



New  
Direction



# ARTIFICIAL INTELLIGENCE AND THE FUTURE OF TECHNOLOGY

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# New Direction



Founded by Margaret Thatcher in 2009 as the intellectual hub of European Conservatism, New Direction has established academic networks across Europe and research partnerships throughout the world.



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# INTRODUCTION

Artificial Intelligence (AI) is all around us, and has been for some time. However over the next decade, technological advancements mean that it is highly likely, if not certain, to become the pervasive technology of our age.

It is also an incredibly wide topic, as AI can refer to a wide variety of things, from self-replicating robots that could threaten humanity, to tools that can predict human diseases such as cancer. It can even refer to the reaction of sprites in a computer game trying to avoid a missile fired by a human player

As such, any report on AI has to be both broad, and partly speculative. Many of the potential AI applications are not yet here and their impact can at this point only be guessed. Yet at the same time, we are currently living with many applications, which could be described as having AI attributes.

There is little doubt however that the future development of AI has the potential to radically change many aspects of the human existence. Even if it doesn't succeed in going that far, the technologies that we can already see around us will develop to such an extent that they will have significant implications and both opportunities and threats, for all aspects of society.

In 2019, we do not know what new technologies, industries or military applications these will spurn. Just as the development of smartphones, online marketplaces, social media networks and search engines were merely figments of the imagination 25 years ago, it is impossible to know, with any sense of confidence, just how AI will change our lives, our politics and our societies in the years to come.

However, we can make an educated guess based on the current development of AI and its limitations in the short to medium term. AI offers the promise of increased economic growth yet that could put many existing industries, companies and jobs under threat. If they disappear completely, it will cause new and

significant economic and societal challenges. This fear can fuel negativity around the development of AI from policymakers around the world. Yet, as has been the case in every previous economic revolution, history suggests that over time jobs and industries that are lost are replaced by many more better and higher paying jobs. There will be a period of disruption, as the new jobs often don't immediately replace the lost ones, however in the long run, they will emerge. The challenge for policymakers will be in managing the period in between the two, and ensuring that education and social systems are built in such a way to ensure that lower skilled workers, who are more at threat of automation in particular, are able to find their way into the new jobs that will be created.

AI applications are also set to offer many more opportunities for consumers and are likely to drive a new wave of goods and services which will make life easier and which have the potential to drive a significant increase in living standards around the world. They also have the possibility to detect and cure diseases much earlier than is currently possible

However there is also a darker side to AI. It has the potential to create a future where so much data is available on an individual that a surveillance state emerges. Rather than being encouraged by AI, freedoms could be crushed by it instead. We are already seeing the emergence of this phenomenon in China.

In addition, human biases on gender, race, nationality or religion could be translated to the software that drives machine learning and those biases could become inbuilt into the AI system, leading to potential discrimination against those on the wrong end of the algorithm. Some fear machines that can learn for themselves may eventually run unchecked and could ultimately threaten the security of the world and the future of mankind.

This report looks in depth at the opportunities and challenges that AI will bring. It will look at the

ethical, societal and industrial aspects of this digital revolution. It will examine how policymakers can respond to these challenges and how legislation and tax policies can be moulded to ensure that the developed world, and Western countries in particular, can minimise the risks associated with AI, and manage the significant opportunities that these technologies will bring.

AI will be a key technology driving the second phase of the digital revolution. This phase will go far beyond what the Internet has already achieved. For this reason, this report makes a distinction between the two phases of the digital revolution. The first phase (the Early or First Digital Revolution) can be mapped broadly between 1992-2018 and is dominated by the development of new industries such as search engines, online marketplaces, e-commerce platforms, social media networks and the emergence of the smartphone in the latter part of the first decade of the 21<sup>st</sup> Century.

The second phase will see the Internet move from the smartphone and the personal computer to everything else. An internet of Things (IoT) will emerge where every object, from a fridge in a suburban kitchen, to a car on a motorway, will have the potential to be permanently connected to the internet and to communicate with each other. Autonomous or self-driving cars will increasingly be present on our motorways and in our cities. Urban infrastructure will change in order to accommodate them. Digital assistants, already beginning to become a presence in many customer service related industries, will become far more prevalent. Machines used in manufacturing will increasingly be able to predict and react to changes needed in the production process. Over time such technology will be able to fit into virtually every object, no matter how small. It may also increasingly become part of human beings themselves

This second digital revolution has already begun, but it is still in an embryonic state. It is for this reason that this report starts from the premise that we are at the start of the second digital revolution, as the

technology already exists and is being applied in an embryonic form. However it will take some time for these technologies to fully develop. The second part of the digital revolution will be dominated by the Internet of Things, connected and autonomous cars, machine learning in the manufacturing process and quite possibly cloud robotics and 3D printing.

We are therefore at the start of this Second Digital Revolution and its impact is likely to begin being felt most strongly in the first half of the next decade. Over this timeframe, the biggest impact will be seen in the workplace, where the development of more advanced AI technologies, including machines which can potentially learn on the job, has the potential to fundamentally reshape the industrial environment and the role of humans within that workplace.

AI itself is a huge field, and there are many aspects to it, however its continued development relies on the processing of large amounts of data.

The amount of data produced will grow exponentially over the coming years and how that is processed and how the algorithms interpret that data will be key to unlocking the potential of AI. For consumers this will mean much more convenient services and goods, but will also mean that every aspect of life can potentially be tracked. The data that these machines collect will contain truths and secrets that will change, enhance and challenge our perception of virtually every aspect of the human experience.

From a political and ethical perspective this is where the biggest policy battles of the next decade will reside. In 2019, more data will be produced globally than humans have produced in all preceding years. The same was true in 2018 and 2017 and with a continually growing global Internet community this is likely to continue for the foreseeable future. Connected cars alone are producing 4 terabytes of data per day and Facebook produces 4 petabyte of data daily<sup>1</sup>

According to the Domo Data Never Sleeps 6.0 report, by 2020 for every person on earth, 1.7 megabytes of data will be created every second.<sup>2</sup>

Inside this incredible amount of data hides the fuel for artificial intelligence. No artificial intelligence system can grow without vast quantities of data, as within that data lies evidence, information and clues which can help answer many of the mysteries inherent in the modern world. From the relatively mundane such as traffic flows or food tastes, to the ability to identify, predict and cure diseases even before then have occurred. In most cases the answer lies within the data and as long as the data can be accessible and data sets are of good quality, computers will increasingly be able to identify the key trends within it.

This will give consumers huge advantages, but will pour flames on an already challenging political debate around personal data - who owns it, who can use it and to what extent should data sets be used for the public good?

New industries will spawn from this data and the software used to process it.

We therefore face a crucial phase in technological development and one which has already unleashed fierce international competition. Today, it is primarily the USA and China who are leading the development of Artificial Intelligence. Those who are the first to master it will reap significant benefits. Europe remains an important region for the development of AI, but lags behind the USA and China, for a variety of reasons. However Europe will need to ensure that it has the right framework to ensure that it can catch up if it hopes to retain its preeminent position in the international system over this century.

AI offers both Europe and the USA some new industrial opportunities, as machines learn to customise themselves we may enter an era of mass customisation, where products can be mass produced to different specifications on the same production line. This something that is far closer to the Western humanist tradition. Western systems often are more tailored to individualisation and it has the technology, institutional knowledge and educational systems in place for it. This means that for industry, AI offers a unique opportunity for the West to re shore industry that it has lost to cheaper competitors in recent decades and replace the lost jobs with newer and better ones. Those new jobs may not be directly in

the factories producing the goods, but are likely to be in the supply chain and the ancillary industries which surround it.

It also offers the West a technological tool with which it is well placed to win the on-going battle for hearts and minds between individual rights and freedoms, and totalitarian dictatorship. However on this point there are risks, AI technologies will also give dictators the strongest tool yet invented by humans to monitor and control their populations.

Many jobs are likely to be threatened by AI technologies, but they will be replaced by new and better jobs. These jobs don't currently exist but automation will free up the human potential to create them. This transformation could pose public policy challenges as the job losses are likely to be focused on the lowest paid and lower skilled part of the economy. This could strain social relations and may accentuate the existing split in many Western countries between urban, connected cities and post industrial hinterlands.

However a far fewer proportion of jobs in the West are unskilled or at threat from automation than the jobs in the developing world. Developing countries are therefore likely to be hit much harder by the AI revolution. They could lose entire manufacturing industries and entire workforces at a time when more people are entering the workforce and without the institutional knowledge to replace them. This has the potential to fundamentally alter the social structure and stability in these countries.

It is within these realms that this report looks at the potential impact of AI and how policymakers should respond. The three key challenges are ethical, societal and industrial and while the military aspect should not be overlooked, it is not the subject of this report.

Whilst the challenges and opportunities are great, the impact of AI over the next decade is likely to be less obvious than many assume, Like the first phase of the Digital revolution, it will slowly seep into all aspects of our lives and will become the norm before we have fully realised what is happening. If it reaches only a fraction of its potential, and we manage the potential pitfalls, it will make life on earth much better.

<sup>1</sup> <https://www.weforum.org/agenda/2019/04/how-much-data-is-generated-each-day-cf4bddf29f/> There is a significant amount of info available as to the scale of the data created on a daily basis. Some sources and infographics can be found here, including the Domo Data Never sleeps Report <https://web-assets.domo.com/blog/wp-content/uploads/2019/07/data-never-sleeps-7-896kb.jpg> <http://res.cloudinary.com/yumyoshoin/image/upload/v1/pdf/future-data-2019.pdf> <https://www.forbes.com/sites/bernardmarr/2018/05/21/how-much-data-do-we-create-every-day-the-mind-blowing-stats-everyone-should-read/#76f1580f60ba>

<sup>2</sup> [https://www.domo.com/assets/downloads/18\\_domo\\_data-never-sleeps-6+verticals.pdf](https://www.domo.com/assets/downloads/18_domo_data-never-sleeps-6+verticals.pdf)

## THE FIRST DIGITAL REVOLUTION

Artificial Intelligence has been around in an embryonic way since the start of the digital revolution. CPU controlled characters in computer games have often contained an element of artificial intelligence that governed how they react to a human players moves. In 1997, IBM's Deep Blue computer famously beat World Chess Champion Garry Kasparov.

The algorithms that govern many of the existing platforms are also a basic form of artificial intelligence. However, we are now on the threshold of computer power being increased so exponentially that computers will be able to go far beyond what they have done previously. This will spark, and is already beginning to spark, the next phase of the digital revolution. This has been variously described as "The Second Machine Age"<sup>3</sup>, the "Fourth Industrial Revolution"<sup>4</sup> "Industry 4.0" in Germany and "Society 5.0" in Japan. Max Tegmark described it as Life 3.0 in his book of the same name.<sup>5</sup> As it's impact will be felt far beyond industry, this report is using the term "The Second Digital Revolution" to differentiate between the age we are living through now, which saw the dawn of mass computing, which is described as the "First Digital Revolution" and the coming age which will be dominated by far more powerful computers and artificial intelligence applications.

The first digital revolution can be traced to the mid 1990's when the internet, email and personal computers started migrating from the workplace and into the home.

Since then those computers have become far more powerful and have increasingly moved from the home, directly into consumer's pockets. The Internet, combined with mobile technology and Global

Positioning Systems in the second half of the first decade of the twentieth century, have fundamentally changed the way we work, play, communicate, date, travel, consume, read, invest, socialize, advertise, campaign and educate ourselves. Primarily this has been achieved by providing a global population of billions of people with the means to be permanently connected to each other via the super computer, or mobile phone, that they carry in their pocket.

This process and the new data that it produced, allowed a wide variety of companies the opportunity to process that data and turn it into opportunities to market new applications and services to this newly connected global population. This process decisively shifted the power structures in our societies. Existing elites, companies and industries found themselves being swept aside by this technological change, in the same way that incumbent industries had been in previous industrial and agricultural revolutions. New industries such as the search engine, online commerce and the social media platform emerged from nowhere, creating completely new power brokers who were far more dominant in their industry than anything that came before.

This changed society as well as industry. The online commerce stores such as Amazon had a reach far beyond any bricks and mortar store, who themselves focused on the techniques that had made them successful in the previous era. Used to having significant market share, they didn't see what was coming and were unable to react in time. The Amazon store was open 24 hours a day 7 days a week, and was open to anyone, regardless of where they lived. Amazon didn't need to spend anything on large retail units which would stand empty at night and on Sundays. They didn't need to staff those shops.

<sup>3</sup> Bryan Jolfsson, Erik & McAfee, Andrew 2016, "The Second Machine Age, Work, progress and prosperity in a time of Brilliant technologies" W.W.Norton & Company

<sup>4</sup> Schwab, Klaus (12/12/2015) "The Fourth Industrial Revolution, what it means and how to respond" Foreign Affairs

<sup>5</sup> Tegmark, Max 2017 "Life 3.0, Being Human in the age of Artificial Intelligence" Penguin Books

They didn't need to hold huge amounts of stock in duplicate stores around the country and they could offer a vast array of products, easily outstripping even the most powerful retailer on the variety of choice they offered. They had a potential footfall of the entire internet community, numbering hundreds of millions.

The internet made bricks and mortars retailers uncompetitive at nearly every level. The only advantages they kept were "instant gratification" for a customer. They could buy and immediately have the product, whereas when they ordered online they would have to wait for days to receive it. The second advantage was the human interaction of dealing with a real person. This was seen to be important in terms of trust and was also a significant advantage in terms of customer services. Retailers could also offer an "experience", so that a day out shopping itself was something to look forward to.

Retailers tended to think that these advantages would see off the online competition, and for bigger retailers, with economies of scale, it did. Often for smaller, independent shops located in town centre high streets, these advantages weren't enough to compensate the fact that they couldn't compete on price. As a result, throughout the Western world, the first digital revolution has changed the appearance of many town centres. Retail chains around the world have fallen victim to digitization and these have had a knock on effect far away from the world of the Internet. Town centres had often been the focal point of local communities.

Today only the most agile retailer can survive, yet their advantages continue to be hollowed out. Instant gratification for online purchases may come very quickly if Amazon's experiments on drone deliveries are successful. Digital shop assistants are increasingly replacing human staff and politicians seem intent on making a day at the shops an unpleasant experience with restricted opening hours, parking charges and overzealous parking enforcement.

However consumers were the main beneficiaries, online competition mean that they could now shop whenever they wanted, not when politicians allowed them to shop, they had a new choice which through

its economies of scale offered them a greater array of goods at far cheaper prices. The fact that the bricks and mortar retailers reacted only increased the benefit to consumers, who benefited from the full force of competition that was now charging towards the established retail chains.

This same process, and challenges for incumbents, was repeated in industry after industry. Netflix challenged the old fashioned view that TV executives decide the mood of the nation by being able to control what, when and how people could watch major TV shows and films. Instead of having to watch a program when the TV network chose to film it, people could watch it at any time. And again, the TV networks had to respond by offering their own on demand services to compete with Netflix. The end result is networks have far more competition and viewers far more choice, not just about what they watch, but also about when they watch it. Music consumption has also changed dramatically, with a shift from buying physical albums to consuming digital music, often through streaming services. CNN estimated that music sales in the US were cut in half between 1999 and 2009<sup>6</sup> as a result of the move to digital music.

Newspapers, travel agents, banks, hotel chains, taxi companies and a wide variety of other consumer services saw the same disruption. Established names in many industries fell, unable to adapt to the unregulated market liberalization that that the Internet had given consumers.

Invariably the established actors went to legislators and plead for protection, mainly proposing a series of restrictive measures that would limit the competitiveness of their competitors. Partly because some of the changes provoked by this digital revolution were unnerving to many and partly because this was a completely unplanned market liberalization provoked by a new technology, politicians generally acquiesced to their demands.

In recent years the European union has introduced a number of laws which aim to address perceived problems with these industries.<sup>7</sup> Yet they will not save the legacy businesses that are unable to adapt.

It is not unfair competition which is driving these sectors, but competition in general. In any market where there is competition, there will be companies who fail, mainly because they don't offer customers what they want, in the way they want it and at a price which customers are prepared to pay. No amount of legislation will change that basic fact. The companies that survive will be those that adapt to the digital age, not those who seek to hide behind legislation which defends their business model.

The impact of digital only strengthening and the companies that survive will be those that adapt to the digital age, not those who seek to hide behind legislation which defends their business model. However the first digital revolution focused on services, the second one will focus far more on machines.

The first digital revolution also saw the emergence of completely new industries, enabled for the first time by the new digital environment. Social media companies such as Facebook created a new industry from scratch. By seeking to fill the gap in the market for a product which allowed people to connect with their friends, the social media platform was born.

They have since had, arguably, the greatest impact on society of all the technologies from the first digital revolution. By collecting and processing large amounts of personal data, originally in order to try to find a way to monetize platforms which were being offered for free to users, they quickly morphed into something much more than just a place to connect with friends. Social media platforms are now de facto news, editorial, publishing and information sites, as well as a place for everyone to advertise their views, opinions and products.

People could access news and information on a wide range of topics. In theory it gave everyone access to information which previously was only be available to the most well connected, however the algorithms ensured that a person would mainly see content tailored to their own views, and those of their friends. This has had an effect on many industries and many key issues in society, including politics, publishing and advertising.

Some social media platforms have, at times, morphed into echo chambers due to the algorithms tending to reinforce existing views and there is significant evidence that they have led to an increase in radicalization, both in extreme political views and also with relation to terrorism.<sup>8</sup>

Communication has also been transformed by the social media platforms. Online messaging and calling services which are often provided for free, have been a significant challenge to mobile telephone operators. Mobile text messaging was a huge growth industry in the 1990's and provided significant revenue to mobile telephone companies. It is increasingly being challenged by free messaging services. Landline use is in continual decline as the proportion of calls placed exclusively on mobile phones continues to rise. This has forced the incumbent companies to react and in many cases they have, by offering consumers cheaper and better services.

Like social media platforms, search engines effectively created their own industry. Prior to the 1990's many people used directories which listed businesses in local areas, the "Yellow Pages", but they were focused only on business and in a local area. Search engines such as Google transformed that, and provided a door to every service that had an Internet presence. They were able to create an online virtual directory which negated the need for any other directory, and by directing consumers to the online retailers they also started collecting a huge amount of data, which effectively became a new and highly valuable commodity, which could be used to tailor advertising to the specific interests users of the platform, in the process offering advertisers a far more effective form of targeted advertising.

The cumulative effect of these changes has meant that a few, often US based, very large platforms have developed and now dominate many of these markets. Amazon, Facebook, Google, Apple are the main examples, and they have grown to such a size where they have huge influence, not just in industrial markets, but also in many other issues that affect our societies.

6 [https://money.cnn.com/2010/02/02/news/companies/napster\\_music\\_industry/](https://money.cnn.com/2010/02/02/news/companies/napster_music_industry/)

7 Reform of the Copyright regime, Audio-visual media services directive, E-Privacy, Platform to Business Regulation, the refit of the consumer rules for the digital age and the digital contracts directive were all proposed during the European Commission's "Digital Single Market agenda" 2014-2019. All bar

E-Privacy were passed in that period.

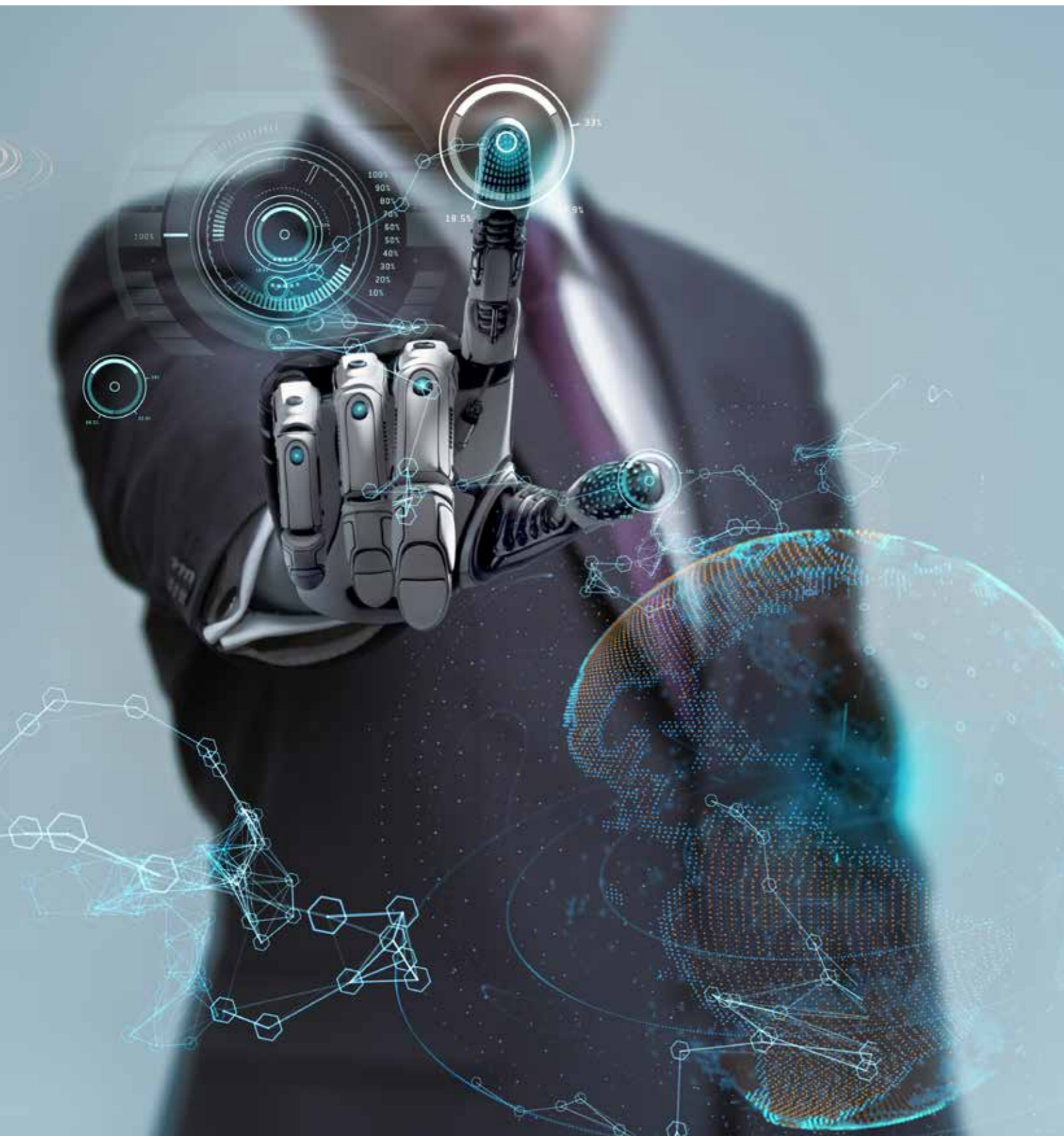
8 In 2018 the European Commission published proposals for a new law –"on preventing the dissemination of terrorist content online" – focused on removing terrorist content from the Internet. At the time of writing the law has not been passed as it touches on challenging and controversial issues, including censorship [https://ec.europa.eu/commission/presscorner/detail/en/IP\\_18\\_5561](https://ec.europa.eu/commission/presscorner/detail/en/IP_18_5561)

This digital revolution has been disruptive for many industries and for society as a whole, and it has provoked a backlash, particularly among regulators but also increasingly amongst consumers, many of whom are concerned about the amount of information about themselves that is available online.

However it has also been of huge benefit to consumers, who have seen the choice of products they can buy and how they consume them

significantly increase, whilst at the same time generally seeing costs reduce. Consumers have been the main beneficiaries of the first digital revolution, mainly because it has focused on how to deliver goods and services to consumers.

The next phase of the digital revolution is likely to focus not just on the means of delivering goods and services to consumers, but far more on the production of the goods and services themselves.



## 3

## WHAT IS ARTIFICIAL INTELLIGENCE?

Artificial Intelligence is a very broad field and it can refer to a very wide variety of methods, including self-replicating robots, computer controlled game characters or machines processing data to find out hidden clues that may help predict or cure diseases. It can be found in algorithms that drive online retail sites or search engine results and in machines that assemble cars in a factory. The European Commission Joint Research Centre describes AI as “A generic Term that refers to any machine or algorithm that is capable of observing its environment, learning, and based in the knowledge and experience gained, take intelligent actions or propose decisions”<sup>9</sup>

At its most simple, AI describes the ability for a machine to learn from and react independently to inputs it receives.

Although it covers a wide variety of applications, Artificial Intelligence, has long been imagined and feared by humans and has played a part in a significant bulk of human legend, literature, philosophy and storytelling throughout human history.

Greek mythology included many stories of mechanical men including the legend of Talos, a giant robot made of bronze that protected Europa from invaders. In Chinese mythology it was also present, with Yan Shi presenting King Mu of Zhou with mechanical men. It is an enduring theme in the human psyche, as are the ethical questions raised by the potential creation of sentient beings. This question was addressed in fictional works such as Mary Shelley's Frankenstein. There has been a constant fear represented in film and cinema that intelligent robots, able to learn for themselves, would eventually rebel against mankind and even threaten humanity itself. This is an enduring feature of the science fiction genre

and there are many examples of its use, in films such as Terminator, iRobot, and in TV series such as Battlestar Galactica and The 100. These portrayals in popular culture have potentially played a role in contributing to public skepticism and to popular concern about the development of AI.

However, AI in the real world is far away from achieving “the singularity” where machines are able to replicate or self improve themselves to such an extent that the process becomes irreversible and machines surpass human intelligence in such a way that they might pose a threat to human civilization. This remains the domain of science fiction, even though the public often perceives AI in these terms.

Modern AI and that of the near future is focused on much more mundane applications, most of which will complement human endeavor in those fields, such as a data driven economy, machine learning and the ability of technologies to perform tasks that would otherwise require human intelligence.

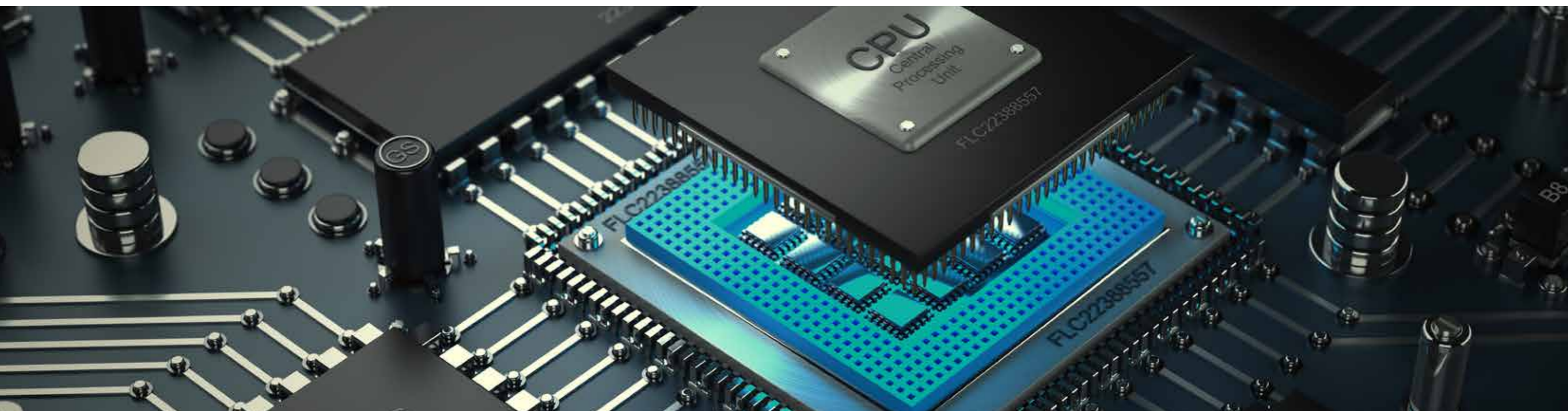
The field of artificial intelligence is widely believed to have been founded at the Dartmouth Summer Research Project on Artificial Intelligence in 1956 at Dartmouth College in Hannover, New Hampshire.<sup>10</sup> It complemented Alan Turing’s “Turing Test” which aimed to test a machine’s ability to show intelligent behavior similar to a human.<sup>11</sup>

In the years since them, despite significant development and research into AI, there is still no officially recognised definition for Artificial Intelligence. Instead, it has tended to become a catch all term used to describe a wide range of general technologies including Algorithms in general, machine learning, neural networks, data driven economy and deep learning.

<sup>9</sup> European Commission Joint Research Centre, (2019) Artificial Intelligence, A European Perspective. P8

<sup>10</sup> John McCarthy, Marvin Minsky, Nathaniel Rochester and Claude Shannon, A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence (31 August 1955), p 1: <http://raysolomonoff.com>.

<sup>11</sup> <https://www.turing.org.uk/scrapbook/test.html>



However in recent years, there have been several attempts to better define what Artificial Intelligence relates to and to define the various categories within it.

The UK is one of the leading developers of Artificial intelligence in Europe and in 2017, the Department for Business, Energy & Industrial (BEIS) proposed the following broad definitions with specific distinctions for Artificial Intelligence, Machine Learning and Data driven economy.<sup>12</sup> These definitions best explain what artificial intelligence is in the modern environment.

**Artificial intelligence:** technologies with the ability to perform tasks that would otherwise require human intelligence, such as visual perception, speech recognition, and language translation

**Machine learning:** a type of AI that allows computers to learn rapidly from large datasets without being explicitly programmed

**Data-driven economy:** a digitally connected economy that realises significant value from connected, large-

scale data that can be rapidly analysed by technology to generate insights and innovation

For the purposes of this report, the term artificial intelligence is used as a catch all term that covers all the definitions above.

The UK House of Lords built on the work of BEIS and further defined artificial intelligence into two categories.

**General Artificial Intelligence,** which refers to a machine with broad abilities to think for itself or to convincingly simulate or even surpass all of the intellectual capabilities of a human being.

**Narrow Artificial Intelligence,** which relates to systems which perform a specific task which would require intelligence in a human being. Narrow AI can surpass human abilities, but it is limited in the range of tasks that it can perform. Essentially it is bound within the tasks it has been created to perform.<sup>13</sup>

The European Parliament Research Service (EPRS) has also tried to identify the different categories

of AI by identifying three broad waves of artificial intelligence.

It describes the three waves as: -

**Symbolic Artificial Intelligence.** - This has been with us for some time and describes a very basic AI, where a human expert creates precise rules for a computer to follow together with a decision process that is easy for a human to follow. They are easily updated and are limited in their scope. This may also include a variety of variables for a computer to react to within certain boundaries, for example automatically changing settings when certain conditions are identified. It also includes systems that can perform tasks autonomously, but only in line with human instruction that has been coded into them.

**Data-driven machine learning** - This describes machines that can improve their own performance without human input. Essentially they use data to identify patterns and learn from them. The EPRS notes that “ The recent major advances in this field are not due to major breakthroughs in techniques per se, rather, through massive increases in the

availability of data”<sup>14</sup> Artificial neural networks, which are inspired by the neural networks in human brains and deep learning, where an algorithm is applied to automate the training of the artificial network are however poised to revolutionise this wave. As they are improved, they will drive the applications that we will see in the near future. I

**The future wave of artificial super intelligence** - This where AI gains a higher level of intelligence than an average human and eventually and is so intelligent and autonomous that it can itself develop even more intelligent and autonomous AI.<sup>15</sup> This is in effect the singularity described in the previous page.

Most of the advances in AI, and the main focus of this report are on narrow AI and on the rapid development of data driven machine learning that is especially dominant in the AI field today.

The main social, economic and ethical issues relate mainly to the implications of machines driven by this AI, which are increasingly able to simulate specific narrow aspects of human intelligence and replace the human being that was previously doing it.

<sup>12</sup> Department for Business, Energy and Industrial Strategy, *Industrial Strategy: Building a Britain fit for the future* (November 2017), p 37: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/664563/industrial-strategy-white-paper-web-ready-version.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/664563/industrial-strategy-white-paper-web-ready-version.pdf) [accessed 20 March 2018]

<sup>13</sup> AI in the UK Ready, Willing and Able? House of Lords report of January 2018 summary Page 5

<sup>14</sup> ibid

<sup>15</sup> Boucher, Philip (2019) How Artificial Intelligence works – European Parliamentary Research Service (EPRS) March 2019

## WHAT WILL MACHINES BE ABLE TO DO

Many people are familiar with the concept of Moore's Law,<sup>16</sup> the basic premise, articulated in 1965 by Gordon E. Moore that computing power doubles on average around every 2 years, and that the cost of computers is roughly halved over the same period.<sup>17</sup>

That prediction has been more or less accurate for the past 50 years,<sup>18</sup> and although there are some indications that the advancements in computing power may gradually slow down in the near future, Moore's Law is still a good guide to the potential development of computers. However, the implication of this rule and the exponential growth that it implies is not always well understood. Martin Ford offered two examples of just how fast this growth is in his book 'The Rise of the Robots.' If you start driving your car at 5 miles per hour (mph) and double your speed every minute, you would cover 440 feet in the first minute. By the third minute you would be travelling at 20mph and would cover 1760 feet. By the fifth minute, the car would be traveling at 80mph and you would cover over a mile in the minute. Alternatively, if you deposited a cent in a bank account and double the amount you deposit every day, you would, after less than a month, have to deposit over a million Euros.<sup>19</sup>

To translate that to practical applications, in 1996, the US government created the world's fastest supercomputer at the time, it cost \$55 million to develop and was big enough to take up nearly 80% of a tennis court. It was the first computer to reach a speed of 1 teraflop.<sup>20</sup> In 1997 it reached 1.8 teraflops.

9 years later, in 2006, the PlayStation 3, a computer gaming console was launched and also hit a speed of 1.8 teraflops. Yet it only cost around €500.<sup>21</sup> Nearly 87 million were sold worldwide.<sup>22</sup>

It is easy to underestimate the speed at which computer power increases and just how powerful today's computers are compared to those of just a few years ago. However this century has already witnessed one of the biggest technological leaps forward in history. In June 2007 Apple launched the iPhone.<sup>23</sup> This gave consumers a computer in their pocket that had more power than the computers that NASA sent to send astronauts to the moon.<sup>24</sup> A commercially viable smartphone had been born and that in turn spawned a plethora of new consumer services that upended existing businesses and industries. People now consume the news, music, audio-visual content and even books, in an entirely different way. They book transportation,

16 Moore, Gordon (January 1998). "Cramming More Components onto Integrated Circuits (Reprint)" (PDF). *Proceedings of the IEEE*. **86** (1): 82–85 this can be accessed here <http://www.cs.utexas.edu/~fussell/courses/cs352h/papers/moore.pdf>

17 <http://www.moorelaw.org>

18 Bryanjolfsson, Erik & McAfee, Andrew 2016, "The Second Machine Age, Work, progress and prosperity in a time of Brilliant technologies" W.W.Norton & Company p48 and also an explanation of whether the law will continue to hold is here <https://www.electronicweekly.com/news/moores-law-still-law-2017-09/>

19 Ford, Martin (2015) *The Rise of the Robots, Technology and the Threat of Mass Unemployment*, Oneworld. Pxi & p65

20 1 teraflop equals trillion floating point operations per second

21 Bryanjolfsson, Erik & McAfee, Andrew 2016, "The Second Machine Age, Work, progress and prosperity in a time of Brilliant technologies" W.W.Norton & Company p49

22 <https://www.guinnessworldrecords.com/news/2018/12/top-10-best-selling-videogame-consoles-551938>

23 The first iPhone was announced by Steve Jobs on the 9<sup>th</sup> January 2007 and was released on the 29<sup>th</sup> June 2007

24 Kaku, Michio 2012, "The Physics of the Future: The inventions that will Transform our lives" Penguin

accommodation, and food, invest in the stock market, film themselves and communicate with each other almost exclusively through a small device in their pocket. That device has cannibalised the old markets for many electrical devices, including digital cameras, video cameras, scanners, fax machines, and forced content providers such as publishers, music labels and film makers to ensure their content can be accessed through a smartphone.

This revolution appears to have happened almost instantaneously (although the truth is that slow progress was being made consistently before this sudden explosion) and with it, huge amounts of data started to be created electronically. The existence of this data, in volumes that dwarfed everything that came before, has opened up the ability for mankind to know more about itself than ever before. But the volume of data is so huge, that only machines can process it meaningfully. In processing it, then can also glean information that offers new innovations. There is now so much data that they can use it and learn from it, allowing newer innovations to come to market.

The existence of this data has allowed the development of machine learning. This is a process whereby a computer processes the data that is fed into it and works out for itself how best to write its own programme based on the statistic relationships that it has discovered. Normally the process would involve two steps, firstly the algorithm is trained on the known data and then it is left to solve similar problems with new data that is given to it.<sup>25</sup>

Machine learning is already widely used in products such as spam filters, product recommendations on online retail platforms, film recommendations on Netflix and online translation tools. The more data these machines have, the more accurate these services can be. However, increasingly the same techniques can and will be used in the manufacturing process.

The prevalence of data and the ability for computers to process it is also being used in the development of self-driving cars. Only a decade ago, these were

perceived to be a science fiction fantasy, however they are driving on our streets. Google has been testing these autonomous vehicles for nearly a decade,<sup>26</sup> and Tesla has been selling cars with autonomous driving capabilities since at least 2016. Each time one of these cars hits the streets it produces more data, which in turn allows the system to learn more and improve itself.

There is potentially no end to this process but in the next few years, computers are expected to make their way into every many more products. The Internet of Things (IoT) will make smart homes a reality. Fridges will be able to automatically order items based on the eating habits of its owners, which it will have learnt. Lights, heating and air conditioning will turn on and off automatically depending on whether someone is there and having learnt from and reacted to the likes of the people living there. In reality most of this technology is already here, but it will be tailored, enhanced and mass commercialised over the next decade.

Robots have long been present in our factories, however their role has mainly been restricted to replacing a human by performing a single activity, like connecting two parts together with screws. Generally these are tasks that remain the same, constant and take place in the same environment. These robots haven't been designed to adapt to different tasks or to changing environments without a human intervening and resetting them for the new activity. This is why, up to now, machines have not fully taken over all the jobs in a factory. Factories may be fully automated and have many robots, but these are not yet general-purpose robots and can't operate without some human interaction.<sup>27</sup>

The challenge in developing general-purpose AI systems and general-purpose robots was articulated by Hans Moravec, together with Rodney Brooks and Marvin Minsky in the 1980's in the principle of Moravec's paradox. This states that whilst reasoning and simple skills can be achieved relatively easily and requires little computation; sensorimotor skills such as hand to eye coordination or perception require enormous computer power. Moravec himself writes, "it is comparatively easy to make computers exhibit



adult level performance on intelligence tests or playing checkers, and difficult or impossible to give them the skills of a one year old when it comes to perception and mobility"<sup>28</sup>

Given the likely continued principle of Moore's Law, there may well come a time when Moravec's paradox will be seriously challenged. The robotics community continues to invest and robotic power is continue to expand exponentially.

Already companies such as Amazon are using smart robots to manage logistics in their warehouses and robots are becoming far more effective at reacting to changes on the factory work floor.

If they can develop capabilities and traits that more closely resemble those of humans, such as being able to sense changes and then being able to react to them, developing and using their memory, and recognising different objects, they are likely to be able to do many more industrial jobs. This could include jobs such as testing and inspecting products, packing and even picking fruit. They may also be able to develop the ability to collaborate and work with humans who train them through product demonstration.<sup>29</sup>

The next decade of AI will be one where robots and computers gradually take over more and more

of the tasks that were previously done by humans. How fast that process develops is still unknown. Computing power continues to increase exponentially yet it remains to be seen whether or not there are technological limits to what robots and machines will viably be able to do, given the huge amount of processing power needed to move to some of the capabilities described above.

Even if robots are unlikely to fully crack the Moravec paradox, they are still highly likely to revolutionise industrial manufacturing in the coming decades.

Bryanjolfsson and McAfee argue that we are now in a second machine age<sup>30</sup> as steady exponential improvement has brought us "into a time where what's come before is no longer a reliable guide to what will happen next"<sup>31</sup>. They envisage a near future where supercomputer power is available in toys and where science fiction will become a reality.

Whatever the future path takes, for the immediate future, AI applications are likely to become an increasingly important part of everything around us. The main constraints on the widespread use of AI technologies in industry will be the cost and not necessarily the existence of the technology. However, the costs of advanced robotics are falling and that suggests that widespread adoption is likely in industry over the next few decades.

25 Ford, Martin (2015) The Rise of the Robots, Technology and the Threat of Mass Unemployment, Oneworld. P91

26 Bryanjolfsson, Erik & McAfee, Andrew 2016, "The Second Machine Age, Work, progress and prosperity in a time of Brilliant technologies" W.W.Norton & Company p14

27 Bryanjolfsson, Erik & McAfee, Andrew 2016, "The Second Machine Age, Work, progress and prosperity in a time of Brilliant technologies" W.W.Norton & Company p29

28 Moravec, Hans (1988), Mind Children, Harvard University Press. P15

29 Price Waterhouse Cooper (PWC) in conjunction with the Manufacturing Institute (2014) "The New Hire: How a new generation of robots is transforming manufacturing" September 2014

30 Bryanjolfsson, Erik & McAfee, Andrew 2016, "The Second Machine Age, Work, progress and prosperity in a time of Brilliant technologies" W.W.Norton & Company p55

31 ibid

## 5

## DATA AND AI

The key driver of the recent growth of AI applications, and the expectation of significant new breakthroughs in the future, is the sudden availability of huge amounts of data.

Data growth is currently growing at an exponential rate, and also appears, on the surface at least, to be the subject of Moore's Law, with the total amount of data available doubling every two years.<sup>32</sup>

In 2015, Google's servers were already handling 24 petabytes of data a day.<sup>33</sup> Estimates suggest that this data will continue to grow at an exponential rate for the foreseeable future. The number of embedded devices, such as smart homes, factory machines and autonomous cars are predicted to grow from less than one per person to more than four per person in the next decade. The average person is expected to interact with a connected device nearly 4,88 times a day.<sup>34</sup> By 2020 businesses will be making 450 billion online transactions every day.<sup>35</sup>

In the past 20 years, this data come from many sources, including website visits, search enquiries, consumption habits on platforms such as Netflix or Spotify, emails, social media, advertising clicks, chip cards, business transactions, customer contacts, financial accounting data, marketing systems, and cameras and sensors embedded in factories, hospitals, cars, aircraft, smart homes and industrial machines. The fact that the vast majority of the population is permanently connected to the Internet via their smartphones has greatly increased the amount of personal data that is being created. Every form that is filled in, every decision that is recorded by a computer,

every Internet based transaction is all added to the existing big data set.

Data is the fuel of not only the modern digital economy, but also of artificial intelligence and machine learning. Computers have always been able to calculate, but with AI, they cannot only identify trends in the data, (which can then be used to develop new commercial products or to help governments better target public services) but they can also learn and draw conclusions for themselves. However in order to learn, they need vast amounts of data. AI applications consume that data in order to learn. The huge data sets that have begun to become available are now referred to as "Big Data" and can be analyzed by AI driven machines. This can reveal patterns and trends which were previously not visible and cannot only offer analysis of the current trends but can also make predictions about the future.

It is only now that the amount of data available is sufficient to drive AI machine learning. We are now entering a truly exciting time where both the data exists in huge quantities and the computers have reached a stage in their development where they can process and react to this data.

As more embedded devices become available, the amount of data produced will increase exponentially.

Big data is already being used to optimize the consumer experience in many industries, retailers can use the insight they provide to understand shopping preferences so they can market exactly the right product at exactly the right time to a customer, and

32 Inside Big data (16th February 2017) The Exponential Growth of Data. <https://insidebigdata.com/2017/02/16/the-exponential-growth-of-data/>

33 Ford, Martin (2015) The Rise of the Robots, Technology and the Threat of Mass Unemployment, Oneworld. P88

34 Paulsen, John (2018) Enormous Growth in Data is coming – How to Prepare for it, and prosper from it. Seagate Blog <https://blog.seagate.com/business/enormous-growth-in-data-is-coming-how-to-prepare-for-it-and-prosper-from-it/> citing results from the following report – Reinsel, David, Gantz, John and Rynding, John (2018) Data Age 2025 – The digitization of the World, From Edge to Core. IDC November 2018 – available here - <https://www.seagate.com/files/www-content/our-story/trends/files/idc-seagate-dataage-whitepaper.pdf>

35 Cryer, Ben (19th November 2019) Artificial Intelligence and Big Data. Hackernoon.com <https://hackernoon.com/artificial-intelligence-and-big-data-zys3258>

reduce the cost of storing products. They can also help to streamline the logistics system to ensure the right products are in the shops at the time they are needed. Video on Demand platforms can use the data to develop new programs that they know consumers will like. Navigation platforms such as Waze, can use the data to predict when traffic jams will occur and to direct drivers away from certain stretches of roads at certain times of the day.

Data is therefore a resource. In many ways it is not unlike many other physical resource. It can be mined and when it is processed, it can then be used in a wide variety of ways, all of which can add value. Due to the unlimited potential applications that processed data could be used for, and the immense value that could be created from it, data has often been described as the new gold.<sup>36</sup> Yet unlike gold, data is not a finite resource and the same piece of data can be processed many times.

From a commercial perspective, data is a wonder commodity. However much of this data includes an element of personal data, which could be used to identify a specific individual or specific personal secrets. Personalized product recommendations for example are normally created using the data on that individual based on their prior purchases, their searches and demographic information such as age, sex, and where they live.

This has many advantages; it allows platforms to monetize the data they have on an individual by selling that data to advertisers who can then target adverts based on what the individual is likely to want to buy. This type of targeted advertising is far more successful for advertisers and therefore the targeted data is much more valuable.

Platforms already receive far more money for targeted personal data than they do for random unpersonalised data. This has driven the growth in the platform and app economy over the last decade and has allowed start up platforms to offer products and services for free. Customers are paying for the service, but they are not paying with their cash, they are paying with their data which is sold to advertisers who use it to target those customers with adverts for products which the algorithm suggests that they may want to buy.

It is a system that, from an economic and consumer point of view, has been very successful. The consumer receives free services that they would previously have had to pay for (or services which they do pay for but which are much cheaper than they would be without the targeted advertising). The platform receives revenue from the advertisers to fund its growth and also data from its users that allows it to tailor the products more closely to the consumer's wishes.

However the system has become increasingly controversial over the years and now faces a potentially existential challenge in the face of EU regulations. The General Data Protection Regulation (GDPR) enshrined the principle of consent. Effectively a user would have to opt in to any of his or her personal data being used for the purposes described above. In the GDPR there are a number of grounds for processing personal data, which allows some flexibility however none of this flexibility exists in the proposed E-Privacy Directive. This proposal, launched by the Commission in 2016, is still unfinished. At the time of writing, it is blocked in the Council of Ministers where the member states cannot agree to an initial draft position that would be the base of negotiations with the European Parliament. However the proposals on the table from the European Commission and the European Parliament not only threaten the existing business model but also the future AI led development in this sector.

The European Commission proposed that there should only be one grounds for processing and using personalized data, the opt in and informed consent of the user, which would need to be given regularly. Without the explicit consent of the user, that users data could not be used for targeted adverts based on that users previous history. The European Parliament went further, stating that a platform couldn't refuse to offer a service to a user who wouldn't let the platform use their personalized data. That would mean that if there were two users on the same platform, one giving consent to their data to be used, and the other refusing, would both receive the same service. One would have "paid" for the service with their data and the other would be getting the service for free. As the data pool would be shrunk considerably and therefore would be less reliable, and as the free users couldn't be targeted with personalized adverts, revenue for

the platform would be reduced substantially. The platform would be faced with a large number of its users freeloading on it, receiving a service for free that others had paid for, and greatly reduced revenue. The most likely outcome would be that the platform would start charging all users for the service, as this would be the only way to recoup the lost advertising revenue.

The end result would be that all users would have to pay more for a less targeted service. Many would not pay at all, meaning that many of the existing apps would not be economically viable at all and would exit the market. In addition, the data sets that those apps rely on would be incomplete, with much of the user data not being able to be used, as a result the services would be less tailored to what customers want and less likely to succeed commercially.

Such an approach would therefore reduce consumer choice, make it far harder for start ups to enter the market and would severely reduce the ability for AI applications to create new and exciting services for customers or to streamline the existing ones.

However there will be pressure to move in this direction. The European Union is reacting to public pressure in some member states, particularly in Germany, where there is significant unease about the amount of personal information that has been collected. This is amplified by the NSA hacking in Germany and the Facebook/ Cambridge Analytica. In many countries there is a perception that there is too much personal information available and it is particularly concentrated in the hands of a few private companies.

Most people, when polled, suggest that they want more control over their personal data, however the polling rarely asks to what extent consumers would be prepared to pay for existing free services and for fewer new services as a trade off for better protection of their personal data.<sup>37</sup>

The European Union approach to protecting personal data is robust in that regard, however it does pose challenges to the future development of AI, given the need for complete data sets. Personal data is often difficult to separate from non personal data and if the

definition for personal data is set too wide, significant amounts of non personal data could be excluded from data sets, leaving incomplete data sets which will not give a true picture of a particular situation. An example of this is data produced from connected cars about a particular route taken at a particular time of day. That journey provides useful information about the route taken, the duration of the trip and the traffic around at the time, in addition to the performance of the car, but it also can identify that the driver went between those two places at that time. Health data is another example of the challenges on separating personal from generic data. AI offers huge potential in the field of healthcare, but only if health data from entire populations can be effectively mapped. This will enable disease outbreaks to be analyzed and future disease outbreaks to be predicted, potentially down to the level of specific individuals. It could also ensure that cures for diseases can be found. However, this will also need complete data sets, some of which could expose highly personal and private data about individuals.

How to separate the potentially personal information from the generic travel information in examples such as these will be a key challenge if we are to balance the right to privacy concerns with the need for complete data sets.

Data policy is therefore becoming a key unknown for the future development of AI. If the current trends and the approach being taken by the European institutions prevail, it is likely to significantly reduce the potential impact of AI development and deployment in Europe, and in other jurisdictions that follow this approach.

There is also the challenge of who owns the data, who can access it and under what terms. Given that the secrets hidden within these large amounts of data can only be uncovered by that data being processed, and some of that information could reveal insights that could have huge benefits for humankind, the focus should be on more access to the data, not less.

The European Union recently updated its framework on copyright protection and missed an opportunity to get the right balance. It allowed an exemption to normal copyright rules for research organizations to be able to access public data sets and mine them - this is known as the Text and Data Mining exemption,

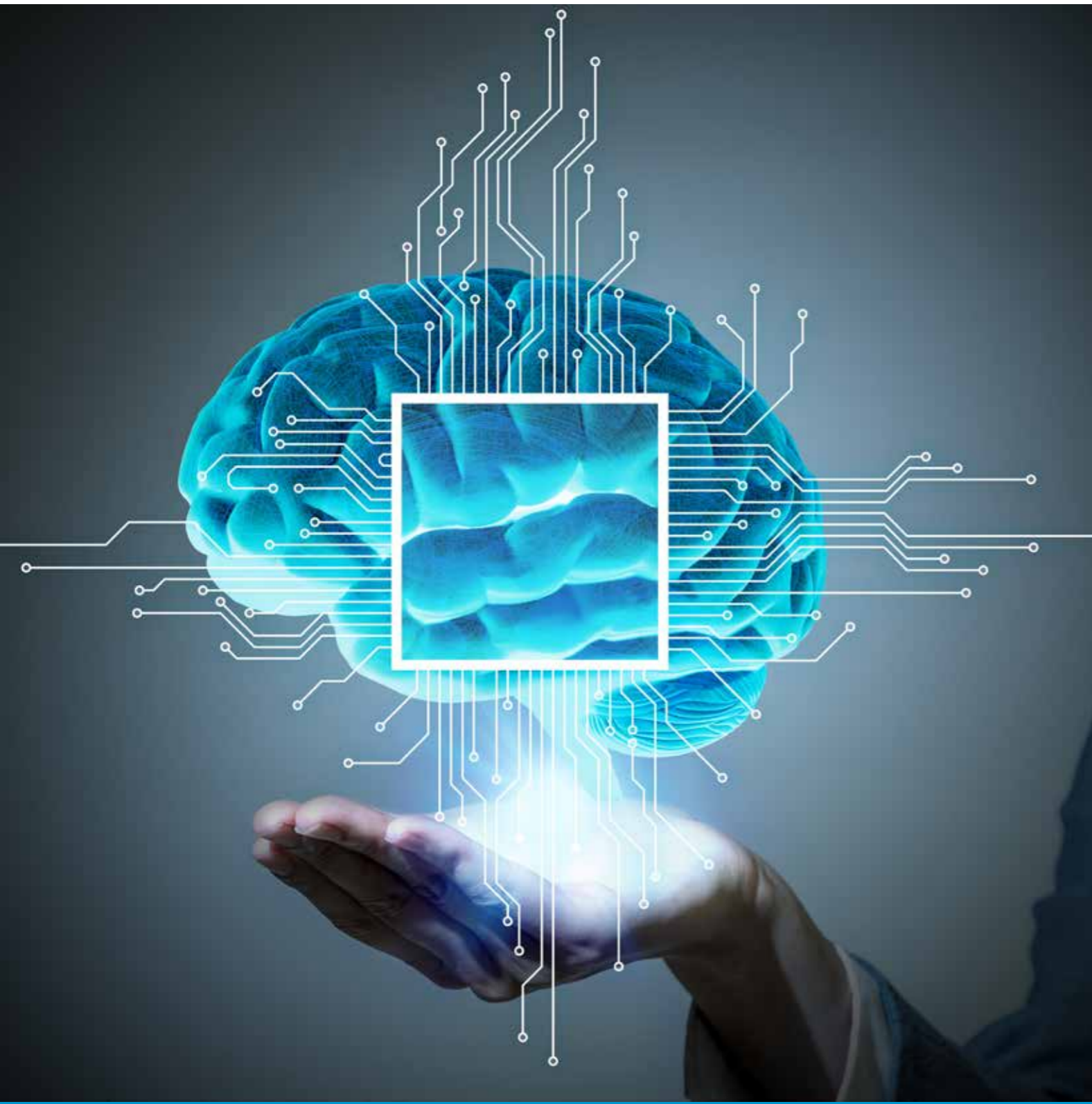
<sup>36</sup> Forbes Africa (18<sup>th</sup> July 2019) Data is the New Gold <https://www.forbesafrica.com/technology/2019/07/18/data-is-the-new-gold/>

<sup>37</sup> for example see <https://theodi.org/article/odi-survey-reveals-british-consumer-attitudes-to-sharing-personal-data/> & [https://data.europa.eu/euodp/en/data/dataset/S2075\\_83\\_1\\_431\\_ENG](https://data.europa.eu/euodp/en/data/dataset/S2075_83_1_431_ENG)

but it did not extend the exemption to commercial organizations. Ensuring research organizations have such an exemption was a step forward, however it should be extended to commercial actors as well, and to others such as journalists. The more avenues by which data can be analyzed and the more different perspectives that are applied to it will ensure that there is more potential to identify trends and for businesses to develop groundbreaking new applications, particularly in the field of healthcare.

Europe took the wrong approach by only focusing on research organizations and it is a

symptom of a wider issue with the EU approach to data. The copyright reform, the GDPR and the upcoming E-Privacy proposals, all take the view that access to data, both personal and public sector data, should be more restrictive. For the AI revolution to take hold, and for Europe to be a major part of it, the restrictive approach needs to be relaxed. Data is a valuable resource, and a framework for protecting personal data does need to be robust, however other parts of the world will not impose the same restrictions on the development of their industries and Europe risks being left behind as a result.



6

## THE ETHICAL CHALLENGE POSED BY AI

We are not always aware of it, but artificial intelligence already affects every aspect of our social lives. On a daily basis we are interacting with highly intelligent systems that optimise what we see on a screen when we go online, which prompt us to watch certain films, which create our favourite playlists, optimise our journeys and our news feeds and protect our inboxes from spam. They are not always wholly accurate, spam filters are notoriously unreliable, but AI is already our invisible workforce, and in many ways it is making our daily experiences easier and more efficient.

Its influence on our lives is growing. Self-driving cars, image recognition, virtual assistants mean that AI will be at the centre of our lives in the near future.

As this grows, questions have been raised from many quarters about the ethical issues involved in developing artificial intelligence technologies and in the use of algorithms. Many of these questions focus on potential negative effects that might emerge in the future rather than those effects linked to the current use of the technology.

Ethics is a branch of philosophy and therefore is a subjective issue. Not everyone agrees on the starting point nor do they necessarily agree on what is good or bad from an ethical perspective.

The speculative considerations about AI's existential threats to humanity are for the distant future. As highlighted previously in this report, we are a long way away from creating AI systems with that potential.

Current debates and concerns about AI tend to focus on the algorithms which govern modern AI applications and which determine why certain

recommendations are made. Although much of that might focus around fairly mundane ethical issues, such as which film to watch or which route to take to work far bigger questions are raised when the same technology is used to decide issues such as which candidate to reject during a CV sifting process.

We are not all equal before these algorithms and their decisions have a real, tangible and growing influence on our lives. As Cathy O'Neil puts it in her book "Weapons of Math Destruction" the big data economy and by extension AI algorithms "not only saved time but also was marketed as fair and objective. After all, it didn't involve prejudiced humans digging through realms of paper, just machines processing cold numbers"<sup>38</sup>

The information contained in those cold numbers influence the results the algorithms come up with, and as a result influence an increasingly large proportion of our lives. Anyone who has been rejected for credit will know the impact of falling on the wrong side of these algorithms.

It is important that those algorithms are making fair decisions, and not influenced by things that would amount to discrimination in the real world, such as basing decisions on race, gender or name. However, those algorithms are also designed to serve a purpose. In the case of credit checks, that purpose is to advise a financial organisation whether or not a particular individual is worth the risk to lend to. The algorithm will do its job effectively without prejudice based on the information it has. Yet its impact will be felt differently.

As a result there are increasing calls for an ethical framework within which to place the future

<sup>38</sup> O'Neil, Cathy (2016) Weapons of Math Destruction, Crown Publishing, p3

development of AI. The European Commission is likely to be the first authority globally to try to turn such a framework into legislation.<sup>39</sup>

This approach is likely to be counterproductive. We are still too early in the development of AI to start introducing legally binding regulations to govern it, particularly as AI is such a wide field in terms of its potential applications.

A better approach would be to issue guidelines, and closely monitor how the technology develops. The majority of the potential ethical concerns about AI remain speculative and for the future, very few are manifesting themselves now. To legislate now, at such an embryonic stage in its development, risks making it much harder for organisations based in Europe to fully explore the potential of AI. Such an approach risks reducing Europe to becoming a digital backwater. The investment, development and risk will take place outside Europe, with European businesses and consumers missing out as a result.

Mandatory legislation is not therefore the optimal approach, at least not on a regional basis. A framework based on guidelines and best practice would be a better approach that can then be further moulded depending on the path that AI takes and in response to genuine concerns that emerge as more advanced AI applications emerge.

In European circles there appears to be a major concern that AI will not be seen as trustworthy and therefore the decisions AI systems take will not be trusted. This, on the surface appears to be an overly negative approach to the new technology. Europeans have been amongst the most enthusiastic users of existing platforms with AI characteristics, such as Facebook and Google. There is little evidence to suggest that Europeans do not trust these systems or that they will shun further digital developments.

However, the European Commission is pressing ahead with plans to develop an EU framework for AI and as part of the preparation ahead of this, it set up a high level expert group on artificial intelligence. This

group was tasked with creating Ethical guidelines for Trustworthy AI. It concluded that in order for AI to be trusted it needed to be human centric and used “in the service of humanity and the common good” and that producers of AI systems should seek to “maximise the Benefits of AI systems whilst at the same time preventing and minimising their risks”<sup>40</sup> It also noted that trustworthy AI had three elements. It should be lawful, ethical and robust.<sup>41</sup>

The EU appears to be far ahead of other jurisdictions in thinking about these issues. The guidelines that emerge are expected to include information on transparency and auditability of autonomous systems.

A major ethical concern is that the data that is fed into the algorithm and how the algorithm is programmed to interpret that data, will dictate what results emerge at the other end. If the human programming skews or slants the algorithm towards certain individuals or certain values then there is an argument that such information should be transparent and available for others to scrutinise in order to ensure that the values assigned to particular data points are not discriminatory.

Some, such as Cedric Villani go further, arguing, “The protection of our rights and freedoms needs to be adapted to accommodate the potential for abuse involved in the use of machine learning systems. Yet it appears that current legislation, which focuses on the protection of the individual, is not consistent with the logic introduced by these systems – i.e. the analysis of a considerable quantity of information for the purpose of identifying hidden trends and behaviour – and their effects on groups of individuals. To bridge this gap, we need to create collective rights concerning data.”<sup>42</sup>

This is one of the key areas that the European Commission and campaigners in general are likely to look at, however this raises significant issues for all companies operating in this sphere. The hidden trends that are uncovered by machine learning systems could well be accurate and if they are, those insights are useful, not only in a commercial sense such as the

risk of lending money to an individual, but also for the public sphere, such as the identification of trends related to disease or other challenges to public health and safety.

At what stage does an individual’s right to hide certain information which may be processed negatively by an algorithm trump the right of a company to use that information to work out whether or not to offer that individual a service, or to tailor content or services towards them which the algorithm has identified that they may be interested in. Developing this further, does that individual’s right to hide that information trump the public need to have access to it for public health or safety concerns?

Many of these arguments have already been explored by EU policymakers in the context of the GDPR, E-Privacy and E-Evidence pieces of legislation. These debates related to personal data in general, and how much can be made available to companies or in the case of the E-evidence, to judicial and law enforcement authorities. Those debates were long and controversial, yet at some stage they will need to be addressed in the context of the extension of that debate to potentially negative assessments made by machines based on processing of data that doesn’t necessarily identify an individual and is therefore classed as non-personal data. It is a debate that will not be easily solved.

For companies working in this field, complete data sets are vital for the algorithms to work effectively. Without all the information, those hidden trends are less easy to identify. Yet once they have the data, the values attributed to different types of data are the essence of the algorithm. They are the key component of the artificial system and what differentiates it from other systems developed by other companies. The algorithm is therefore the intellectual property of its owner.

Any regulation which forces a company to be transparent about how that data is attributed and what values are assigned to different elements of the data, potentially even asking a company to open it up to others to examine, will be unattractive to many companies. This is not because they are necessarily insensitive to the reasons behind such requests, but because it risks the revealing and potential

expropriation of its intellectual property. As most algorithms are still, even in Europe, developed for a commercial aim, the key defining factor for such an algorithm is that they work in getting an outcome that is commercially viable and works in terms of producing results that are accurate for the commercial purpose for which it was created, be it in an area which is utilised for public benefit, such as healthcare, or in a encouraging the consumption of certain media.

However it is here that the greatest ethical challenges are to be found. It is possible to see what data goes in, and what the final outcome is, but the internal operations are not well understood, and that is partly because of the changes being introduced by machine learning. In the previous age, when the machine simply follows the instructions given to it, this could be easily explained, however as the machine starts to learn itself and starts to make its own judgements based on the trends it is seeing in the data, and therefore potentially tweaks values attributed to certain data itself, we start moving a long way from easily being able to understand what is going on in the process. If people don’t understand how the decision is made, they are unlikely to have trust in it. This what is described as the “Black Box” problem. Explaining how these systems operate will be a key challenge, but it is likely to be a vital one in order to ensure that people trust AI systems and the results they come up with. Explaining how systems come up with decisions, so that people can understand them and their rationale, especially in the case of life or death situations in healthcare or the military will be absolutely critical to the widespread adoption and trust in AI systems.<sup>43</sup>

Explainability is likely to be necessary to ensure trust is maintained in AI systems, but it doesn’t necessarily need to be mandated by regulation. If lack of trust is a problem, it should be up to the manufacturer to demonstrate how the system works. Without it, trust in the platform and the commercial viability of the project could be put at risk. Those commercial considerations are likely to push manufacturers into that direction without the need for a legislative framework.

Explaining how these systems operate will be a key challenge, but it is likely to be a vital one in order to

<sup>39</sup> European Commission President Ursula Von der Leyen promised that the EU Commission would come up with proposals for an AI Regulation within 100 days of taking office. “A Union that strives for more, My agenda for Europe” Ursula Von der Leyen (2019)

<sup>40</sup> European Commission (8<sup>th</sup> April 2019) Ethics Guidelines for Trustworthy AI, HighLevel Expert Group on Artificial Intelligence. P4

<sup>41</sup> ibid p5

<sup>42</sup> Villani, Cedric (2018) For a Meaningful Artificial Intelligence, Towards a French and European Strategy. P113

<sup>43</sup> Bloomberg, Jason (2018) Forbes.com “Don’t trust Artificial intelligence? Time to open the AI ‘Black Box’ www.forbes.com/sites/jasonbloomberg/2018/09/16/don-t-trust-artificial-intelligence-time-to-open-the-ai-black-box/amp/



ensure that people trust AI systems and the results they come up with

This also relates to another second significant concern in the ethical debate surrounding AI, which is the potential for bias and discrimination that a machine learning system could introduce, either through the data used to train it or from the algorithm itself. This could be in the form of targeting less well-paid jobs to women, which was picked up by analysts and reported in the Guardian newspaper in 2015<sup>44</sup>, or by discriminating against people from a certain ethnic background.

Many of these biases are likely to replicate the prejudice that exists in the original data that the machine is fed with. Human biases continue exist in many areas. In the UK for example there is already a form of postcode lottery related to insurance premiums and access to credit, which often offers higher insurance premiums and lower likelihood of being offered credit to individuals with some postcodes compared to those with others.

The difficulty is that many of these prejudices could, on the surface, be justifiable, certain postcodes have higher crime rates than others and therefore insurance premiums are likely to be higher. However if the majority of residents of that area are poor and from minority ethnic groups, they are likely to see this as discriminating against them.

While this economic discrimination is currently tolerated in many countries when it comes to commercial decisions like insurance risk, when that same type of algorithm is applied to job applicants, and the result is that the already marginalised in society are marginalised further by an algorithm, there is the potential that there will be a lack of trust in AI.

The groundwork for such a lack of trust is already there. “The Computer says no,” is already a source of frustration for many and if the reasons why decisions are taken by computers cannot be widely explained and understood, there is the potential for trust in the systems to be lost.

This also raises the question of whether the data used by these algorithms is personal data or not.

Personal data is currently defined quite narrowly in European law as data that would allow the identification of an individual. This is strictly regulated by the GDPR and could become even further regulated by the upcoming E-Privacy proposals. However the use of non-personal or generic data is not regulated in the same way on the grounds that it does not identify an individual. However if the widespread use of generic data allows machines to make decisions about a specific individual that may be detrimental to that individual, this distinction is unlikely to remain for long into the future. Given the need for access to large data sets in order to drive AI algorithms, this is hugely problematic for the future development of AI. We can expect many more decades of privacy debates.

This area is also likely to fall victim of a bigger political battle between the economic left and right of politics. The left generally puts more emphasis on equality of outcome, whereas the right generally focuses more on equality of opportunity and is more relaxed about differing outcomes. AI algorithms are likely to replicate the biases that are inherent in a system that has differing economic outcomes. In fact the social inequalities that develop from there are likely to be embedded in decision algorithms.

The political traditions of the left have already begun to challenge the potential of AI to make such inequalities worse. However, the answer does not lie in forcing tech companies to reveal the secrets behind their algorithms, which would reduce the economic value of investing to develop such algorithms in the first place. It also doesn't lie in manipulating certain criteria to produce results that alleviate inequality. That would make such algorithms imperfect and potentially make everyone poorer. This has already happened. The sub prime market in the US in the late 1990's and early 2000's developed after the criteria governing lending were tweaked to allow credit to be given to people who would previously have been excluded from accessing credit to buy their homes with. This allowed many people to buy their homes but also left many of those same people with unaffordable mortgages. Many of them eventually defaulted on those mortgages, making them and their communities far poorer in the long run.

44 <https://www.google.co.uk/amp/s/amp.theguardian.com/technology/2015/jul/08/women-less-likely-ads-high-paid-jobs-google-stud>

Tweaking the criteria for a supposedly desired outcome rarely ends well and policymakers should resist using AI for that purpose. However, we must be mindful of the concerns about the increased marginalisation, and in particular the increased awareness of these inequalities that AI could bring and which could, if left unchecked, threaten the stability of our societies.

There are two ways that this could be addressed. Firstly by companies that design AI algorithms recognising that will need to be more open and transparent than they are at the moment and there may also be the need for some sort of auditing system to be developed.<sup>45</sup> Algorithms will play an increasing role in all aspects of society, so it is not reasonable to expect that they will escape attention from legislators if they start becoming too omnipresent in our lives.

The large platforms that currently dominate the tech environment are facing attention because they play such a large role in many elements of society. It is to be expected that AI algorithms will play a much larger role, and they will not escape legislative attention as a result.

Secondly AI will also provide the path to further reducing inequalities by uncovering the previously hidden secrets and trends that may be able to explain, in an evidence-based way, why inequalities exist. This can identify why some individuals are more likely to be more marginalised than others. This in turn can provide the catalyst to developing policies, systems and programmes that can reduce those inequalities and the cause of them in the long run. This has significant potential to effectively address the many challenges that all societies face, including social exclusion, poverty, and obesity and which to date no one has been able to truly explain why they persist.

There are many political and philosophical ideologies that try to explain their prevalence and how to eradicate them, however in reality none have effectively been able to do this, and in most cases have brought other, just as serious challenges to society.

However for this to be effective, the algorithm needs to be impartial and non judgemental in the first place. The real challenge will be designing algorithms

that are not infused with the norms, impressions or prejudices of their creators in the first place.

There are many other ethical challenges that AI could bring. Healthcare is one such example, as it is area that has the potential to benefit hugely from advances in AI. Effective predictive techniques could identify the prevalence of potential illnesses in populations and individuals long before those diseases actually arrive. That can mean that the cure is effectively administered before the disease arrives, potentially saving millions from premature death or chronic illness. However it also means that individuals can more easily be identified as being at risk of a certain disease. This in turn could impact on their ability to access health insurance or even could mean to them being excluded from certain jobs on account of the likelihood that they will be more susceptible to a disease many decades into the future.

The world of the early twentieth century is one that assumes that a large proportion of future risk, especially with regards to health, can't be adequately calculated. However if we enter an age when the risk can be accurately mapped, potentially allowing humans to have a glimpse of the future, this will have monumental repercussions, both on the individuals themselves, who will have far more information about their likely fate, and on how society as a whole manages that risk.

From where we stand today, it is clear that much work needs to be done and that we are not ready yet to truly understand AI, its impact and the questions that we will need to grapple with as it gradually seeps into our lives. Cedric Villani, drawing on inspiration from the US Agency responsible for defence research projects, DARPA, suggests that the nature of AI needs to be properly understood before we can effectively trust it and that to do that, governments should invest in three lines of research.

- How to produce models which are more easily understood.
- How to produce more intelligible user interfaces
- Understanding the cognitive mechanisms at work in the production of satisfactory explanations.<sup>46</sup>

In this regard the incorporation of AI into our education systems and school syllabus will be an important step. This will aid not just the technical, coding, software and maintenance skills needed to allow everyone to have the opportunity to work in an economy likely to be dominated by technology, but it should also be focused on the ethical questions highlighted above. These ethical questions could also be incorporated into the training of engineers and researchers studying AI.<sup>47</sup> However, the challenge here, as with everything in the world of philosophy, is how to teach students about ethics.

Is it enough to provide them with a philosophical framework within which they can muse over these questions and come to different answers, or do we have to instill a specific ethical framework within them and only allow them to address ethical questions within that framework. The former approach would be the better one, as the latter approach leads us to the challenging question of who sets the ethical goals that we are trying to enshrine into the thinking of researchers. Max Tegmark highlighted this issue in his book "Life 3.0" where he asks whose ethical goals are we talking about? "There is a vast difference between the goals of Adolf Hitler, Pope Francis and Carl Sagan"<sup>48</sup>

Data protection is an example worth analyzing in this context. In the European context the protection of personal data is a fundamental right (enshrined in the European Union treaties). When Europeans talk about an ethical framework covering data protection it is invariably in this context. It therefore becomes virtually impossible to argue that not protecting personal data is a viable ethical position to take, it is ethically right to view it as a fundamental right and ethically wrong to question that.

However the approach to data protection varies depending on where you are in the world, the Chinese approach is not the same as the European one, which is not the same as the American one. It cannot be said that there is a yet human approach to an issue such as data protection.

Data protection attitudes are affected by many factors including historical experience, ease of doing business and personal freedom and each society reacts to them differently. This is similar for the other outcomes that are addressed in this section, including tolerance for income differences for example.

Every other contentious issue regarding the ethical dimension of AI will provoke the same differences in approach in the years to come. The debates won't be about technology; they will be about what our ethical values are. These are the most contentious debates possible, as individuals, as well as nations and regions, have never agreed fully on ethics. "Since ancient times, philosophers have dreamt of deriving ethics (principles that govern how we should behave) from scratch, using only incontrovertible principles and logic. Alas, thousands of years later, the only consensus that has been reached is that there's no consensus."<sup>49</sup>

Although there are some overarching ethical principles that appear to be fairly universal in human societies, such as not killing other people, many others vary by culture and region. There is no consensus on the basic ethical questions of life, let alone on how to address an issue such as the protection of personal data.

If there is no solution to this debate at this stage, we must recognize that these debates will happen and are likely to be intense in the years to come. This will be a major source of strife in the short term, however we should not take our eye off the bigger picture.

As AI develops in the long term and if it ever reaches the level of super intelligence, the initial ethical programming we will have given it may decide whether AI becomes an existential threat to humankind or not.

As Max Tegmark notes " To program a friendly AI, we need to capture the meaning of life. What's "meaning?" "What's Life?" What's the ultimate ethical imperative? In other words, how should we strive to shape the future of our universe? If we cede control to a super intelligence before answering these questions

45 Villani, Cedric (2018) For a Meaningful Artificial Intelligence, Towards a French and European Strategy. P117 explains in some detail how such an auditing system could work. Such auditing systems may be necessary given the potential impact such algorithms could have on society, however ensuring that they are genuinely impartial and free of political bias will be a significant challenge to their development.

46 Villani, Cedric (2018) For a Meaningful Artificial Intelligence, Towards a French and European Strategy. P119 and Turek, Matt (Dr) (2016) Explainable Artificial Intelligence (XAI) - <https://www.darpa.mil/program/explainable-artificial-intelligence>

47 Villani, Cedric (2018) For a Meaningful Artificial Intelligence, Towards a French and European Strategy. P119

48 Tegmark, Max 2017 "Life 3.0, Being Human in the age of Artificial Intelligence" Penguin Books p269

49 Tegmark, Max 2017 "Life 3.0, Being Human in the age of Artificial Intelligence" Penguin Books p269

rigorously, the answer it comes up with is unlikely to involve us.”<sup>50</sup>

The debate about what ethical bias we impose on AI algorithms will therefore be a crucial question, not just in ensuring or eliminating bias in outcomes that could effect outcomes for individuals, but also for the time when machines are able to learn for themselves.

There is another area that demonstrates how difficult the ethical questions raised by AI will be. This is in the area of predictive policing. Police departments around the world are currently exploring the possibilities of using predictive algorithms in order to predict crime and potentially stop it before it happens. This can take the form of identifying crime hotspots where crimes are more likely to take place and by identifying individuals who are likely to be the perpetrators of crime in future.<sup>51</sup>

As so often in this field, Hollywood tried to address this issue first. In the 2002 film “Minority Report” the main character Tom Cruise, is a police detective on a unit investigating and stopping future crimes who is himself wrongly accused of a murder that will take place in the future. The film follows his attempts to clear his name.

The film raises many issues that we might all need to face soon. If predictive algorithms can accurately predict who will commit a murder in the future, what should we do about it? The role of governments and of our police forces is to keep us all safe and therefore on one hand they should take all action necessary to stop the crimes taking place. However our societies are also governed by the rule of law, and the principle of free will. In the case of the UK at least, there is also presumption that you are “innocent until proven guilty.” Does that presumption of innocence remain until the point that you take an innocent life, or if we know with certainty that you are going to commit that murder, is it right that you are arrested and put in prison for a murder that you yourself didn’t even know you were going to commit?

Such ethical questions will be immensely complex to unravel. There are not at this stage any right or wrong

answers. At some stage in the future we will have to grapple within the context of AI and within a legal framework, with the question of “free will” versus “determinism” – ultimately whether human beings have any control over our destiny. It will also mean we will have to address the very philosophical question of what it means to be human and what our rights and obligations are as humans. It also raises the question of how much power are we prepared to invest in the state to imprison people who computers believe are going to commit crimes.

To deal with these questions, and more specifically how humans can keep the upper hand in this debate, the French Parliament commissioned the CNIL to look into this issue.<sup>52</sup> Cedric Villani also suggested that in France a national body should be set up to look at these questions, and this may be a route that other countries also seek to follow. Such an approach would allow these questions to be debated at a relatively early stage in the development of AI. However, humans have been discussing similar issues for thousands of years and to date, we are no closer to a settled view.

AI will undoubtedly create ethical questions, and ones that cannot be easily answered now, however, it has the potential to provide an immensely better world than currently exists, and a more economically efficient one as well. More targeted and evidence based healthcare programmes, driven by AI, offer a possibility of a far healthier, and longer living future for mankind. It offers us the hope that health outcomes can be far better for everyone, including those from the poorest communities.

AI also offers the potential to have a world that is far more fact based in which secrets, up to now far out of the reach of humans, can be unlocked and used to create new goods and services tailored towards those needs. From an ethical perspective this is a positive effect as long as the systems remain trusted and people can understand the process behind which these secrets are revealed.

The negativity surrounding the development of AI technologies is often used to try to articulate a scenario where we should abandon or regulate them

in such a way that their development can be bounded and slowed. This is ill placed and will only exacerbate the existing inefficiencies and inequalities that we find in the modern world.

The main challenge to AI from an ethical perspective is not therefore the oft-repeated concerns about AI taking us over or making decisions on our behalf. It is not even the challenging debate on how to ensure that algorithms are not rigged or discriminatory.

The main challenge is that it will spur a grand debate about who we are as humans, what our values are

and whether we are predestined to experience the outcomes we do. These are not new debates, and for many centuries we have discussed them only on the periphery of public policy and only in relation to specific threats.

In the age of AI, they will cloud the debate on many more fundamental aspects of public policy and as a result we will be forced to confront them. Whether we are any more successful in defining who we are in this age, when we have been unable to come to any consensus in previous ages, remains to be seen.



50 Tegmark, Max 2017 “Life 3.0, Being Human in the age of Artificial Intelligence” Penguin Books p279

51 Villani, Cedric (2018) For a Meaningful Artificial Intelligence, Towards a French and European Strategy. P123

52 How can humans keep the upper hand? Report on the ethical matters raised by AI algorithms. 15<sup>th</sup> December 2017. <https://www.cnil.fr/en/how-can-humans-keep-upper-hand-report-ethical-matters-raised-algorithms-and-artificial-intelligence>

## INDUSTRIAL AND ECONOMIC CHALLENGE POSED BY AI

The industrial challenge posed by AI can be broadly divided into two categories.

The impact of AI on jobs and secondly the opportunities and challenges for the future of industry in general, and in particular for high wealth developed countries.

Most studies on AI come to the conclusion that its widespread adoption will lead to the significant job losses throughout the economy, and that these job losses won't be limited only to low paid, low skilled jobs. AI has the potential to also start taking white collar and traditionally middle class jobs as well.

Martin Ford devotes most of his book, "The Rise of the Robots" to this premise.<sup>53</sup> Frey and Osborne from the University of Oxford estimated that 42% of total employment in the United States was at risk of disappearing over the next two decades.<sup>54</sup> The McKinsey Global Institute predicted that as will cause between 40 and 160 women worldwide to have to change occupations by 2030.<sup>55</sup> Oxford Economics estimated that 20 million manufacturing jobs will be lost by 2030.<sup>56</sup> As Max Tegmark notes, the fear is not just that more and more people become unemployed, but that they become unemployable.<sup>57</sup>

Technology in general has always advanced, and with that advance it has always destroyed existing

jobs. While much of the attention surrounding new technology is always on the jobs likely to be at risk, not much emphasis is placed on the (often better paying and higher quality) jobs that replace them.

Agriculture is a prime example of this, in the late 19<sup>th</sup> century; half of all American workers were employed on farms. By 2000 this had fell to 2%.<sup>58</sup> To put that in a modern context that meant that over 100 years, half of all US jobs disappeared.

The same is true of all major economies, over the past 500 years; agricultural jobs have been systematically replaced by jobs in other parts of the economy. The main driver of this was the industrial revolution, which fundamentally changed every aspect of society and brought with it jobs which were better paid and higher quality. The graph below shows just how severe the replacement of agricultural jobs has been over history and in particular over the past 500 years.<sup>59</sup>

At the same time, average farm yields in the US have gone up substantially, from 1.6 million tonnes in 1866 to 10.7 million tonnes in 2012, as the graph below shows.<sup>60</sup>

Agriculture is today far more efficient and productive than it has ever been and yet it employs ever fewer people. AI is likely to do the same thing to many other industries, however the key fact is that we, as humans,

<sup>53</sup> Ford, Martin (2015) The Rise of the Robots, Technology and the Threat of Mass Unemployment, Oneworld.

<sup>54</sup> Frey, Carl and Osborne, Michael, (2013) The Future of Employment, Oxford University. Available here [https://www.oxfordmartin.ox.ac.uk/downloads/academic/The\\_Future\\_of\\_Employment.pdf](https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf)

<sup>55</sup> McKinsey Global Institute (2019) The future of women at work: Transitions in the age of automation. <https://www.mckinsey.com/featured-insights/gender-equality/the-future-of-women-at-work-transitions-in-the-age-of-automation>

<sup>56</sup> Oxford Economics, (2019) How Robots change the World, What automation really means for jobs and productivity.

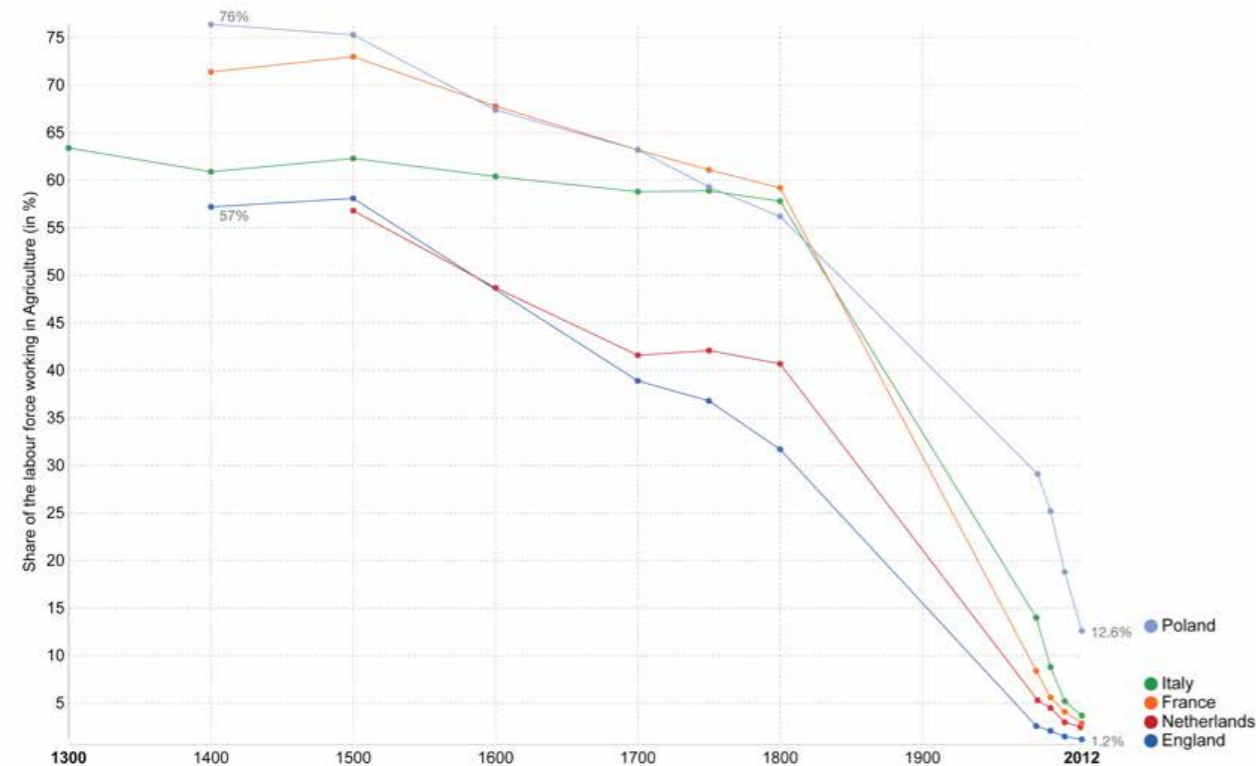
<sup>57</sup> Tegmark, Max (217) Life 3.0, Penguin Books, p123

<sup>58</sup> Ford, Martin (2015) The Rise of the Robots, Technology and the Threat of Mass Unemployment, Oneworld. P23/24

<sup>59</sup> [https://ourworldindata.org/uploads/2013/04/ourworldindata\\_share-working-in-agriculture-since-1300.png](https://ourworldindata.org/uploads/2013/04/ourworldindata_share-working-in-agriculture-since-1300.png)

<sup>60</sup> <https://ourworldindata.org/crop-yields> - This website contains data on crop yields over history for many of the leading economies

**Our World in Data** Share of the labor force working in agriculture, since 1300 – By Max Roser



Data source: Pre 1800 is from Allen (2000), "Economic Structure and Agricultural Productivity in Europe, 1300-1800". Newer data from the World Bank. The interactive data visualization is available at [OurWorldinData.org](http://OurWorldinData.org). There you find the raw data and more visualizations on this topic. Licensed under CC-BY-NC-SA by the author Max Roser.

have already been through this transition once. Agricultural jobs were destroyed and were replaced by many more new jobs in a wide variety of industries.

The burning question with regards to Artificial Intelligence is whether this time is different, and that the technological advances are so great and of such a specific nature, that they will destroy jobs without creating new ones. Are we approaching an age where computer technology is so different from anything that has come before that it actually has the potential to usher in a completely new age.<sup>61</sup>

Machines are already beginning to take over many of the routine jobs that are currently done by human beings. They have been present on production lines for many years. However the real game changer will come when computers have the widespread ability to use and process data in order to teach themselves how to do the jobs that are less predictable. At that stage many more jobs, much higher up the value chain, are likely to be under threat.

Most of the concern about jobs relate to the manufacturing sector, and low skilled workers on production lines are likely to be, and are already, being replaced by machines, due to the routine and predictive nature of many manufacturing jobs. China, as the world's largest manufacturer is already on the front line. 20% of the world's robot stock is in China. Approximately every third robot in the world is now installed there.<sup>62</sup> At the same time, China is believed to have lost 15% of its manufacturing workforce between 1995 and 2002. Increased automation isn't affecting only China, Vietnam, Indonesia and other developing nations are also seeing the effects of automation. These are only likely to grow as robots develop new abilities in the coming years.

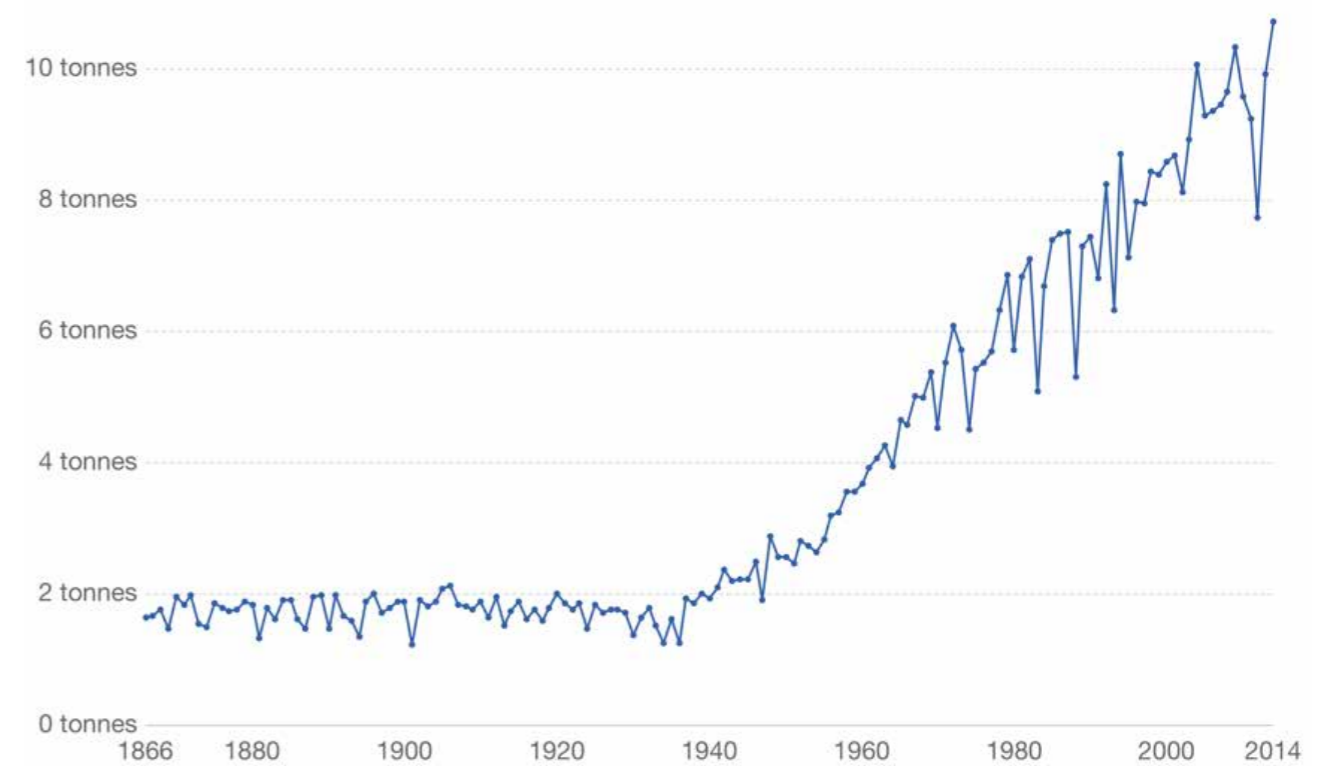
Automation is likely to have significant impacts in the developing world, and in any country with a high proportion of jobs in manufacturing. However, for advanced economies such as the United States and the United Kingdom, increased automation may provide an opportunity. In these countries

61 This was the view of Norbert Wiener, widely considered to be the originator of cybernetics and one of the first to theorise about the future role of computers and artificial intelligence

62 Oxford Economics (2019) How Robots Change the World p13

**Our World in Data** Average corn yields in the United States, 1866-2014

Average corn (maize) yields in the United States, measured in tonnes per hectare.



Source: United States Department of Agriculture (USDA) & UN Food and Agricultural Organization (FAO) [OurWorldinData.org/yields-and-land-use-in-agriculture/](http://OurWorldinData.org/yields-and-land-use-in-agriculture/) • CC BY

manufacturing accounts for less than 10% of total employment.<sup>63</sup> They are therefore less likely to see significant falls in manufacturing employment and they may also benefit from the reshoring effect, where manufacturing output that had been lost to lower cost jurisdictions returns. There are already signs that this effect is in motion in the UK.<sup>64</sup>

Automation and AI has the potential to significantly increase Europe and the United States ability to encourage the reshoring of manufacturing work in two ways.

Firstly it can make these areas more competitive against low wage economies, as rather than relying on large numbers of relatively low cost workers, Western companies can use a few, relatively cheap machines to do the same work. As Western factories can be located closer to the richest consumer markets, (which is always an important consideration for manufacturers), they hold an important advantage over facilities in the developing world. While labour

was very cheap in third countries, producers were prepared to produce further away from markets to gain the benefits of cheaper cost of production, however with machines beginning to erode that advantage, the proximity to consumer markets is likely to again become an important and alluring advantage.

Secondly, as machines develop the ability to react to product design changes and even recalibrate themselves without human intervention, we are likely to enter an age of "mass customisation". Where potentially each item is produced slightly differently depending on the wishes of the customer. This is currently very difficult to do with either a human or a machine production line. Most factories are designed for mass production, not mass customisation. However, the ability to combine both and have a production line that can produce large numbers of products but with each product being slightly different would fundamentally change the nature of manufacturing.

63 Ford, Martin (2015) The Rise of the Robots, Technology and the Threat of Mass Unemployment, Oneworld. P xv

64 Bounds, Adrian & Powley, Tanya (2015) "UK textiles eye reshoring jobs boost" Financial Times, 9<sup>th</sup> February 2015.

The customisation that AI could promise could allow each consumer to have a unique product. Whilst there would probably always be a need for the older style production lines which reproduce the same product over and over again, these new production lines would allow companies to add greater value to each item they produced and to be closer to the consumer, not just physically, but also in terms of trying to react to consumer needs and demands.

So the West may be able to bring the manufacturing back in house, through greater use of automation. What it won't be able to do is to bring the jobs back with it, at least not in great numbers. The jobs these types of advanced manufacturing will bring will primarily be for machine designers, software designers, and maintenance specialists.

Reshoring manufacturing output is therefore unlikely to directly drive job increases in the manufacturing sector. What it is likely to do is to increase employment in the ancillary sectors that develop around manufacturing centres, for example amongst suppliers in the supply chain. Other industries such as logistics could also see improved employment opportunities.

This process will mean that the machines will take human jobs, but they are likely to be human jobs based primarily in developing countries. This could have significant short-term effects on the stability of these countries and repercussions regionally and globally. However from the perspective of the advanced Western economies, manufacturing is not the area where AI is likely to have the biggest effect on jobs. For that, we need to look much more closely at the services sector.

In most advanced economies, the service sector is where the majority of the jobs are. This is especially true in both the United States and the United Kingdom. With such a large proportion of the population employed in service jobs, any disruption by machines could pose major problems in the decades to come.

However, whilst there are significant risks, there is also probably an upper limit to how far into service

sector employment, the machines could go. Oxford Economics notes, "It will be difficult for machines to replace humans in service sector occupations that demand compassion, creativity and social intelligence"<sup>65</sup>

Humans are always likely to want an element of human interaction in the services sector. In addition, technological advancements in the service sector have often led to an increase in demand and therefore an increase employment and not a reduction. Installing cashpoints or ATMs in banks didn't lead to a reduction in bank workers, instead it lowered the cost of opening new branches and allowed banks to open up more branches and hire more workers.<sup>66</sup> The provision of ride sharing apps such as Uber has not reduced the demand for taxis. It has widened the market for people who are prepared to use any type of 'taxi' service, forced taxi services to offer better service and has therefore resulted in more demand in general, as more people are now prepared to use all types of taxis.

Technology and the development of AI therefore has huge potential for the services industry in general and for the development of services which will drive new demand in existing industries. However the services sector is also vulnerable to machines, particularly with regards to potential job losses.

Many unskilled services jobs are vulnerable to automation in the short term, including secretarial work, shop assistants, cashiers and customer services departments. In the longer term more skilled jobs could also be in jeopardy.

Over the past few years, touchscreen self service checkout machines have begun to appear, particularly in supermarkets and in a wide variety of convenience stores. Most airports now rely on check in machines, as do fast food restaurants for ordering food. Whilst in all cases there is an option to be served by a human in the old fashioned way, these machines are beginning to dominate the sector.

These machines have the advantage that they are very cheap in comparison to hiring human staff and they mean that fewer workers need to be employed.

Several machines can service far more customers than the equivalent number of humans can. Companies still need to employ humans in these roles and to help with customer problems, but there are far fewer than there were before.

The fast food industry is one of the biggest employers of low skilled workers in the developed world, particularly in the United States and the United Kingdom. However the industry provides an example of the career challenges that may face these workers in future. The production of food is an area that is ripe for an automation takeover. One restaurant in San Francisco is already making the transition, having spent several years trying to perfect the technology needed. Creator restaurant<sup>67</sup> opened in 2018 and employs a series of robots to make burgers to order. The jury is still out on whether it will succeed or if robot burger production will catch on, but it potentially offers many advantages, particularly in food safety. If the automation revolution does come to dominate the fast food sector, many jobs in the fast food sector could be in jeopardy.

As this is one of the largest employment sectors and tends to employ mainly low skilled, low-income workers, it could entail significant disruption in the sector.

However, as machines are employed because they reduce the cost of doing business, those cost savings also open up the possibility of offering substantially more services, including potentially opening more branches or restaurants in smaller towns that may previously have not them. That in turn could provide new employment opportunities in places that normally don't get them.

In the retail sector, shops could well go in a similar direction. Amazon opened an AmazonGo store in Seattle in 2018 that allows customers to walk in, take whatever product they want from a shelf and walk out of the store, with their pre downloaded app automatically billing their credit card. There is potentially no need for any interaction with human staff. This model is the prototype for the likely future of retail, which could essentially develop into a series of large kiosks and shop size vending machines that do not need shop assistants.

The AmazonGo store and the Creator restaurant are currently novelties and prototypes, but they show

a glimpse into the near future. If these concepts succeed to any extent at all then there are likely to be far fewer employment opportunities in the retail and food sector in the future.

Online retailers have already completely revolutionised the retail sector. The rise of companies like Amazon in retail and Netflix in broadcasting has demonstrated the advantage online purchases have over the High street stores. Consumers have almost endless choice at the touch of the button, and in the case of online retail, this is backed by centralised and very large warehouses. These warehouses, which offer huge savings to retailers because of their economies of scale, are also becoming easier to automate. Amazon for example, has already started experimenting with the widespread use of robots in their warehouses.

High street stores still have one major advantage over online retailers, which explains their continued existence. That is the instant gratification that you get from having the product in your hand as you exit the store and the ability to instantly use it. Most online retailers can't deliver the product to you for several days and then they are reliant on postal or courier services and on you being at home when the delivery arrives.

These are significant disadvantages. However the online retailers are investing heavily in new technologies, including AI, to bridge that gap. Amazon are trialling drone delivery systems, allowing them to cut out the postal or courier services and potentially ensuring that a customer can receive their purchase on the same day as they order it.

There is little doubt that automation will continue to revolutionise the service sector and in doing so it will reduce the amount and type of existing jobs available. However the service sector exists to make life more comfortable for consumers, and therefore it will continue to find new ways to offer new services to people. Some of the solutions that develop cannot yet be imagined, and they are likely to ensure that new jobs, in new sectors are also created.

McKinsey Global estimates that only 5% of all occupations can be fully automated. In 60% of existing occupations up to a third of the constituent

65 Oxford Economics (2019) How Robots Change the World p7

66 Reece, Byron (2019) AI Will create more jobs that it will destroy, Here's how. Singularity Hub 1st January 2019 <https://singularityhub.com/2019/01/01/ai-will-create-millions-more-jobs-than-it-will-destroy-heres-how/>

67 <http://creator.rest>

activities could be automated. However these job losses can be more than offset by a combination of rising incomes, especially in emerging economies leading to a rise in global consumption, aging populations which will create new demand for health related occupations, the development and deployment of new technology, investments in infrastructure and renewable energies and the marketization of previously unpaid domestic work<sup>68</sup>

Therefore whilst it is prudent to try to make predictions about the future, history has taught us that when technology ushers in a transformation towards new types of industries and jobs, some jobs may be lost and many workers may need to retrain or change careers, however at the end of the process many more job opportunities are opened up by the transition and automation of previously labour intensive jobs.

As Roger Bootle points out, “In my view, robots and AI should be regarded as the latest phase in the process of capital accumulation mixed with technological advancement that has been going on since the Industrial Revolution.”<sup>69</sup>

It is also a common misconception that there are only a limited number of jobs in the economy and that if some jobs are taken by computers then that will reduce the number of jobs available in the economy for humans. This “lump of labour” fallacy is often mentioned in relation not only to automation, but also to immigration. It is rarely true because, as Byron Reece explains “There are not a fixed number of jobs that automation steals one by one, resulting in progressively more unemployment. There are as many jobs in the world as there are buyers and sellers of labor.”<sup>70</sup>

The argument against automation has been a constant one since English textile workers, known as the Luddites, destroyed machinery in wool and cotton mills in the early 19<sup>th</sup> century<sup>71</sup>

The Industrial Revolution sparked the Luddite movement; yet that same revolution created so many jobs that modern cities became possible as the population and demand exploded. The Luddites had been proved spectacularly wrong because they also assumed that the number of jobs were finite.

That fallacy remains stubbornly strong today, despite overwhelming evidence to the contrary. Economies are organic. Jobs follow demand which itself dictates whether a job is worth doing or not. As technology gets cheaper, it opens up many more jobs that now become worth doing, which then leads to more jobs, more demand and for the economy as a whole, more wealth.

Automation and AI will change many existing industries and create new ones. Whilst we cannot fully understand what the new industries will be, in some areas we are already seeing the start of the development of these new industries. In Healthcare AI promises to be hugely important, potentially giving us the ability to pinpoint specific diseases, both through the increased ability for computers to find clues to diseases in the data they receive about a specific patient and through the ability of AI to find patterns within a population. The construction industry could be transformed by machine learning, giving the possibility that the construction process could be made faster and safer by the utilisation of data.<sup>72</sup>

The mass customisation potential in manufacturing is likely to be driven in part at least by the development of additive manufacturing, or 3d printing. This is the process by which objects can be made (or printed) from a digital file on a computer. Layer after layer of a material is printed and the object is gradually built up in this way. A wide variety of materials can be used, including metals, plastics, wood or ceramics. A key benefit of additive manufacturing is that interlocking or moving parts can be created as a single unit, eliminating the need for assembly and potentially reducing the number of weak spots in the

object. As they are printed from a digital file, they can be customised in a potentially unlimited number of varieties.

When 3d printing first started entering the public consciousness several years ago, it aroused expectations that consumers would be able to print out their purchases at home in the same way that we print out an airline boarding pass today. Whilst that could come to pass, it is much more likely that additive manufacturing will be used at an industrial scale and drive the mass customisation process in our factories.

The object of value in additive manufacturing is the digital file, and it therefore has the potential to will create significant opportunities for employment in the area of digital design of these software files and will mean that intellectual property enforcement around the world, already a source of concern for many companies, will become a far more pressing concern. One leak of the digital file could mean unlimited copies of the product could be produced.

Additive manufacturing has the potential to revolutionise manufacturing, and to help the Western world recover manufacturing output by focusing on customisation. It may also drive the development of many new jobs, particularly in product design.

Self-driving or autonomous cars are also likely to become a key industry of the future. Cars with self-driving features are already available to buy and have been driving on our roads for some time. Whilst the technology is still embryonic, and there have been some high profile accidents, it is becoming increasingly clear that at some point in the future, self driving cars will become mainstream. When this happens, it has the potential to disrupt a variety of industries and make substantial changes to society as a whole.

The major changes in automation are likely to come when the intelligence driving robots and machines no longer resides in the machines themselves but instead exists in the cloud. Cloud robotics is already

developing quickly and it is now already possible for robots to have the advanced computation that runs them, effectively their “brain”, to be in the cloud rather than stored internally in the machine itself. This means that it is possible to build much cheaper robots and for the system to learn as a whole from all the data that is sent back by every machine connected to the system.<sup>73</sup>

However none of this can be sustainable without effective cyber security systems. As more processes are automated, the more vulnerable they become to cyber attacks. At some stage between 2005 and 2010 the Stuxnet worm was created, no one knows for sure by whom, although it is widely attributed to the US and Israeli governments. It “infected fast-spinning centrifuges in Iran’s nuclear-enrichment program and caused them to tear themselves apart”<sup>74</sup>

Although this was in a military, or geopolitical context, the cyber threat also exists for civilian and manufacturing industries. If a cyber attack can inflict the same sort of damage to a factory production line, or can take control of driverless cars, then a lack of protection could be fatal, both for individuals and for the viability of an entire factory.

Cyber security will therefore be one of the major growth industries over the next few decades. Cyber defence systems will engage in an arms race with the hackers, with potentially devastating results if the defence systems are not robust enough. The threat is so severe that this could limit the development and take up of automated systems.

AI will both be necessary to predict, detect and stop cyber attacks,<sup>75</sup> and will drive the development of the cyber security industry that is likely to develop in importance over the coming decade, with significant opportunities for employment and for value to be created, particularly in the Western world.

Europe and the United States both have significant opportunities and advantages in all of these industries. With a strong and stable manufacturing base, universal education systems, including the

68 Manyika, James, Lund, Susan, Chui, Michael, Bughin, Jacques, Woetzel, Jonathan, Batra, Parul, Ko, Ryan and Sanghvi, Saurabh (November 2017) Jobs Lost, Jobs gained : What the future of work will mean for jobs, skills and wages. McKinsey Global Institute.. <https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages#part2>

69 Bootle, Roger (2019) The AI Economy, Work, Wealth and Welfare in the Robot Age. Nicholas Brealey

70 Reece, Byron (2019) AI Will create more jobs that it will destroy, Here’s how. Singularity Hub 1st January 2019 <https://singularityhub.com/2019/01/01/ai-will-create-millions-more-jobs-than-it-will-destroy-heres-how/>

71 An explanation of the Luddites and their movement can be found here <https://www.history.com/news/who-were-the-luddites>

72 Forbes (2019) 13 Industries soon to be revolutionized by Artificial Intelligence – 16th January 2018. <https://www.forbes.com/sites/forbestechcouncil/2019/01/16/13-industries-soon-to-be-revolutionized-by-artificial-intelligence/#a555ba53dc18>

73 Ford, Martin (2015) The Rise of the Robots, Technology and the Threat of Mass Unemployment, Oneworld. P21

74 Tegmark, Max 2017 “Life 3.0, Being Human in the age of Artificial Intelligence” Penguin Books p118. For further reading on the Stuxnet worm, this article is worth reading :- <https://www.forbes.com/2010/10/06/iran-nuclear-computer-technology-security-stuxnet-worm.html#36880dfd51e8>

75 Columbus, Louis (14th July 2019) Why AI is the Future of Cybersecurity. Forbes.com <https://www.forbes.com/sites/louiscolumbus/2019/07/14/why-ai-is-the-future-of-cybersecurity/#21a1a8aa117e>

best universities in the world, infrastructure laid over centuries of gradual technological advancement and the largest consumer bases in the world, both regions are likely to benefit hugely by these technological changes. The risk in terms of job losses are far less in the developed world than they are in the developing world and the likelihood that new jobs will replace those that are lost are much higher, as are the opportunities available to workers who might lose their jobs to retrain.

This means that the development of Artificial Intelligence will have profound implications for many workers throughout the world. Existing skills will be out of date very quickly, existing educational systems will increasingly be out of sync with the needs of industry and a significant divide could emerge between those who can't find a job because they don't have the skills and can't compete with automation, and those who design, code and maintain the systems and as a result can command significant salaries.

The world of world is therefore likely to change significantly. The key question is how will this change manifest itself and can we realistically predict it in an organic system where we don't yet know what many of the new technologies will be?

Whilst low paid and low skilled workers in the West will face significant challenges, much of the evidence suggests that more striking and dangerous threat will be in the developing and recently developed countries, mainly in Asia.

Countries such as China, and more recently Bangladesh, Indonesia and Vietnam, modelled their economies around manufacturing. In recent decades many manufacturing jobs moved from the West to the developing world. This happened because these countries could offer a huge workforce that was prepared to do manufacturing work at a fraction of the labour costs that were incurred in the West.

This changed the world, it allowed consumers in the West to buy far cheaper consumer goods, and it allowed China in particular, to develop and to raise hundreds of millions of people out of poverty. This offshoring effect wasn't restricted only to manufacturing. Service industries including call centres also moved to lower cost jurisdictions.

It had a significant impact in the West, where traditional industries began to die out and regions which had always had a proud manufacturing tradition, often built around a single industry which defined a regional identity. Whilst better-educated workers could now compete in a global economy and a global market of billions, ensuring they could receive far higher rewards, low skilled workers were in the West were increasingly uncompetitive. Workers in the developing world would do the same job for a fraction of the cost.

This shift brought social, economic and increasingly political upheaval in many of these regions. Economies, jobs and wealth increasingly clustered around the large cities that were plugged into the global economy, and international transport networks and which had the economies of scale to support several large industries in the same place.

The big cities boomed, whilst the industrial hinterlands withered. The UK is a good example of this, where London and the South East of England boomed thanks to its links to global markets which the provincial towns and cities couldn't match. Investment focused mainly on London, and to a lesser extent Manchester and Birmingham, yet the other towns, often with proud industrial heritages such as Stoke on Trent or Liverpool, struggled to gain investment and tended to suffer from a brain drain to the bigger cities. The manufacturing jobs that remained in these regions were often automated in an attempt to retain production in the same place, but not the jobs.

A similar phenomenon can be seen in the United States of America, where the large coastal metropolises on the East and West coasts boomed and the smaller previously highly industrial areas such as Detroit or Ohio, stagnated.

In both cases this led to social upheaval and then an element of political upheaval.

This movement of manufacturing jobs from the West to the developing world is a precursor to what will happen when the AI revolution really takes hold. Instead of competing against cheaper human workers situated in poorer parts of the world, workers will compete against robots and machines that will do the job for nothing, other than the initial investment. Martin Ford describes offshoring as “the precursor

to automation” as the jobs it creates in developing countries may be short lived as technology develops. It is a form of “virtual immigration” as it gets the job done by paying people a lower wage before the machines are able to fully automate the role.<sup>76</sup>

Western countries have already had a taste of what automation will do to jobs and economies as a result of the offshoring process. Economies have adapted and thrived in the process; in many cases moving towards a more services focused economy. Employment has generally increased in those countries most exposed to this process. For example, in the UK there were more people in jobs in 2019, than there were ever before, with an overall employment rate of 76.1% between November 2018 and January 2019.<sup>77</sup> This seems to suggest that the mass offshoring of manufacturing jobs along with increasing automation in the services sector does not affect overall employment figures, in part because the technological development also allows new jobs to be created. It is also worth noting that while the UK employment figures are generally seem as positive, in many other European countries this has not been repeated, suggesting that it is not technology or automation alone which is the biggest factor that affects job creation. A positive regulatory environment for business and job creation, a smaller tax burden on companies when they employ people and more flexible contract conditions appear to be as important as automation in the story of overall employment in the economy.

The UK experience does suggest that countries in the developing world will be able to manage a transition

away from mass employment in manufacturing, however it is unlikely to be trouble free. In both the UK and the US, the economy as a whole grew yet some sections of society and some regions felt left behind. It is one of the possible explanations for the radical departures from previous political norms that were seen when the UK voted for Brexit and the USA voted for a Donald Trump Presidency.<sup>78 79</sup> In both cases the national economies as a whole were growing at the time of those votes. In 2011, when the Arab Spring created popular revolutions in several Arab countries, most of the national economies affected were booming, yet this growth was not necessarily being felt by everyone in the society, with high youth unemployment a particular feature of many of these economies at the time of the revolution.<sup>80</sup>

These experiences suggest that automation and the increased globalisation which the digital economy fosters can have unanticipated and unpredictable effects in the population as a whole, which are often difficult to discern from general statistics about the overall state of the economy. In the US and the UK, with long and strong democratic traditions and constitutional orders that protect that democratic tradition, the political effects of these phenomena were still strong. In countries without these protections there is a significant possibility that automation will lead to changes that could fundamentally threaten their stability. This has already been seen in the case of the Arab Spring and could also affect Asian countries, including China, in future. The global repercussions of such instability on the Western world could, as a result, be severe.

<sup>76</sup> Ford, Martin (2015) The Rise of the Robots, Technology and the Threat of Mass Unemployment, Oneworld. P118

<sup>77</sup> Office for National Statistics (UK) (2019) Employment in the UK: March 2019 <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/employmentintheuk/march2019>

<sup>78</sup> Goodwin, Matthew & Heath, Oliver (25th July 2016) A Tale of two countries: Brexit and the 'left behind' thesis. London School of Economics <https://blogs.lse.ac.uk/politicsandpolicy/brexit-and-the-left-behind-thesis/> and Inman, Phillip (2nd December 2019) Brexit voters more likely to live in areas at risk from rise of robots. The Guardian <https://www.theguardian.com/business/2019/dec/02/brexit-voters-more-likely-to-live-in-areas-at-risk-from-rise-of-robots>

<sup>79</sup> Swain, John (2016) White, working class and angry: Ohio's left behind help Trump to stunning win. The Guardian, 9th November 2016. <https://www.theguardian.com/us-news/2016/nov/09/donald-trump-ohio-youngstown-voters>

<sup>80</sup> World Economic Forum (6th March 2018) Spotting triggers of unrest – the case of the Arab Spring. <https://www.weforum.org/agenda/2018/03/spotting-the-triggers-of-unrest-the-case-of-the-arab-spring/>

## THE SOCIAL AND SOCIETAL CHALLENGE OF AI

As automation changes the types and number of jobs available for workers, this will provide a number of challenges and opportunities for governments with regards to work. However, it is also worth analysing the impact on consumers, as all workers are also consumers, as is virtually everyone in any given society.

Workers are also consumers, the wages they earn allow them to buy goods and services. On the whole consumers are looking to consume a range of goods and services which meet both their basic needs and also their more frivolous desires. They expect them to be safe and of a quality good enough to do the job they are advertised to do. A wide range of goods and services from which to choose from allow consumers to exercise their purchasing power and to pick the product which most suits their needs.

While the Ai revolution appears to be challenge for the world of work, it looks nothing but exciting for the world of consumers.

Just as previous consumer advancements such as the washing machine and the microwave reduced the time taken doing everyday household chores and made things much more convenient, remoulding society as a result. The widespread adoption of AI is likely to have a similar effect.

In the home, life will become far more convenient and efficient. We are already approaching an age where fridges will automatically order replacement food whenever stocks are low. They will have learnt what food you consume and in what quantities. The deliveries will automatically arrive at your door, having been transported by drones or driverless vans, they may even enter your house and place them inside the fridge and cupboards, having been let in by a computer which manages the house. Computers

will automatically turn on and off lights in different rooms depending on your preferences, which it will have learnt over time by observing your behaviour. Your alarm clock will monitor your sleep patterns and cycles to wake you up at just the right time to make you feel fully refreshed.

All of this is already available in an embryonic form, but over the next decade it will be refined, the Artificial Intelligence will improve and it will gradually find its way into every appliance in the house, all of which will have the potential to be permanently connected to the Internet and to each other.

Outside of the house cars will also be connected, sending data out about traffic flows to all the cars around it. The car will almost certainly plan the quickest route to the destination for that particular time of day. Some cars are already able to drive themselves and over the next few decades this is likely to become far more prevalent, with all cars being connected. We may not be far from a time when fleets of autonomous vehicles will be driving in convoys around our motorways, reducing the time spent in traffic and the risk of accidents.

Smartphones are already able to perform a myriad of tasks that seemed amazing only a decade ago. They are often the gateway to the many new services which have made life and the consumer experience more convenient. In the near future they are likely to get smaller and smaller and at the same time far more powerful, opening up new opportunities for a myriad of new apps which will further reduce the time, cost and stress of every part of life. In the process this will drive increased efficiency, both in the terms of time people spend on certain tasks and on their environmental footprint. Automatic lights will reduce the amount of time light are unnecessarily on and reduce electricity consumption, connected cars

have the potential to significantly reduce time spent in traffic jams, one of the biggest causes of pollution in cities.

The explosion in digital services in the last two decades has been a golden age for consumers. The first digital revolution allowed a far wider variety of goods and services to be available, in far larger quantities and in far more convenient ways. This has empowered consumers to an unprecedented extent.

However, this aspect of being a consumer is often forgotten in policy discussions about consumers. Policymakers and Stakeholders often claim to care about consumers whilst at the same time imposing remedies that greatly reduce consumer choice and increase the price of goods on the market.

There are policy discussions around the world about consumer protection, and they all approach the issue from the perspective that the consumer is weak in his/her relationship with businesses and therefore need protecting from the excesses of industry. That may have been true of the industrial world, as consumers often only had limited knowledge of the goods available to them and their safety standards.

Today consumer protection remains vitally important especially with regards to safety standards, and human and environmental health yet the focus should be far more on consumer empowerment. As digital services exploded, competition increased, prices dropped, legacy industries were challenged and all the time consumers were being empowered. They got more services, at a cheaper price and with more choice, and they got more information about the products they were buying, through reviews and basic searches on the Internet. For the first time, a truly informed consumer could start to emerge, and this process will only continue through the next phase of the digital revolution.

The prime driver of this explosion of consumer driven services has been the development of ever cheaper technology, together with copious amounts of data which has allowed entrepreneurs to extract the information needed to highlight areas where consumers were previously short changed, or under serviced.

The next generation of connected machines driven by data fed AI will take consumer comfort to a new level,

but it also poses challenges, some of them will be very difficult to reconcile.

The biggest challenge is how to manage privacy. AI is fed by data, with much of it being personal data that can offer an insight into how someone lives, what their likes and dislikes are. It can also reveal their darkest secrets. Without that data, the service won't function to its potential, but with it, it holds secrets and insights into someone far beyond anything we have previously seen in human history.

Managing this is the biggest policy challenge faced by legislators around the world. The EU has recently implemented the General Data Protection Regulation (GDPR) which aimed to give individuals complete control over their personal data. Based on the principle of consent, it shifts the balance in favour of the individual. However the GDPR could already be out of date in face of technological advances that have happened since its introduction. The advent of blockchain technologies and especially public, open ledgers are already challenging the GDPR. As are innovations such as the Amazon Go shops where customers can automatically go into a shop, take things off the shelves and have their accounts automatically debited. Both of these are embryonic compared to services that are likely to develop in the next decade, yet already the EU legislative framework may be out of date.

The challenge with the GDPR is also that it doesn't go far enough for many privacy advocates, who would like to make consent the only grounds for processing personal data. In the GDPR there are several justifications that an organisation can use to process personal data, including the legitimate interest of the organisation collecting the data. If explicit consent becomes the only grounds for processing personal data in the future this will hugely reduce both the potential of AI in the EU, but also the benefits it can bring for consumers and society as a whole. It will make it much harder to develop products. From a financial perspective, the entry level to market will be raised substantially as a company could no longer rely on offering a consumer a free service and instead monetising the data they provide to bring in revenue. The data sets consumers provide would also be incomplete, as it would not include the data from those who chose not to give it. That would translate to potentially skewed results when the data is fed into an algorithm, as it would be excluding a potentially

large chunk of the overall data. Future products would therefore be less likely to be attractive to consumers, as the data may not be complete enough to accurately reveal the secrets hidden within it.

The battles around data and privacy are just beginning, and their importance will grow as the influence of data fed AI infiltrates all parts of our lives. A balance will need to be struck between the protection of personal data and the need for the same data to drive AI technologies.

The other major concern associated with data and AI is that the AI may show bias and discriminate against certain sections of society. That could be based on race, gender, social status, poverty or any of the other inbuilt prejudices that humans can carry with them. As humans design the algorithms that will run AI, can these systems be isolated from human biases?

The promise does exist that AI will show the world for what it is, without any of the typical human biases, and that will provide new insights and opportunities in every walk of life. However the human input can never be removed, and this will have to be monitored and managed for AI to truly meet its potential.

Another major unknown is how these new technologies will affect the current fabric of society. The development of self-driving cars is one element of a general transition away from owning and towards renting services. This can be seen in the music market, with services such as Spotify, which offer unlimited music streaming for a monthly fee and Netflix, which offers the same service for audio-visual content. The services are available on smartphones and therefore are always available.

These services negate the need to buy physical versions of the music or film and move us into a position where a consumer can consume far more content in exchange for far less money, than they ever could before. This shift has repercussions on a variety of existing industries, including the broadcast television sector, which has lost its monopoly on the screening of content and with it, its ability to dictate what time and how populations consume content, in addition to what that content actually is.

This principle of renting rather than sharing is beginning to make its way into a far bigger industry. Automobiles. When the technology develops

sufficiently for cars to become fully autonomous they are likely to become very expensive to buy. That technology will not come cheap. If the car can communicate with other cars and drive itself in a convoy to a destination, it no longer needs to just be your car. A car is therefore much more likely to become a shared resource, that an individual can call up on their phone, have it drive them to their destination and leave it there for the next user to call up. In this way, the sharing model is likely to engulf the car sector and the car will become a part of the public transport model, in cities at least. This will provide benefits for consumers but will pose challenging questions for the car industry as a whole, as in such a circumstance it is likely that far fewer cars will be needed overall.

This model is already emerging. Uber, a ride sharing platform started from the premise that by driving customers around in your car in your free time, you could extract some extra revenue out of the car. The various e-bike platforms offer a different but similar model where you hire an e-bike on your phone, ride it to your destination and just leave it there, the company confident that before long someone else will hire it from that location. A number of apps such as Poppy, Somo, Cambio, and DriveNow, a platform set up by BMW, all offer the same principle for cars.

These are likely to be forerunners to the coming sharing age. They offer many benefits for a consumer, but also offer benefits from an environmental and traffic congestion perspective.

Such a shift will provoke significant social challenges, particularly with regards to liability in the event of an accident of an autonomous car. This is a pressing concern for governments around the world and the policy debate which will come on this issue will be clouded by the fact that for a period of time, the road will be shared by a combination of human drivers and autonomously driven vehicles. There will need to be a new and robust liability framework in place to deal with crashes caused by autonomous vehicles. This will need to address the key point of who is liable if a self-driving car causes a crash. If the driver remains liable, even if not in control of the car, this could significantly hamper the acceptance of autonomous vehicles. A better approach would be to make the manufacturer liable in the case of such accidents, however such a liability could end up crippling smaller manufacturers and lead to a consolidation of the industry into the

hands of the bigger manufacturers. As there is always likely to be some element of human control, even in a fully autonomous car, it is likely that some balance will have to be found. In a modern airliner, the human pilot is always in ultimate control and ultimately is responsible for the safety of the flight, despite the fact that modern airliners have the ability to fly themselves. It is likely that autonomous cars will develop in a similar way, with the human driver always able to take over control if necessary. The process to gain a driving licence and the training involved will therefore need to change, as will the liability regime.

Autonomous cars also raise another question about the type of society that will emerge in the future. Autonomous cars have the potential to greatly reduce accidents, and potentially even eradicate them completely from a statistical perspective. Human error is by far the biggest cause of motor accidents, the US National Highway Traffic Safety Authority estimates that 94% of all serious crashes are due to human error. In 2017 37,133 people died in motor vehicle related crashes in the United States<sup>81</sup> Globally 1.35 million people die in road traffic accidents.<sup>82</sup>

Self-driving cars could save the vast majority of these lives if they develop to their full potential. However, that will come at a cost, in terms of individual freedom. Many drivers like to drive their cars, and many like to maintain and upgrade them themselves. Many crave the freedom associated with hitting an open road. There are countless publications and television programmes that play to this audience. Driving has huge popularity and a sense of romance about it, in addition to the freedom it provides to simply pull onto a road and to drive wherever you want. Convincing people to give this up in favour of fully automated cars which operate within a regulated system, where there is a data trail of every trip made, will be a challenge. This will be more so in rural areas, where driving is often a more enjoyable experience than it is inside cities.

Regardless of how autonomous vehicles develop, an economy based more on renting and sharing is likely to develop. This will continue to provide

challenges, as it will disrupt existing industries and challenge existing legal regimes, however the sharing economy offers economic opportunities to many who were previously excluded or marginalised from the traditional economy. It may also become a form of safety net for those whose jobs are threatened by increased automation.

The sharing economy has a long way to develop, however it already offers us some clues as to its potential. In most European cities, if you order an Uber, it is likely that the driver will be of an immigrant background. In Paris, many of the drivers are from North African descent and for many, using their car to drive customers around town is the first time they have been able to earn a regular income. Partly because of rigid labour laws, many have found it difficult to get full time employment in the regular economy.

Uber has given them a chance to make their own future and to earn their own money when other employment has not been available. The “Gig Economy” as it is sometimes known has its fair share of critics, however it provides opportunities to earn money with very little entry cost and provides opportunities for people not in full time work to earn money. This is particularly true for young people and those from poorer backgrounds.<sup>83</sup>

Airbnb is a platform that allows people to rent out rooms or their entire apartments for short periods. It has become hugely popular in many cities, especially those with many tourist attractions and has lowered the cost of accommodation for travellers in many cities as well as allowing people to earn some money out of unused rooms or times they are not using their apartments. It has significantly increased the amount of accommodation available in many cities.

In the developing world this has opened up the ability for many people to earn money legitimately. In Rio for example over 25,000 units were advertised on Airbnb during the 2016 Rio Olympics, up from just 900 four years before. Many of these were in underdeveloped favelas.<sup>84</sup>

Both ride sharing platforms and short-term rents fill gaps in the market that were not adequately addressed before, as do other platforms including those that allow someone to rent out a parking space on their drive. They are all allowing individuals to make better economic use of their underused resources. These opportunities only emerged once the technology was sufficiently sophisticated and mobile, and enough data was available for these gaps in the market to be identified and effectively filled.

AI systems, fed by the data produced by these platforms are helping to make the platforms more responsive to consumer behaviour, which can now be identified and can provide substantial insights into how people travel in cities. This information has significant potential with regards to improving urban mobility and to the environment impact of travel within cities.

Society as a whole benefits from these platforms, consumers get more convenient and cheaper options as a result of the increased competition, everyone gets the possibility to earn a little extra money through a “side gig”. Crucially for the economy, resources are better assigned from an economic perspective. However opposition has grown in recent years to this “Uberisation” of the economy. Taxi drivers around the world have demonstrated against Uber, and the bigger hotel chains have been vocal in their opposition to Airbnb rentals in major cities. Many cities have responded by imposing rules that tighten up the sharing economy and have imposed similar regulations to those that taxi drivers and hotel chains face.

This is the wrong approach. Many of these rules were designed to protect consumers when they didn't have much of a choice. If there was only one taxi firm in your city, you had to choose them. The taxi company, for example, had no incentive to improve its service or its safety beyond the basic requirements of the legislation. Hotel chains rarely offered consumer friendly choices such as free cancellations prior to the introduction of competition from online platforms.

Sharing economy platforms became hugely popular because they anticipated and reacted to consumer demands. Consumers no longer saw official accreditation with the city authorities as important when they had a digital trail of who their driver was and of the entire journey they take on the app. They

could also analyse the history of their driver and judge him/her based on the reviews and ratings of previous users. These platforms therefore came up with a better market solution to an industry where previously it was believed that consumers would only use it if the local authority could provide a guarantee of safety and security. That monopoly also gave the local authority complete control on who could offer the service, allowing them to limit the number of licences they give and raise the price of the licence, with those fees being passed onto the consumer.

Data, mobile technology and AI have allowed these platforms to be created, and as AI develops it is certain that similar disruptive platforms will emerge in most, if not all sectors. Whilst history suggests that there will be an initial attempt to limit their influence, as is currently the case with the sharing economy, in the long term the technology will win through. It can identify what customers want and can offer them a solution that was not available previously.

Governments and local authorities would therefore be better advised to lessen some of the regulations which they currently impose on existing incumbents. Their inability to compete is directly linked to the fact that they have to comply with rules that the sharing economy platforms don't and which customers have demonstrated that they do not value as important in a digital age. For consumer markets, the next phase of the digital revolution could well be an opportunity for more consumer facing and flexible legislative solutions, which are more driven by market forces and less by government regulation. Where the balance between government responsibility for ensuring safety and security in consumer markets and regulatory flexibility will lie remains to be seen, however in the digital age the increased transparency of the data trail and peer to peer reviewing systems suggest that future regulatory frameworks will be more flexible and market facing than many currently are.

The first digital revolution has been an exciting time for consumers and the coming AI revolution promises to be even more exciting, however some worry that there won't be any consumers around, if automation means that machines are doing all the jobs. The concern rests on the assumption that if people are not earning money through work, they will not be able to consume anything, and the development of new consumer friendly goods and services in the digital

81 <https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety>

82 Global status Report on Road Safety 2018 – World Health Organisation [https://www.who.int/violence\\_injury\\_prevention/road\\_safety\\_status/2018/en/](https://www.who.int/violence_injury_prevention/road_safety_status/2018/en/)

83 Alton, Larry (24th January 2018) Why the Gig economy is the Best and Worst development for workers under 30. Forbes <https://www.forbes.com/sites/larryalton/2018/01/24/why-the-gig-economy-is-the-best-and-worst-development-for-workers-under-30/#64719cf56d76>

84 Dalton, Daniel (6th December 2016) CapX “Why the Left should embrace the sharing economy”



age will stall, further contributing to unemployment.<sup>85</sup> The jobs that are available are likely to be high paid and high skilled jobs and this could therefore lead to much higher levels of inequality in society. With a low skilled workforce unable to find any work on one end of the spectrum, unable to service mortgage and other debt and a super rich global elite able to house themselves in gated communities at the other extreme.

Such an outcome seems unlikely.

It is far more likely that automation will create more and better paying jobs as well as new types of work opportunities which didn't exist before. Whilst there is a possibility that a super rich elite will develop, given the possible rewards on offer from an ever-growing global market, governments have a variety of tools in their arsenal to ensure that inequality would never reach those levels.

Nevertheless the concern about job losses and widespread inequality is driving the development of political ideas that would be at best counterproductive and at worst, would contribute further to the loss of human jobs to automation.

The British Labour party proposed a four day week during the campaign for the December 2019 British General Election.<sup>86</sup> Their policy officially involved a 32-hour a week cap on the number of hours an individual could work. In France there has been a 35-hour a week policy since 2000.

This policy ties into the hope that widespread automation may one day mean that humans can work less, earn the same money, and enjoy far more leisure time. It is an attractive vision, and one which may eventually come to pass.

Whilst robots may free humans from more monotonous tasks, the response shouldn't be to encourage humans not to make the most economically of the extra time they now have. Rather than retreating to leisure time, humans can also respond by using the free time they now have to be more productive and to add value in other areas. If companies are forced to allow workers to

only work for four days, the productivity benefits for the economy of automation will be lost. In a competitive world, those countries that don't take the same approach will have a significant competitive advantage as a result.

Such an approach also betrays a paucity of understanding of how the free market works. If automation frees up as much as one day a week, humans don't simply stop being economically active during that time, they will fill that time with other economic activities. To give that up is effectively surrendering to the machines, and effectively saying "we don't even want to compete against you any more."

The question remains as to how humans would make best use of the extra time and how work can be found to replace that now done by machines. In a free market those opportunities will emerge organically. A four-day working week could become the norm as a result, but it won't be by its mandatory imposition on all of society, it will be because humans naturally become more productive with the help of machines and because they have the flexibility to choose for themselves what and how they work.

In addition, this thesis is not tested in current economic reality, as we do not know what the future development of automation will fully mean for the work of work. At the moment the evidence suggests that there will be increased competition from machines for human jobs, especially at the lower end of the income scale, but that less predictive jobs and higher skilled jobs will be far less vulnerable, at least in the short term.

There are calls in many European countries to raise the minimum hourly wage paid to workers. Many social democratic parties continue to campaign to raise the minimum wage around Europe. Whilst this policy is targeted to try to help the lowest paid workers in society, in the age of automation there is a real possibility that it could do the opposite and increase the automation of low paid jobs.

The sure fire way to ensure that machines take low skilled jobs is to make it economically more attractive

<sup>85</sup> Martin Ford focuses on this premise in his book - Ford, Martin (2015) *The Rise of the Robots, Technology and the Threat of Mass Unemployment*, Oneworld. P21

<sup>86</sup> <https://www.bbc.com/news/50405068>

to buy a robot than to employ a human. Reducing the number of hours a human can work whilst paying them the same salary will directly lead to fewer human jobs and more automation. In many countries, it is not worth replacing low paid human jobs with robots. The investment in the robot is often more than the payments to low wage workers. In effect the low wages outweigh the benefits of automation. Whilst this will inevitably lead to debates about what is the right wage to pay a low skilled worker, we cannot ignore the obvious fact that machines are competitors to humans in these jobs. If we raise the human wages, or reduce the amount of time they can work, companies will invest in machines instead and will make it harder for those unskilled workers to find alternative jobs. After the initial capital outlay, machines can conceivably work 24 hours a day, 7 days a week. Making humans less competitive against such machines is the wrong approach to take to the challenges that automation poses.

Other proposals to try to address the potential job losses of automation have centred on giving everyone in society a guaranteed and universal minimum income. The idea of all citizens receiving a guaranteed minimum income has been around for centuries, Thomas Paine first wrote about it in 1797,<sup>87</sup> and even Friedrich Hayek, one of the theorists in support of free market political ideology wrote in support of a basic minimum income for everyone.<sup>88</sup>

In reality most countries have a welfare system that guarantees some sort of public payment to citizens who are not in work. However in recent years the idea of paying a universal basic income in the AI era has caught the attention of many policymakers in Europe. Finland tried in in the form of a short-term pilot project but quickly abandoned it in 2018.<sup>89</sup> On the surface it appears attractive in an environment where work could be scarcer and if it replaced all other benefit schemes that national governments offer, it could be less bureaucratic to administer than those schemes are. However, to offer a basic income

at a substantial enough level to make a difference to those who are unable to find a job and to effectively substitute the income lost from not working, it would cost national treasuries huge amounts of money, mainly because it is universal in nature and therefore would be paid to everyone, including the very rich. This would almost certainly necessitate a large increase in taxation.<sup>90</sup>

In addition it poses a potentially demotivating effect on people's ability and need to look for work. As a result it could undermine educational initiatives designed to ensure that people have the skills for the modern digital workplace. It also doesn't help someone from a poorer background escape their circumstances, it is more likely to entrench those circumstances and offers little help to human workers in their challenge against automation. It is more likely to lead to even more automation of low paid jobs.

A more effective way to make it more attractive for firms to hire people rather than using machines is to reform the tax system. A government can effectively give people and companies money in two ways. Either through benefits such as a universal basic income, however in many cases a proportion of that money is just reimbursing taxpayers for the money they paid to the government in taxes in the first place, or through reducing the tax burden on them in the first place.

If we accept the premise that automation will affect job creation in the future, the best approach is to make it more economically attractive to pay humans to do the job. That entails reducing the cost of employment for the worker and for the company employing them. There are many opportunities to do this as income and employment related taxes are high in many European countries.<sup>91</sup>

In many European countries to put the equivalent of €100 in a workers pocket, a company will have to pay substantially more. In addition to income tax levied on the employee, the company also pays a tax, or

employee contribution for employing the worker. In some European workers this can amount to more than double the cost of employing someone. In Belgium, in 2013 it cost a company €252 to put €100 in a workers pocket.<sup>92</sup> Belgium has one of the highest tax wedges in the Western world,<sup>93</sup> however many other European countries are not far behind. In France, the cost is €230, in Germany €213. Amongst the lower cost jurisdictions such as the UK, the cost is still substantial, at €157.

Rather than looking at subsidising workers through a universal basic income, or reducing the number of hours workers work, the most effective approach to dealing with the challenge of automation is to reduce the cost of hiring human workers, while ensuring more of the money a company pays to employ a worker actually gets to the employee. The most effective reaction from governments would be to ensure that they do everything possible to make human workers more competitive against the machines.

If governments do not do this, they could lose much of this tax revenue in the long run anyway. (If the more apocryphal predictions come true). Tax from employment may not therefore prove to be a sustainable long-term source of government funding.

Governments have significant scope to reduce these employment taxes and to make a shift towards other forms of taxation. Income tax, especially for low paid workers should be substantially reduced or even abolished altogether. As automation moves up the income levels, government should look at progressively reducing or abolishing income tax at those higher income levels. Employers contributions should also be substantially reduced and potentially also abolished in the long run. There seems to be little justification in taxing companies for employing human workers but not for employing robots. That puts human workers at a significant disadvantage and is likely to be a significant incentive to hire robots to do jobs lower down the income scale.

A tax on robots has also been suggested as a possible solution, however any country that implemented such

a tax would find itself at a distinctive disadvantage compared to other jurisdictions which didn't. Such a tax would also be quite easy to avoid, given the difficulty of defining what a robot is, and many of the jobs that could be at risk of automation may find their competitor to be a normal desktop computer and not something that is easily recognisable as a robot. Such a tax would also amount to a disincentive to innovate, which would affect the competitiveness of the whole economy.

Taxing employment is a counterproductive strategy when there is a concern that jobs may be at risk of automation. The fact that many countries are not looking as radically changing their income tax systems suggests that many governments, despite the concern from some about automation, do not ultimately believe that robots and computers will take jobs on a large scale. Revenue from taxing income is also the largest single source of revenue for most governments. In the UK over 40% of government revenue came from income taxes in 2018.<sup>94</sup> In the US it is around 50%.<sup>95</sup>

As income tax is vitally important to the funding of most governments, it is unlikely that any could make this shift easily in the near future, however if the direst projections on job losses do materialise, governments that have already started to move away from income tax as their main source of revenue will be better prepared to face the AI challenge.

A radical restructuring of the tax system could therefore provide a more viable way of addressing any employment concerns that may develop in the long run. Taxing income less and moving the tax burden onto consumption and capital instead could provide a defence against the possibility that robots will take human jobs to a large extent.

The likelihood remains that jobs that are lost to automation will be created in other parts of the economy, and employment levels can be maintained at existing levels. That has been the experience of previous technological revolutions and remains the most likely outcome from this one. However if this

87 Paine, Thomas (1797) Agrarian Justice - <https://web.archive.org/web/20150912130040/http://www.socialsecurity.gov/history/paine4.html>

88 Hayek, Friedrich (1979) Law, Legislation and Liberty, Volume 3: The Political Order of a Free People. University of Chicago Press, 1979 p54-55

89 Crisp, James (2018) Finland ends universal basic income experiment. 24th April 2018 - <https://www.telegraph.co.uk/news/2018/04/23/finland-ends-universal-basic-income-experiment/>

90 Bootle, Roger (2019) Universal Basic Income is a specious concept. Daily Telegraph 17th November 2019. <https://www.telegraph.co.uk/business/2019/11/17/universal-basic-income-specious-concept/>

91 Eurostat has a series of graphs and data indicating the tax costs to hiring an employee in the 28 EU countries and selected third countries. There are available in these links [https://appso.eurostat.ec.europa.eu/nui/show.do?dataset=earn\\_nt\\_net&lang=en](https://appso.eurostat.ec.europa.eu/nui/show.do?dataset=earn_nt_net&lang=en) [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Wages\\_and\\_labour\\_costs#Net\\_earnings\\_and\\_tax\\_burden](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Wages_and_labour_costs#Net_earnings_and_tax_burden)

92 <http://www.amcham.be/policy/labor-market/labor-costs>

93 <https://www.oecd.org/belgium/taxing-wages-belgium.pdf>

94 <https://www.gov.uk/government/publications/how-public-spending-was-calculated-in-your-tax-summary/how-public-spending-was-calculated-in-your-tax-summary>

95 <https://www.thebalance.com/current-u-s-federal-government-tax-revenue-3305762>

premise is wrong, governments would be well advised to reduce their exposure to income taxes in the long run.

A more immediate challenge for governments is that the nature of work is also likely to change. The sharing economy and social media are already having this effect. Both offer new ways of earning a living. YouTube for example, is a video-sharing platform that now supports the incomes of tens of thousands of creators who are earning a living through the platform in a way that would have been impossible for previous generations. In the past a talented performer, broadcaster or musician would have to wait to be noticed and signed by a platform or media organisation. Today, thanks to these platforms that is no longer the case. If they have content which people like, they can make a success and a career for themselves, regardless of what the media executives think. Many will also earn a living from a variety of sources, no longer relying on just one source of income. This gives many more people many more opportunities to earn a living, however in most discussions about the impact of technology on jobs, this job creation element of new technology is often forgotten.

The AI revolution will change the way we work further, almost certainly in ways that we currently can't even imagine. What seems certain is that the old model of high regulation, full time labour market with lots of protections but no flexibility for workers will have to change. That model developed because employers generally held the upper hand in the worker-employer relationship. They provided the only means to earn a living and with many industrial cities being dominated by one industry, a worker had very little scope to challenge their employer's authority. Unions developed and labour laws started to shift the balance more in favour of workers. Workers gradually got fair working conditions, holiday pay, guaranteed working hours, protections against being dismissed and a raft of other benefits. However they paid for it with their freedom. The guaranteed working hours also meant that they had to work at those set times, come what may. There were often restrictions on what outside activities or income a worker could do. A worker could accurately predict what he would be doing on a given day a year into the future. On the occasions when a

worker needed to take a working day off he would have to get it approved by his bosses. That was fine if it was around a planned holiday sometime into the future, but became much more tricky if it was due to a sudden, unplanned event that needed to be acted upon quickly.

This continues to cause problems for those whose lives are not suited to this type of rigidity. It especially penalises people with young families, working mothers in particular, or anyone who needs some flexibility in how they work.

The sharing economy and changing work patterns as a result of digitalisation have already shown that the existing model has its limits. There are some industries and some people for whom the existing system will still be appropriate, but for many more, probably the majority, who will require flexibility and who will earn income from a variety of different sources, employment laws will need change.

This should focus firstly on ensuring that tax systems are better suited and tailored towards the self-employed and those with multiple sources of income. Many countries penalise self-employed people through the tax system, encouraging them to go into full time jobs where incomes are more easily identified and taxed. However the explosion of Internet platforms have effectively given everyone the potential to be an independent contractor. The future development of AI suggests this trend will only increase, and substantially in the years to come. In the UK, self employed workers made up over 15% of the workforce in 2017.<sup>96</sup>

Governments should be aware of this and should reduce the barriers for individuals to work, and increase the flexibility afforded to them. Too many governments are following the alternative course, namely trying to bring work done on platforms such as Uber into the full time labour law framework. This penalises workers who seek to take advantage of the flexibilities provided by the digital economy. It will also make the workforce less able to respond to the changes in the working environment. Providing an analogue solution to a digital challenge has never worked, and it likely to inhibit society's smooth transition through the upcoming revolution.

Governments should therefore look at embracing the changes in working norms that digitisation will bring, and seek to adapt to them rather than trying to stop them. Governments should look to make both self-employment more appealing from a taxation perspective and ensure an effective and attractive regime for income from the sharing economy. This will ensure that that income is taxed and there is not an incentive to avoid declaring it (which in turn can be used as a justification to delegitimise the sector) and that there isn't a disincentive to enter the sector in the first place. The UK was the first country in the world to bring in a specific sharing economy tax break, when in 2017 it introduced a £1000 threshold for earnings from the sharing economy before any tax would be paid.<sup>97</sup> This type of policy would go a long way to alleviating concerns about the sector and would be a first step in developing a tax system fit for the digital age.

One approach that regulators should try to avoid is the assumption that AI development can be bounded within national or regional borders and that it is a zero sum game, i.e. that new AI developments in the USA or China are somehow bad for Europe. Such an approach will lead to attempts to divide the AI landscape into separate regional actors.

Unfortunately, this appears to be the approach the European Union is taking,<sup>98</sup> where the general opinion is that a global race is developing on AI and that broadly, the digital world can be divided into three separate spheres, all competing against each other for dominance. These three regional spheres are the USA, with its relaxed approach to regulation, in particular privacy and with widespread commercial deployment of AI and digital technologies, China with a ruthless focus on research which accounts for almost 60% of the world total,<sup>99</sup> and that is developing AI in part to enhance its surveillance state and the European Union, with a focus on privacy and ethics and with

a belief that if it regulates first, its legal framework can gradually be exported around the world. Whilst Europe has significant industry and research invested in AI, the EU is already lagging behind. The USA leads commercial deployment of AI, with nearly half of all tech start-ups located in the USA.<sup>100</sup> China leads in research and the EU, which has a healthy amount of AI research, and some commercial deployment, leads mainly on its legislative developments in this area. As such, there is a fear in the European Commission that Europe could fall behind.<sup>101</sup>

However it already is far behind. Six out of the ten biggest Technology firms in the world are American, none are European and 94% of data collected in the Western world is stored in the US.<sup>102</sup>

This has encouraged many in Europe to start discussing Europe's "digital sovereignty" This is likely to inform much of the work of the Von Der Leyen Commission, yet it is misguided and at worse could be counterproductive.

Digital technology cannot be kept behind national or regional firewalls. Governments that attempt to deny goods or services being delivered online from other jurisdictions often find that any barriers are easily circumvented. Any attempts to stop digital technology from outside Europe infiltrating Europe will be futile. It is better to recognise this now, rather than attempting to fight a fruitless and costly battle against the inevitable.

Digital technology is global by default and that offers many benefits. It lowers the costs of doing business and by offering far greater economies of scale, it allows consumers to get cheaper goods and services, and increasingly more individualised offerings.

Just because a technology is developed in the USA doesn't mean that millions of Europeans will not

96 <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/trendsinselfemploymentintheuk/2018-02-07>

97 <https://www.gov.uk/government/publications/income-tax-new-tax-allowance-for-property-and-trading-income/income-tax-new-tax-allowance-for-property-and-trading-income>

98 European Commission (2018) USA-China-EU plans for AI: where do we stand? [https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM\\_AI%20USA-China-EU%20plans%20for%20AI%20v5.pdf](https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM_AI%20USA-China-EU%20plans%20for%20AI%20v5.pdf)

99 European Commission Joint Research Centre (2019) Artificial Intelligence, A European Perspective. P9 <https://publications.jrc.ec.europa.eu/repository/bitstream/JRC113826/ai-flagship-report-online.pdf>

100 *ibid*

101 Scott, Mark (2019) What's driving Europe's new aggressive stance on tech. Politico 27th October 2019 <https://www.politico.eu/article/europe-digital-technological-sovereignty-facebook-google-amazon-ursula-von-der-leyen/>

102 Amaro, Silvia 20th November 2019) Europe's dream to claim its 'digital sovereignty' could be the next big challenge for US tech giants" CNBC <https://www.cnbc.com/2019/11/20/us-tech-could-face-new-hurdles-as-europe-considers-digital-sovereignty.html>

benefit from it, nor does it mean that Europeans won't improve on the original platform.

Whilst China's internet model and its surveillance of its own population both threaten the Western liberal model, we cannot ignore the fact that investment now accounts for half of China's GDP<sup>103</sup> It also has a large amount of data given the size of its population and the centralised nature of the government. Many AI future developments are likely to come from China, and given the nature of the Chinese government, these are more likely to be in the areas that are most morally challenging to Europeans such as censorship, surveillance and military applications.

Europe does not have the ability to process such large amounts of data, partly because of a much smaller population and partly because Europe places far more restrictions on what can be done with personal data that is collected.

Europe should therefore be wary of China and the developments that may emerge from it. However, Europe should not be paranoid. China lacks experience with 40% of their data scientists having less than five years experience, far fewer patent applications than the USA, and far fewer workers in AI positions in general.<sup>104</sup> Europe not only has more people working in AI positions, but also a strong academic and industrial base.

Digital innovations that emerge from China will also have the potential to be applied globally. Whilst some may emerge in uncomfortable and challenging areas for Europeans, many will also emerge that will be consumer or industry focused. Europe should not therefore close its doors to developments in China, some of which may be positive. .

Europe's digital approach to the USA however should be open and welcoming. Together the USA and Europe form the bulk of the Western alliance embodied through institutions like NATO.<sup>105</sup> Despite this geopolitical closeness, the two have never been able to fully reconcile their economic differences,

especially on issues such as trade. There is still no comprehensive EU-USA trade deal, despite the very close security relationship and the shared values that exist on both sides of the Atlantic. The digital era offers a chance for this to be rectified. The march of the US tech firms into Europe shows that in the digital environment, a trade deal is not always needed to increase investment and economic links. However, Europe risks retreating into a digital mercantilism, where instead of maximising the benefits that US/EU cooperation can have on the digital economy, they risk reverting to a confrontational relationship. The US has huge advantages in the digital sphere, a large and unified domestic single market, an entrepreneurial culture that encourages investment and risk in new start-ups, and the largest platforms in the modern era. Europe has the world's largest consumer market, a stable and highly educated population, with many of the world's leading universities and a large manufacturing base. The combined weight of the two, working in collaboration in the digital economy and on AI would leave both parts of the Western alliance stronger and better able to deal with the geopolitical, moral and military threat that China inspired AI may pose.

In the business world this is the norm. Europe and the US collaborate very closely in many areas, however in the corridors of power, particularly in Brussels, Paris and Berlin, the mood is different. European politicians have regularly suggested that data from European citizens should not be stored abroad, and particularly not in the USA.<sup>106</sup> Any retreat towards European "Digital Sovereignty" risks putting Europe at a distinct disadvantage in the AI race and should be avoided wherever possible.

The other area where governments can prepare for the coming changes is through education and by tailoring education systems so that they are better able to equip students with the skills needed to succeed in a digital world.

As the future development of AI and its impact on the job market is unknown and unknowable, there is

little benefit in root and branch reform of education systems now, as any new system which emerges may well prove to have followed the wrong prediction. However there are two basic premises that can be followed.

Firstly there should be a far greater emphasis on digital skills at all levels of education. As many of the jobs of the future are likely to be in coding, designing and repairing machines capable of machine learning, this should be a clear focus in the education systems. Coding skills should be taught to children from an early stage and throughout the education system. Lifelong learning should become the norm, as people will need to react to and stay up to date with technological changes during their working lives.

In addition, as most of the evidence suggests that the most difficult tasks for machines to perform are those which exhibit creativity, social skills and perceptiveness,<sup>107</sup> a greater emphasis should be placed on teaching and bringing out those skills in students.

Education alone will not address all of the societal challenges that AI will bring, however it can better help future generations prepare for what is likely to be a very different world of work to the one which we currently inhabit.

Politicians are always liable to respond in a knee jerk way to developments, sometimes this turns out to be the right response, and on other occasions it is counterproductive and needs addressing later on.

How to regulate AI will dominate the thinking of many politicians in the coming years. Europe, and in particular the European Union, needs to be mindful that regulating an industry which is in such an embryonic state can be counterproductive, particularly when other jurisdictions don't follow suit. Regulating access to data needs to balance

not only the fundamental EU right to privacy, but also the need to have complete data sets in order to develop robust and trustworthy machine learning systems.

Whilst Europe will continue to seek to regulate the digital space, it should avoid applying the precautionary principle<sup>108</sup> to the digital sphere. New technologies and new applications will test the boundaries of existing laws and practices in Europe. Blockchain, the sharing economy and Amazono stores already are among the innovations that are doing exactly this. Such innovations should not be discarded because they might, in theory, pose a challenge to existing consumer or privacy rules.

Often the existing legislation tries to address the problem of a previous generation of technologies, and so it always lags behind the latest technological development. In such circumstances, rather than applying the precautionary principle, governments could look at a regulatory sandbox approach,<sup>109</sup> which would allow companies to test new and innovative products and services in a controlled environment. This can facilitate testing and also ensure that authorities don't immediately rush to enforcement action when there is a grey line.

In such an innovative sphere, this is an approach that can help ensure that the regulations stay relevant and in which innovation isn't dampened.

If this is combined with an open approach to the global economy, and tax systems better able to support and encourage people to work in digital industries, there is little evidence to suggest that that challenges posed by the AI revolution will be insurmountable.

Humans have the capacity to adapt to technology and to changing circumstances; there is no reason to believe that this will not be the same this time round.

<sup>107</sup> McKinsey & Company (Apr 2018) The Role of Education in AI (and vice versa) <https://www.mckinsey.com/featured-insights/artificial-intelligence/the-role-of-education-in-ai-and-vice-versa>

<sup>108</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM:I32042>

<sup>109</sup> FCA (UK ) (2019) Regulatory Sandbox <https://www.fca.org.uk/firms/regulatory-sandbox>

<sup>103</sup> Ford, Martin (2015) The Rise of the Robots, Technology and the Threat of Mass Unemployment, Oneworld. P11

<sup>104</sup> Larson, Christina (8th February 2018) China's massive investment in artificial intelligence has an insidious downside. Science Magazine <https://www.sciencemag.org/news/2018/02/china-s-massive-investment-artificial-intelligence-has-insidious-downside>

<sup>105</sup> North Atlantic Treaty Organisation (NATO)

<sup>106</sup> MEPS have regularly tries to reopen the EU-US Privacy Shield agreement which allows EU citizens data to be transferred to the USA <https://www.europarl.europa.eu/news/en/press-room/20180611IPR05527/eu-us-privacy-shield-data-exchange-deal-us-must-comply-by-1-september-say-meps>

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