive technology:** an innovation that significantly alters the way that consumers, industries or businesses operate.

**Gig economy:** a labour market where characterised by short-term contracts or freelance work. For example, the food delivery company Deliveroo. Although workers have benefits, such as more flexible working hours, there are downsides, such as unpaid holidays.

**Hollowing out of the middle-class:** Since the 1980s technological change has led to more jobs for the low-skilled and the high-skilled whereas there are fewer jobs for the middle-skilled. With this there are more low-paid and high-paid jobs and less middle-paid jobs, and therefore a polarisation of pay contributing to greater inequality. Unemployment amongst the middle-class will be even higher if they are unwilling to take the low-skilled and low-paid jobs, if they do not upskill to the high-skilled and high-paid jobs.



**Intelligence explosion:** where the work on artificial intelligence eventually leads to artificial superintelligence with the intelligence of machines surpassing the intelligence of humans.

**Internet of Things (IoT):** encompasses everything connected to the internet and that “talk” to each other. For example, smartphones and wearables which are connected to each other.

**Machine learning:** an application of artificial intelligence where the machine can automatically learn and improve from experience without being explicitly guided or programmed by humans. This learning is therefore “bottom-up” rather than “top-down” in nature.

**Off-campus workers:** workers who work remotely rather than on-site at the company. Technology has allowed for this more. The opposite of this is on-campus workers.

**Off-balance sheet workers:** contingent workers, such as freelancers. This is part of the gig economy. The opposite of this is on-balance sheet workers.

**Pragmatist view of artificial intelligence:** the view that machines can complete a task in a fundamentally different way and using different rules to how humans complete the task. The human way therefore does not necessarily need to be copied. This is in contrast Purist view which attempts to use artificial intelligence to solve the mysteries surrounding human intelligence.

**Precariat:** people that have a life of unstable and insecure labour. The number of the precariat in the future is likely to increase due to changes in the world of work. Guy Standing has written extensively about the precariat.

**Sharing Economy:** the peer-to-peer (P2P) activity of sharing goods and services on an online platform. This differs from the traditional business model of corporations. Airbnb and Uber are examples.

**Singularity:** a point in time in the future when machine intelligence surpasses human intelligence, and therefore artificial superintelligence is achieved. This will lead to unforeseeable changes to human civilisation. Some even fear that this could lead to an AI Dystopia where machines enslave humans.

**Smart city:** a city that uses smart technology and the internet of things to provide services and solve the city’s problems.

**Structural unemployment:** a mismatch of the skills between the unemployed and available jobs. It can be brought about by technology which makes the skills of many workers out of date.

**Structural changes:** a shift or change in the way that the economy operates. For example, overtime workers have moved from working in the primary sector to the secondary sector and then to the tertiary sector. Many worker in advanced economies now work in offices in tertiary sector industries rather than in farms or factories.

**Technological unemployment:** when developments in technology lead to some workers losing their jobs. It was popularised by famous economist John Maynard Keynes in the 1930s, and is a type of structural unemployment.

**Universal basic income (UBI):** all adults in a country or region receiving a sum of money from the state to cover the basic cost of living, which is paid regardless of the individual’s circumstances. The UBI has been proposed as a solution to problems created by automation.

**Zero-hours (or casual) contracts:** A contract between an employer and a worker, where the employer is not obliged to provide any minimum working hours, and the worker is not obliged to accept any work offered. These contracts are a feature of precarious work.



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