POST-PANDEMIC INDUSTRIES

Opportunities for EU & Japanese Businesses in Adapting Together, to a post-COVID-19 World

EU-Japan Centre
for Industrial Cooperation
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Executive Summary

The 2020 pandemic has caused an incredible disruption in the global economy, with its aftermath being felt in every corner of the world and in every industry. Our scrambling to adjust, gave way to a whole range of technological, political, and social changes, many of which expected to have long lasting effects. In some cases, or so is speculated, the pandemic may have forever changed the way we live our lives and conduct business. That is not to say however, that all of these developments are necessarily undesirable.

The Research

The situation demanded for fast innovation and resourcefulness, resulting in some truly impressive achievements. This research mainly focusses on the (potentially) positive developments, and what they mean for international SMEs. The research explores the policy changes, business practices, and technological advancements during the pandemic, with a strong emphasis on the technological advancements in particular. These analyses will provide valuable insights in the many developments and advancements, and serve the overall purpose of encouraging entrepreneurial activity in European and Japanese SMEs.

A Summary of Events

In a matter of months, the world went from a relatively stable situation to one where one economy after the other would shut down, borders were closed, and people would effectively be stuck inside their homes. By April the virus has reached practically every country, region, and territory in the world, at which point an estimated one third of the world's populations was subjected to restrictions of movement in efforts of containing the virus. The course of events was rather tumultuous, with the situation improving in one region while deteriorating in another at the same time. The characteristic waves of infection, often caused restrictions to be lifted only to be reinstated later. This remained to be the case in 2021 as well, but the global approval and deployment of several vaccines gave hope for a nearing recovery.

A Sustainable Recovery

Once the true impact became clear, many came to the realisation that the approach to solve the situation could have serious implications on itself. Some worried for example, that the looming economic downturn would distract from the ever worsening environmental situation. However others, notably the chairman of the World Economic Forum, suggested that the pandemic rather offered an opportunity for a 'great reset', and to reshape the world in a way that is more in line with the Unite Nation's Sustainable Development Goals. The agenda (in short) suggests that the world puts its efforts into creating a 'stakeholder economy' that is more resilient and sustainable on the long run by utilising the innovations from the fourth industrial revolution.

The fourth industrial revolution, or 'Industry 4.0', follows the digital revolution and is characterised by the fusion of the technological, digital, and biological domains. This revolution is expected to have a great systems impact by giving way to emerging technologies like artificial intelligence, 3D printing, cloud computing, and advanced robotics.

Digitalisation During the Pandemic

Many of these emerging technologies proved to be of great value in adjusting to the pandemic. The digital solutions in particular, enabled businesses and governments to continue their activities. Late 2020, in became clear that the pandemic had accelerated the digital adoption and transition at an incredible pace, in some cases achieving in months what otherwise would have taken years or even a decade. Organisations, large and small, reported drastically increased investments in digitalisation and automation solutions. Interestingly enough, many reported that the transition process was done much faster than previously thought possible. Another interesting result, was that the essential investments and adoption of new technologies took away managerial reluctance, a prominent cause of lagging adoption rates. Worldwide, more than half of businesses said to have accelerated automation and digitalisation efforts, with the highest percentages in developed economies like Europe and Japan.

The adoption of new solutions facilitated (for example) the massive shift to remote work during the pandemic. Surveys found that more than 80% of global businesses required or facilitated remote work to some form or degree. This was largely made possible by solutions like cloud computing, the internet-of-things, and artificial intelligence. In a similar way, the use of digital technologies allowed for the collective shift to online services. During the pandemic the use of ecommerce and online services exploded, resulting in 10% of additional growth. This also accelerated the overall digital adoption, reaching 95% in both Japan and the EU in 2020.

Emerging Technologies

The technologies that played the most vital roles during the pandemic are (perhaps not surprising) the ones with the most prominent roles in 'Industry 4.0' as well. This research found seven emerging technologies that define the 'revolution', and will be of increasing importance in the years to come. These technologies are also characterised by a strong interdependence, as their applications often overlap and/or compliment each other.

1. *Cloud computing* (offered solutions for remote work, adoption grew drastically, in particular in IT and government)
2. *Internet-of-Things* (high investments due to pandemic, high adoption in health care sector and consumer market)
3. *Big Data* (drastic growth due to shift to digital and online, highest adoption in IT, transport and consumer market)
4. *Cyber security* (growth due to remote work and increased online activity, highest adoption in government and IT)
5. *Artificial intelligence* (growth linked to big data, IoT, and robotics. Highest adoption in IT, health care and transport)
6. *Robotics* (growth for service robots and automation solutions in particular, with the highest adoption in manufacturing)
7. *3D printing* (main growth drivers are automotive, aerospace and healthcare, highest adoption in manufacturing)

The years to Come

As mentioned, the pandemic showed that one of the main hurdles in technological adoption was managerial reluctance, not the technologies and solutions available. With this (largely) out of the way, and the benefits of implemented solutions beginning to show, it appears that many of the changes will be lasting. In fact, 75% of global executive expect to see increased investments in technologies over the next few years. This goes in particular for technologies related to cloud computing, big data, cyber security, IoT, and E-commerce.

The investments in digitalisation and automation that enabled the shift to remote work, also ensure that this phenomenon will likely remain much more common than it would have been without the pandemic. This will especially be the case in advanced economies, where a significant percentage of the workforce can effectively perform a large part of their work from home.

A similar lasting change is expected for the use of E-commerce and online services. As both businesses and consumers have moved/become accustomed to online channels, it is unlikely this will all reverse after the pandemic resides. In fact, more than half of the consumers expect to maintain using online channels more often than they did before the pandemic. The largest growth is expected for the use of services related to content streaming, fitness, food delivery, and social media purchases.

In Summation

The main finding, or most notable development, is without a doubt the incredible advancements in technological adoption and the drastic changes they have made possible. The overarching theme here, is the momentous shift from in-person and on-location to online and remote. Whether it is E-commerce or remote work, the accelerated digitalisation and automation brought about by the pandemic has firmly settles the 'industry 4.0' technologies into our lives. With that, it has also brought closer the ambition of a 'green recovery', where we utilise these new technologies to create more sustainable and resilient economies.

Recommendations

With these insights in current developments and what they mean for the coming years in mind, there are a number of important recommendations for businesses preparing for the post-pandemic world and 'industry 4.0':

- *Dot not fall behind in the digitalisation process.* Do not underestimate the speed at which current developments take place, nor the potential risk of falling behind.
- *Take the opportunity to assess and adjust.* Leverage this transitional period to establish an effective and 'future proof' strategy, and explore new options and markets.
- *Make use of the transition to 'online' and 'remote'.* Utilise the plethora of new solutions available to improve your operations and 'future proof' your business.
- *Do not give up on sustainability goals and efforts.* While finding solutions for today's challenges, do not lose sight of other important issues, and plan for the long term.

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Introduction

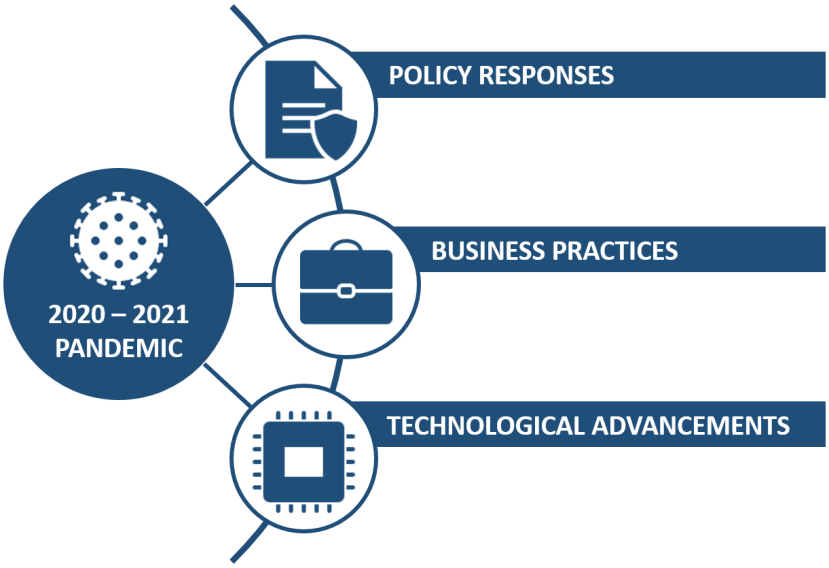
It seems that ever since early 2020, our lives have revolved around the pandemic. Not surprising, as it has been the absolute centre of attention for well over a year. This goes of course for the pandemic's extensive media attention, but just as well for the coverage it received in academic research and economic analyses. While all this attention is understandable and (in many cases) absolutely crucial, a constant exposure to the many worrisome developments by itself, creates uncertainty and turmoil. This introduction, to yet another publication on the pandemic's effects, might raise some questions as to the purpose of this research. However this research, takes somewhat of a different approach, aiming to provide a more optimistic and forward-looking assessment of the situation.

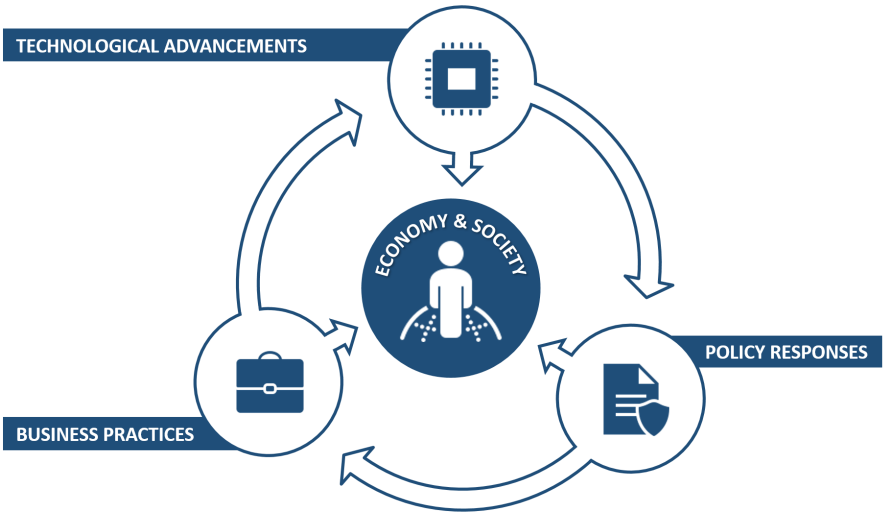
1

The Research, its Purpose and Objectives

The research, in short, aims to show how the pandemic has affected our industries so far, and how it will in the years to come. In this assessment, we will focus in particular on the more promising developments.

To do so, the research includes an analysis of 1) policy responses, 2) changes in business practices, and 3) technological advancements that can be attributed to the pandemic. These analyses will rely on both secondary and primary sources, including interviews with industry experts.

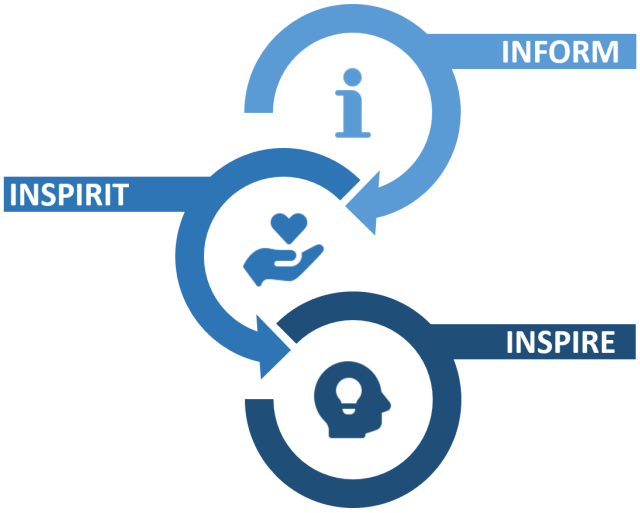




The next step in the research is to answer the question of which of the policy changes, new business practices, and technological advancements will remain once the pandemic subsides. This, is then followed by an assessment of the economic and social impact (and benefits) of these changes on the long run. The focus will lie here with the ambition of more sustainable economies and societies, and how the pandemic could have brought these goals closer.

The final product serves to inform, inspirit, and inspire those (businesses) affected by the pandemic, in particular SMEs that operate on an international level.

As such, it is important to note, this report is composed around, and focused at, the opportunities and (potentially) positive developments resulting from the pandemic, rather than the challenges. This focus should however, by no means, be interpreted as an underestimate of the complex situation, nor as a trivialisation of the immense hardship and suffering the pandemic has caused.



1

2020: The Prologue

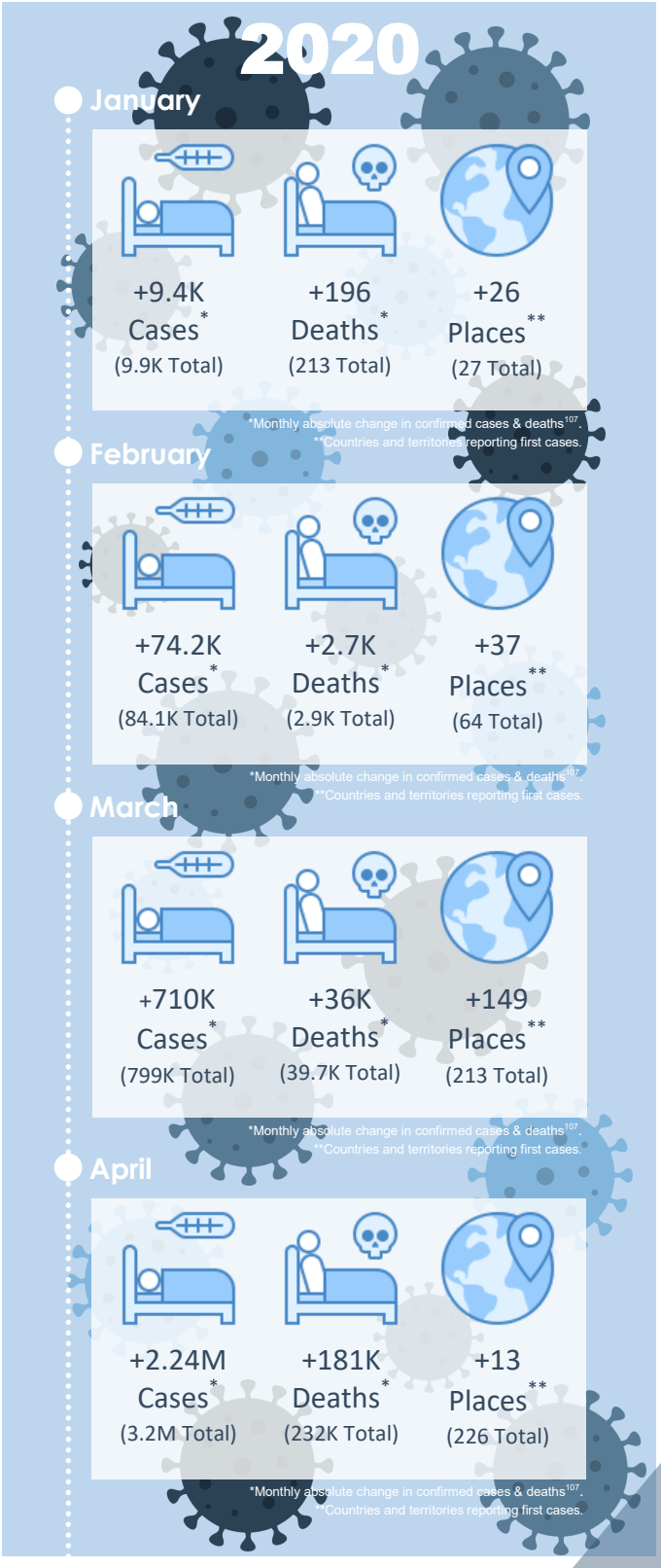
Within the twelve months of 2020, a mostly unnoticed and local event in mainland China evolved into a global catastrophe with a momentous (and possibly lasting) social and economic impact. Because so much happened in this tumultuous year, and it all unfolded at such an unprecedented speed, it would help to start with a brief recap before moving on to the main research. Also because, in the context of this research, it is important to acknowledge the extent, and sheer speed at which the world had to adapt to an unfamiliar situation. This chapter will therefore, (chronologically) outline the main developments on a global level, followed by a short synopsis of Europe and Japan respectively.

From Local Outbreak to Global Pandemic

On **December** 30th 2019, just before the new year, a report of a 'viral pneumonia' outbreak in China's Hubei province gets its first international attention[1], and is picked up by international media outlets the next day[2]. One week later, Chinese scientists investigating the pneumonia outbreak announce the discovery of a new type of corona virus[3]. The next day, **January** 8th, the virus is found in a Chinese expat returning to South Korea[4]. Again one day later, the World Health Organization (WHO) reports the new corona virus being isolated in a Chinese pneumonia patient[5]. In the same announcement, the WHO advices governments against implementing travel restrictions on China. By the end of January, the virus was found in 25 countries in Asia, Europe, North America, and the Middle East[6]. On January 30th, 10 days after Chinese scientists confirm the virus is human-to-human transmissible[7], the WHO labels the virus outbreak a "public health emergency of international concern", although still advises against any travel restrictions[8].

In **February**, while the virus spreads to 35 more countries (including the first in Africa and South America), the first virus related deaths outside of China are confirmed[6]. In efforts of slowing down the outbreak, several countries have closed their borders[9, 10] or imposed travel restrictions for either its own citizens or visitors from abroad[11~14].

On the first of **March**, the global death toll from the disease, now named 'COVID-19', passes the three thousand[15]. In the weeks that follow the number of infections increases dramatically, and by the end of the month the virus will have spread to 149 new countries and territories, with the global death toll having surpassed 30,000[16, 17]. In response, various



governments worldwide have declared a state of emergency[18~21] and imposed restrictions of movement[22~25], putting an estimated one-third of the world's population under lockdown[26].

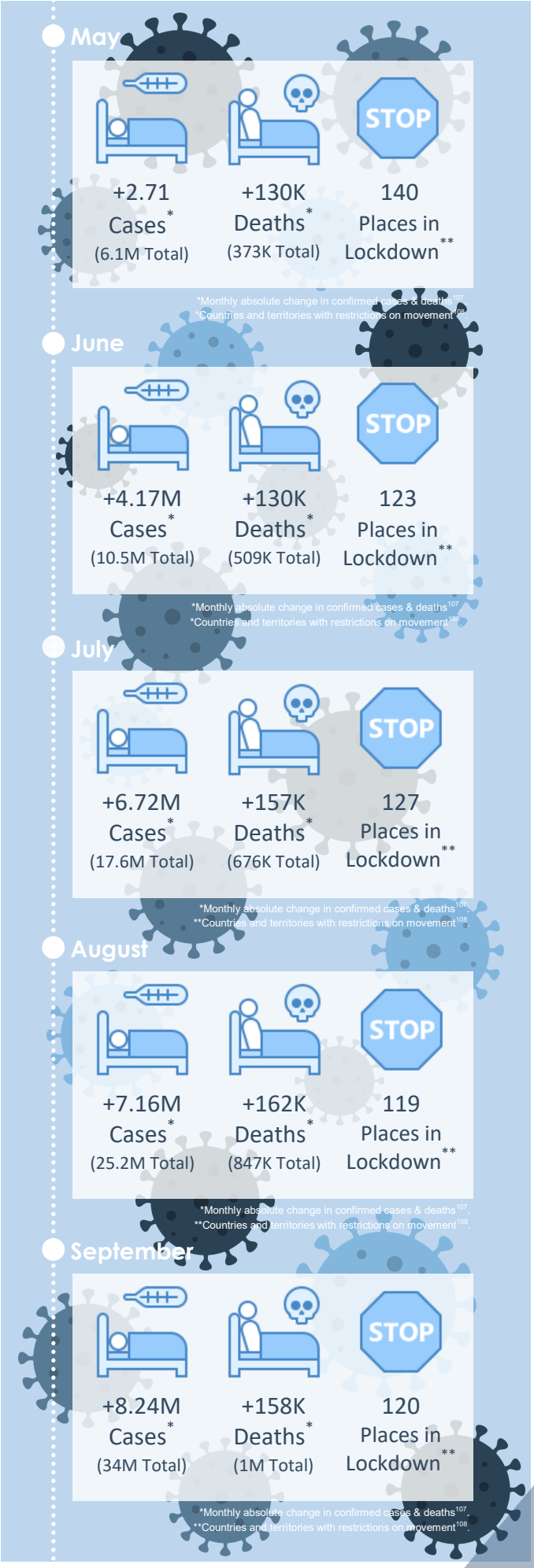
Early **April**, global covid-cases pass one and a half million[27], while countries keep struggling to contain the virus[6, 28]. In some places however, the situation appeared to have improved enough for governments to ease some of the restrictions[29, 30, 31]. The same month, the US announces it will halt its funding of the WHO due to dissatisfaction of its response to the virus outbreak[32].

In **May**, the global counter for confirmed infections passed 6 million[33]. Latin America in particular, suffered heavily from the pandemic's fallout[34, 35]. Nevertheless, the situation in some countries allowed governments to start lifting restrictions[36].

Early **June**, despite global infections reaching a record high[37], various countries in Asia[38, 39, 40], Europe[41, 42], and the Middle East[43, 44] started easing restrictions. In many places however, the situation was still critical[45~48]. Throughout the month, the overall infections, as well as casualties, kept increasing, following an upwards trend in every region of the world[49].

In **July** there are various reports of regional infection spikes, in some cases of record height[50~54]. Halfway through July, the global infections soar to unprecedented levels, increasing rapidly by the day[55, 56, 57]. While the American continent is still affected worst by the virus at this point[58, 59, 60], concern grows over developments in Africa as well[61, 62, 63].

This trend continues throughout **August**, with more reports of surging infections from Latin America[64, 65, 66], Asia[67, 68, 69], and Europe[70~73] (also see Appendix 1). By the end of the month, the number of infections in Latin America would pass seven million[74]. The WHO, citing an International Monetary fund (IMF) research, announces that, at this point, the pandemic is costing the global economy an estimated US$375 billion a month[75]. Meanwhile Russia is the first to announce the approval of a COVID-19 vaccine[76], with production



starting a few days later[77].

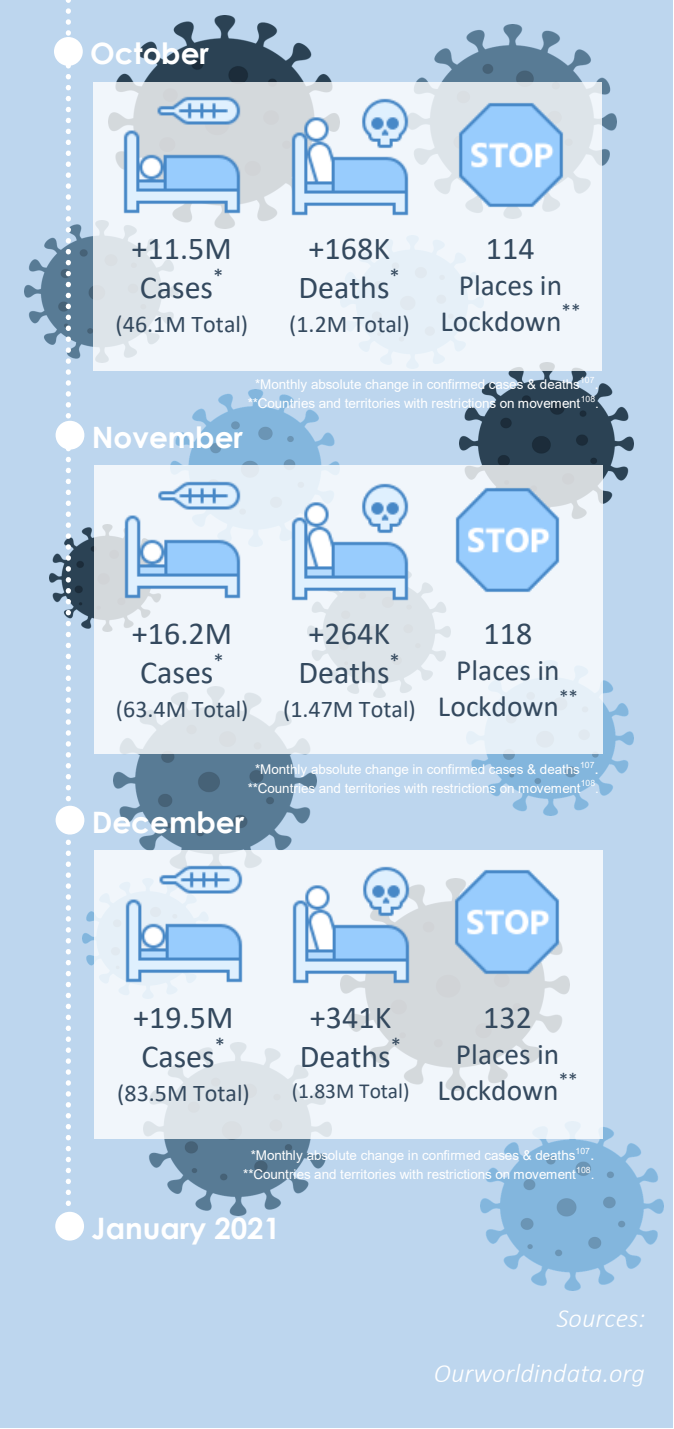
In **September** the pandemic's global death toll passed one million[78]. Overall however, the global infection rate did seem to stabilize, mainly thanks to the statistics from the American continent[79]. That said, in Europe the growth rate is back at the level of March, when the outbreak reached its first peak[80].

Things take a turn for the worse again in **October**[79], during which the global number of confirmed cases reaches 40 million[81]. In Europe in particular, the situation is deteriorating rapidly[82], forcing multiple countries to impose strict countermeasures[83~87]. (also see Appendix 1)

This second wave continues in **November**. In just 21 days, global infections increases with 10 million more cases[88]. The majority of the new confirmed cases are still coming from the European and American continents[88]. On a positive note, both European and American vaccine developers report promising interim results[89, 90].

In **December,** countries worldwide hurry to push forward their vaccination schedules[91~98]. However any optimism is short lived, as reports of two new virus mutations from the UK[99] and South Africa[100] raise many questions and concerns about transmissibility and efficacy of the vaccines. Not long after their discovery, reports of the new virus mutations having spread[101, 102, 103], result in various countries (re)imposing travel restrictions[104, 105].

By **January** 2021, only 12 months after its first occurrence outside of China, the virus has caused 2 million deaths[106] and many more people suffering.



2021: Memorable Turning Point or Dreary Sequel?

Saying our goodbyes to an arduous 2020, the world entered 2021 on a moderately more positive note. The US elections had just (more or less) been finalized [153], the EU and the UK concluded negotiations on the 'Brexit withdraw agreement'[154], and the pharmaceutical industry reported success in the development and approval of several COVID-19 vaccines[155]. While all (very welcome) reasons for relieve and optimism, in regard to the pandemic the world was far from out of the woods yet.

With the global economy still suffering, new outbreaks occurring worldwide, and worrying reports of new virus variants[156], it seemed that the theme for 2021 would be, once more, the world battling the pandemic. This time however, the world has a year of experience under its metaphorical belt, and providing we know how to put this knowledge to use, 2021 could in fact turn out to be an important pivotal point in history.

This does come with a big asterisk of course, namely the "if" in this last statement. Better put, there is no question about 2021 going down the history books as a memorable year, but whether it will be remembered as 'the great turning point', rather than a dreary sequel to 2020 remains yet to be seen. As such, now is the time to look back and evaluate, to gather and share all we have learned and put this towards a comprehensive exit strategy from the pandemic.

That said though, while it might be the most prominently present one at the moment, we shouldn't forget the pandemic isn't the only challenge the world is currently facing. Before being blindsided by the COVID outbreak, the climate issue was on top of the global challenges list, and for good reason[157]. But it remains, of course, a very urgent matter that requires our immediate attention. This urgency is only emphasised by the fact that two issues are likely to be far more interrelated than one might initially realise. Because not only have the effects of climate change exacerbated the COVID situation, it were in fact some of the very same issues responsible for climate change, which facilitated a local virus outbreak in becoming a pandemic in the first place.

Therefore, the most obvious take-away here is that to effectively address the world's most acute challenges, the right approach is a holistic one, aiming for substantial, sustainable, and long-term changes. After all, if these different issues share common causes, they could just as well share common solutions. As such, 2021 should be a year of reassessing our societies and economies, and how they are structured. This way, perhaps, 2021 could be a true turning point. So much so even, that we could in fact come out of this crisis better off than we were entering it.

2

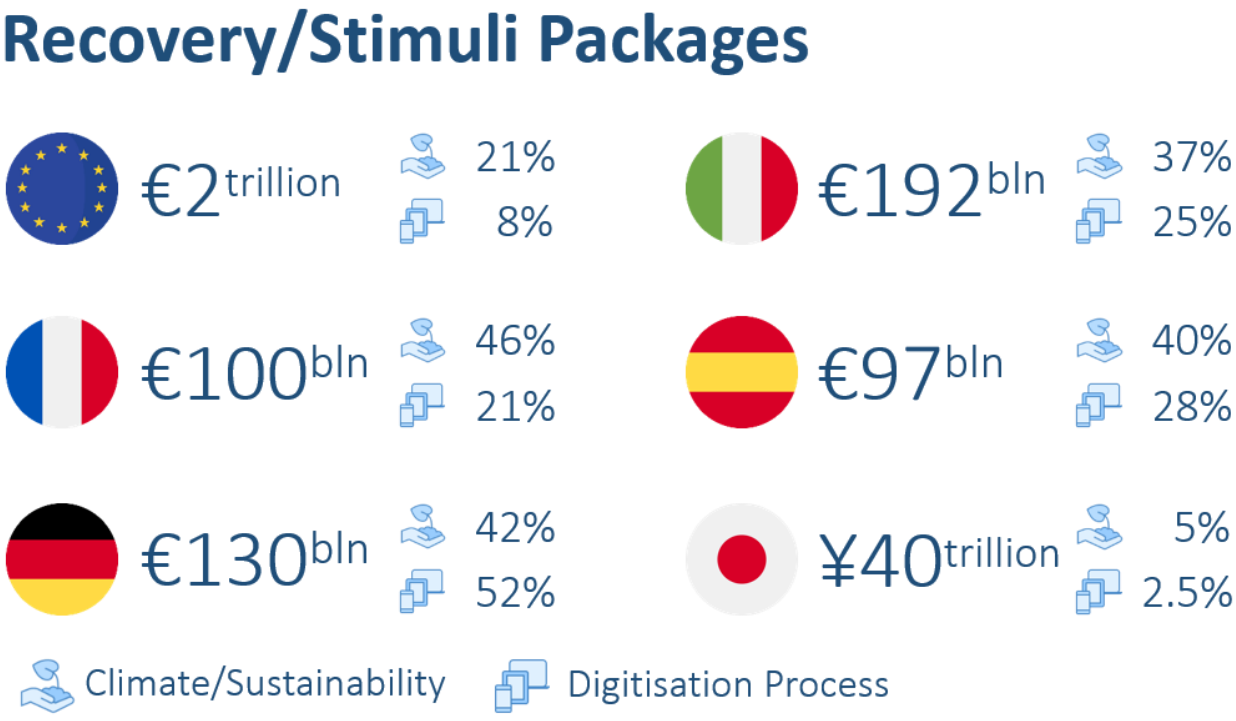
The Pandemic: Recover or Reset?

Considering the amount of extensive changes the pandemic has brought about, it wouldn't be that much of a hyperbole to say that it will go down in history as a major turning point. This, of course, applies more to some aspects of life than others. One of the main areas where the pandemic is expected to have a revolutionary impact, is on our economies and the way we do business. An impact which, in its turn, will have far reaching implications for our social, environmental, and economic situation. With a bit of optimism however, this could be seen as an opportunity rather than a concern. Or as the World Economic Forum suggested: "COVID-19 offers a chance to reset and reshape the world in a more sustainable way"[158].

The Commitment to a Sustainable Recovery

Back in 2020, when the true impact of the pandemic was becoming clear, calls to not have this crisis distract us from our efforts on climate change emerged from organisations like the EOCD, the UN, and the IMF[159, 160]. The concern was that, in reaction to the sudden economic downturn caused by the pandemic, governments would prioritise (short-term) economic and industrial interests over long-term environmental ones. While understandable, this fear turned out to be mostly unfounded as both world and business leaders seemed committed to keep their recovery strategies in line with their long term goals for a more sustainable world[161, 162, 163]. So much so, in fact, that the term 'green recovery' (one with a particular focus on sustainability and climate goals) has become widely adopted when talking about battling the pandemic[164].

This commitment is also found in Japan and the EU. Under the Paris agreement signed in 2016, both have committed to ambitious targets for reducing their emissions on the short and long term[165, 166]. However, in the recovery plans announced by Japan and the EU (as well as the individual member states) , both climate objectives and the digital transition were given high priority. The EU for example, announced its largest ever stimulus package, amounting to over €2 trillion* comprised of both a long term budget and an additional recovery package of €807 billion* (NGEU)[167]. Of this budget, about 21% will be allocated towards climate goals and sustainability[168]. Another 8%, is specifically meant to promote the European digital transition. These same priorities are also evident in the recovery plans and budgets of the individual member states. Germany for example, announced a €130 billion recovery plan, of which at least 42% is allocated towards measures supporting climate change objectives, and 52% to supporting the digital transition efforts[169]. Similarly, of Italy's €191.5 billion recovery plan, 37% is allocated towards climate and sustainability measures, and 25% towards digitalisation[170]. A similar prioritisation of climate measures and digital transformation is seen in the recovery plans of other European countries as well[171, 172]. In the case of Europe, this shows that despite the pandemic, there still is a strong



Sources:
European Commission & Reuters

* when adjusted for inflation

dedication towards creating a sustainable future and continuing to facilitate the digital transition.

In December 2020, Japan announced a JP¥73.6 trillion package in efforts of negating the pandemic's impact on the Japanese economy[173]. This package includes JP¥40 trillion in direct fiscal spending and initiatives that are, amongst others, aimed at the country's environmental and technological ambitions[174]. For example, JP¥2 trillion is directed towards a fund meant to help Japan reach climate neutrality by the year 2050, and another JP¥1 trillion is meant to accelerate the country's digitalisation process.

Of course, these are far from all of Japan's and Europe's policy efforts regarding the environment and digitalisation. However the examples do show these governments haven't abandoned their ambitions on these challenges. If anything, dedication only seems to have increased this year, as many countries around the world have reviewed and sharpened their goals[175, 176, 177].

The Great Reset

At the 50th annual meeting of the World Economic Forum (WEF) in June 2020, the announcement was made for a twin-summit to be held in January 2021, named "the Great Reset"[178]. The theme followed an article by the WEF a month earlier, on how the COVID-19 pandemic provides an opportunity to, rather than just recover, instead "reset and reshape" the world in a manner that is more in pursuant to the United Nation's Sustainable Development Goals (SDG) for 2030[158].

> *"The pandemic represents a rare but narrow window of opportunity to reflect, reimagine, and reset our world"*
>
> *Klaus Schwab, Founder and Executive Chairman of the WEF*

The main three arguments for this agenda are that[158]:

- the pandemic's lockdowns have shown us how strongly human activity is related to environmental issues (e.g., climate change),
- the pandemic has also shown the socio-economic inequalities around the world and how they result in a disproportionate level of vulnerability to any form of disaster or instability,
- and, the importance of economic activity and the creation of financial value.

As such, the 'Great Reset' is proposed to serve as a collective commitment to rebuild the foundations of the world's social and economic systems for a more fair, sustainable, and resilient future[179]. The alternative being, as the initiators argue, is that the existing crises, exacerbated by the pandemic, will have consequences which we won't be able to avert with "Incremental measures and ad hoc fixes"[180]. This belief appeared to be widely shared, as the agenda has already found a broad range of endorsements from both world and industry leaders[180, 181].

The 'Great Reset' agenda consists of six components, which largely revolve around[182]:

- Facilitating a market with "fairer outcomes", by setting conditions for creating a 'stakeholder economy'.
- Use new investments to build a new system which is more equitable, resilient, and sustainable on the long run, based on environmental, social, and governance (ESG) metrics.

Source: WEF

- Utilising innovations from the fourth industrial revolution for the public good.

The third point mentioned, urging to harness the technological advancements emerging from the fourth industrial revolution, is interesting in particular. Firstly because it is actually very much related to each of the other components. But more so, because the 2020 pandemic has in fact greatly accelerated the technological advancements made, as well speeding up the adoption of said technologies[179].

Industry 4.0

The fourth industrial revolution, also referred to as 'Industry 4.0', follows the third industrial revolution[183] which started about half way of the 20th century. The third revolution, also known as the digital revolution, represents the shift from analogue electronic technology to digital electronics. It meant the adoption of digital computers, record keeping, and communication technologies[184], and is what ultimately gave way to the 'information age'[185].

The notion of the world standing at the beginning of a fourth industrial revolution was introduced in 2015, by the chairman of the World Economic Forum (WEF) in an article published in Foreign Affairs[186]. The most important development that led to the idea of a fourth industrial revolution being in progress, is the fusion of the physical, the digital, and the biological worlds. What characterises this development to qualify as a revolution in its own right, rather than a mere continuation of the digital revolution, is its velocity, scope, and systems impact[183]. The developments, or so is argued, are taking place at an exponential rate and will disrupt every industry worldwide. This, in turn, will transform production, management, and governance systems[186]. The revolution's main drivers are believed to be[187]:

- Digitalisation and integration of vertical and horizontal value chains,
- Digitalisation of product and service offerings,
- Digital business models and customer access.

This development is expected to give way to emerging technologies in particular, like: robotics, artificial intelligence, 3D printing, nanotechnology, quantum computing, biotechnology, energy storage, autonomous vehicles, and the internet of things[183].

To paraphrase the WEF, the fourth industrial revolution will fundamentally change the way we live and work, it has lead us to rethink how countries develop, organisations create value, and how everyone (regardless of their background) can benefit from innovation[188]. As would to be expected with such a major transition, the fourth industrial revolution comes with great opportunities, as well as some challenges. For example how to regulate and oversee these frontier technologies to ensure they indeed serve the greater good by contributing to humanity's most urgent concerns[188]. Then there is the unpredictable, but potentially far reaching, effect of new 'general purpose' technologies (like artificial intelligence), as they have the ability of disrupting entire industry groups[188]. Even when assuming that new technologies and their applications do in fact offer a valuable solution of some sort, there is still the challenge of 'inclusion', i.e., making this new technology accessible everywhere, by everyone[188].

The Need for (Digital) Adaption

Faced with the challenge of containing the virus outbreak, one for which there was no effective drug or vaccine at the time, the first course of action was to 'contain and mitigate' (as mentioned earlier). This meant, for all intents and purposes, to reduce human-to-human contact (regardless of setting or occasion) as effectively as possible. This, of course, left for a series of incredibly disrupting measures, which effected essentially every aspect of people's professional and personal lives. Being the first responders in this crisis, local and regional governments had to rely on the available technological solutions right from the start.

The implementation of digital technologies, allowed governments everywhere to maintain their essential public services during times where these were needed most during the unfolding crisis. When putting in place restrictions of movement, digital solutions warranted the public access to (amongst others) health care, information, and communication services[189]. Digital technologies have also allowed local and regional governments to monitor, predict and control the spreading of the virus[189]. Welcome as they were, these solutions did come with some rather serious concerns. The main concerns being those around privacy and accessibility. Controversy around security and privacy implications of emerging digital technologies is nothing new, but the topic did become painfully relevant due to some of the solutions considered for containing the COVID-19 virus [190, 191, 192]. Then there is the 'digital-divide', the fact that digital technologies, regardless of their effectiveness, are not necessarily equally accessible to everyone. So this is especially a concern when the technologies are implemented to provide the public with essential services, vital information, education, and socioeconomic interactions[189]. As such, local and regional governments will (and have) play a vital role in the shaping of digital technologies, as well as ensuring that the developments happen with humanity's best interests at heart[189].

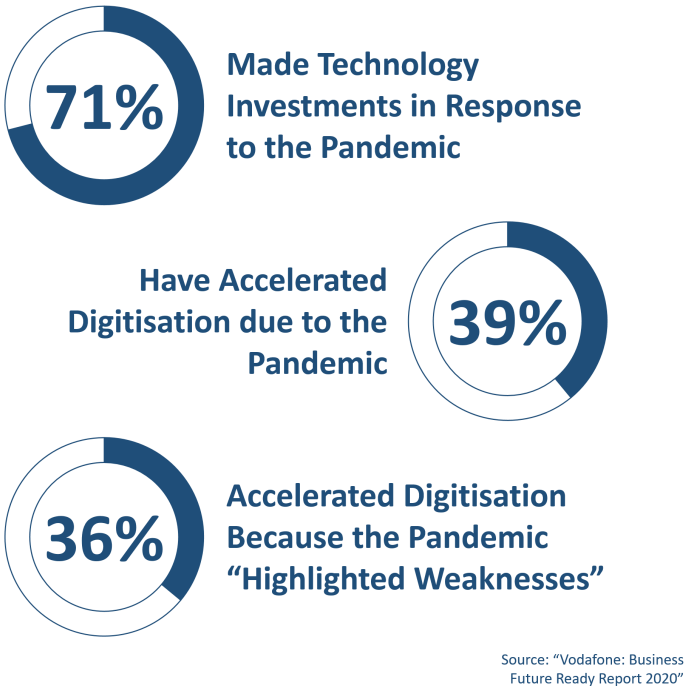
Meanwhile in the private sector, businesses facing the crisis approached the situation from a different perspective. For them the restrictions of movement and economic downturn that followed meant a direct threat to their existence. Earlier crises, like 2008 economic recession, have put a burden on businesses' ability to adapt to reclining sales and profits. Natural disasters, like the 2011 earthquake in Japan, have disrupted supply chains for certain industries[193]. Trade conflicts have restricted businesses from access to their most important markets and/or resources. However the 2020 pandemic alone, achieved all of this and then some, as the world had practically shut down for several months. Scrambling to adapt, for those who could, often meant to be resourceful and look for alternative solutions. Many of these solutions where found in new technologies which, may or may not have been, in use to some extent already. But with necessity being the mother of invention, the development and adaptation of new technologies accelerated at an unprecedented speed.

The Pandemic: a Wake-up Call

The advancements in the adoption of new digital technologies during the 2020 pandemic occurred at an incredible pace. A worldwide survey showed that businesses spent a median additional 5% on technology during the first months of the pandemic, or about a (combined) additional US$15 billion a week[194]. According to a McKinsey survey among nearly 900 respondents from different industries and regions, businesses have sped up the digitalisation of their customer and supply-chain interactions, as well as their internal operation with three to four years over just a few months' time[195]. Meanwhile the digital or digitally enhanced offerings in their portfolios was accelerated by seven to ten years, depending on region and industry. This acceleration was much more noticeable in industries without (or with less) physical products like healthcare and financial services, than, for example, consumer packaged goods[195]. The advancements in the digitalisation of core internal operations and interactions in the supply chain, were affected in a similar way, albeit much more consistent across regions and industries[195].

Something that was particularly emphasised from the research findings, aside from the digitalisation process itself, was the fact the respondents noted the adaptions to the pandemic's fallout were carried out much faster than they would thought possible. For example, respondents said that the time required for transitioning to remote working was (in average) forty times shorter than what they initially thought needed. Similarly, adapting advanced technologies in operations and business decisions making went twenty-five times faster than anticipated.

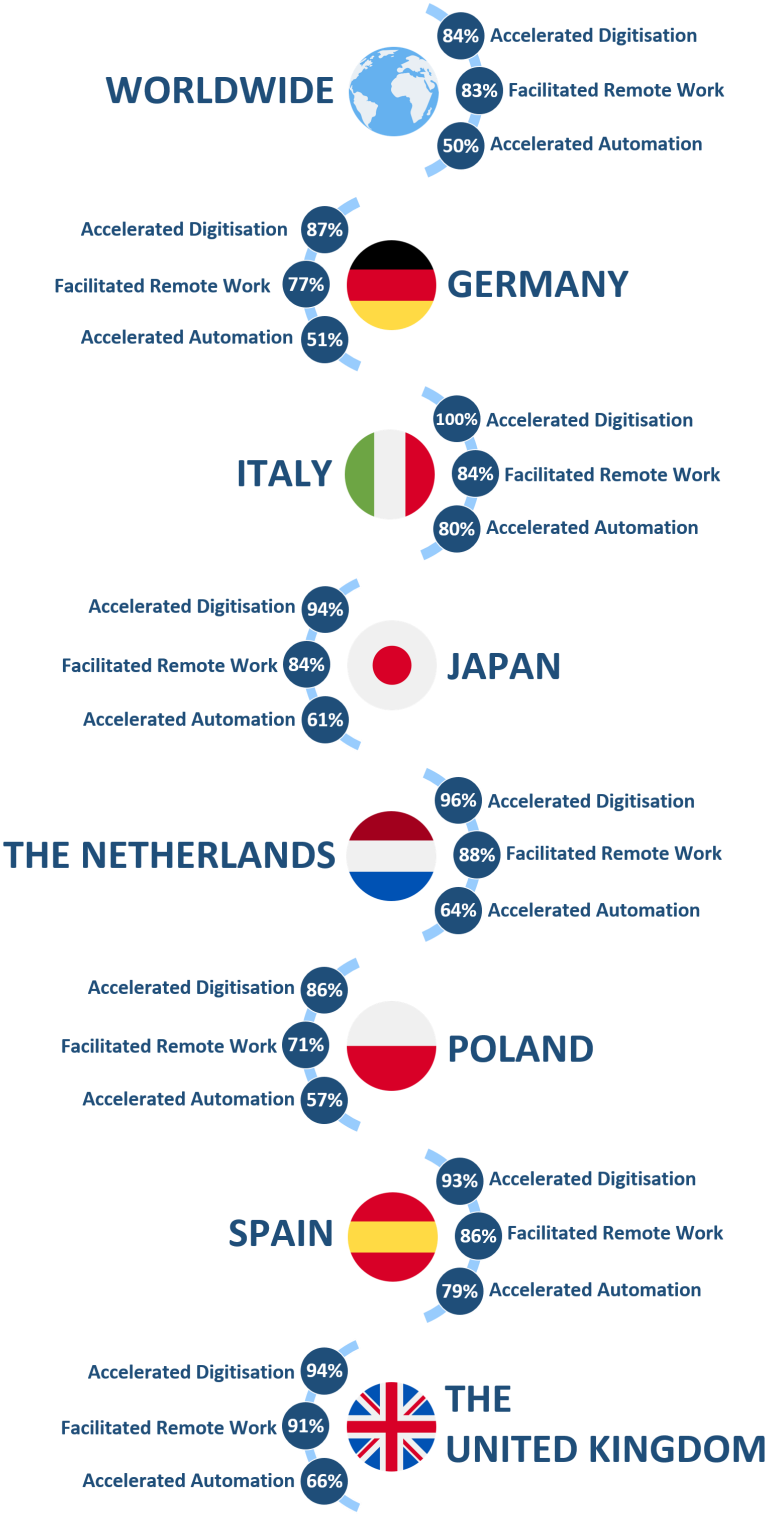
This does suggest that, besides a very urgent incentive, there was in fact little in the way to advance the technological transition (i.e., the industrial revolution) prior to the pandemic. When asked about this, the respondents admitted that the pandemic has removed many of the pre-existing barriers to change[195]. These barriers ranged from technological or organisational challenges, to a fear of customers' resistance to changes. However now the changes have occurred, the majority of the respondents expect many of the changes (the more drastic ones in particular) to be long term or even permanent[195]. A survey by the World Economic Forum from before the pandemic in 2018, actually illustrates this very well. The respondents, from across the world and various industries, when asked about the main barriers for adopting new technologies, admitted that "not understanding the opportunities" was one of the main reasons[196]. In fact, well over half of all respondents said not to understand the opportunities that adopting new technologies could offer. The highest percentages were those in the consumer industry (77%), the healthcare sector (80%) and the industry of 'chemistry, advanced materials & biochemistry' (75%)[196]. This suggests that, if anything, the pandemic was an eye-opening event that removed any managerial doubt or reluctance in embracing the potential of new technologies and the benefits they offer.



Source: "Vodafone: Business Future Ready Report 2020"

With that said, the rapid transition to, and adaptation of, new technologies observed during the pandemic, was not just a showcase of the adaptive capabilities of businesses. It is just as much, a stern reminder of the fact that a comprehensive 'digital strategy', is (or ought to be) an integral part of the corporate strategy[195, 197]. The pandemic was a rude awakening for those lagging behind in digitalisation, as they suddenly found themselves in an exceedingly disadvantaged position[198]. The organisations with the most effective responses to the pandemic, were often those who invested more in digitalisation, where the first to experiment, and already had an extensive range of advanced technological capabilities[195, 198]. In their 'Business Future Ready Report 2020', Vodafone assesses businesses on their 'future readiness' according to certain characteristics, like their attitude towards/use of new technologies[199]. According to the study, businesses qualified as 'future ready' have been able to cope a lot better with the situation in 2020 than those that were not. For example, despite the pandemic, businesses deemed 'future ready' were more likely to report higher profits than the previous year (30% vs. 21%) and were less likely to report lower profits (45% vs. 49%)[199]. It's important to keep in mind that the adoption of new technology was not the only criteria for the qualification of 'future ready' as the business strategy and adaptability were also taken into account. As such, it would be safer to assume that, rather than the adoption of new technology alone, it is a comprehensive incorporation of technologies in business strategies and business continuity plans that improves resilience and viability. This assumption find support from the 'KPMG CIO Survey 2020', which was conducted among more than 4.000 respondents, from 83 countries[200]. The survey shows, that from the respondents that self-identify as 'digital leaders' (i.e.,: "being highly effective in adopting digital technologies to advance their business strategy"), significantly outperformed those who did not[200]. These 'digital leaders' (be

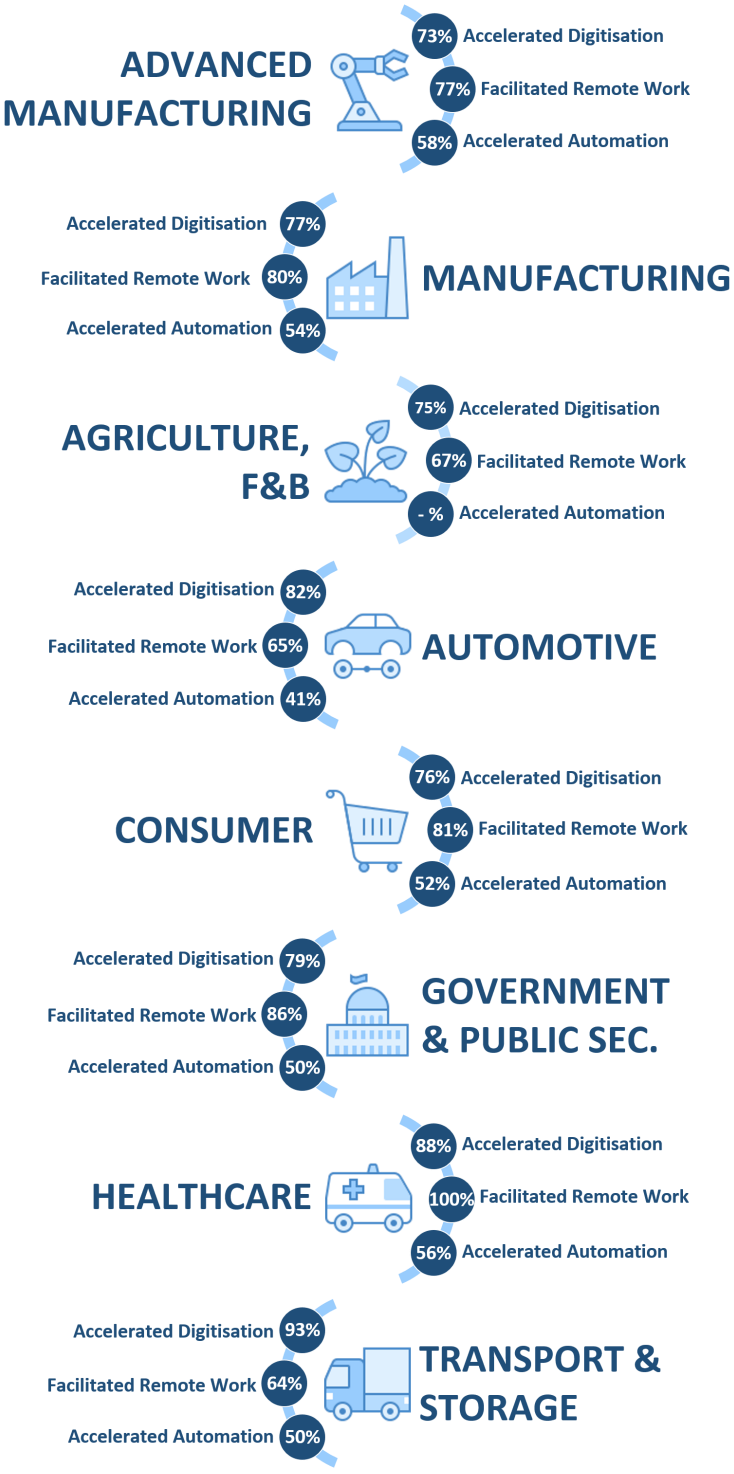
Business Responses to the Pandemic Per Country:



** Percentages rounded up to the nearest percent.*

Source: WEF: Future of Jobs Report 2020

Business Responses to the Pandemic Per Industry:



** Percentages rounded up to the nearest percent.*

Source: WEF: Future of Jobs Report 2020

their large or small), made higher IT investments during the pandemic, and were earlier to adopt new technologies by effectively picking up the changes in the market. This flexibility and adaptiveness gave them a significant competitive advantage over their peers.

It seems that the pandemic has in fact opened a lot of eyes in this regard, and has caused a shift in priorities. For instance, 39% of the Vodafone survey respondents have said to accelerate their digitalisation process in response to the pandemic, and 36% admitted to accelerating digitalisation because the pandemic has highlighted weaknesses in their business models[199].

How fast and how much priorities have shifted was also made evident by the 2020 'Future of Jobs' survey by the World Economic Forum (WEF). The survey, with respondents representing 27 countries and 15 industries, showed that 84% of global businesses had accelerated the digitalisation of work processes in response to the pandemic[196]. When looking at Europe and Japan specifically, it seemed that the number of businesses that have accelerated digitalisation was even higher. In Italy for example, 100% of respondents said to have sped up digitising their work processes in response to the pandemic, with the Netherlands, the UK, Spain, and Japan showing very similar percentages ranging from 93% to 96%[196]. While the level of digitalisation in reaction to the pandemic was not uniform across industries, the vast majority of respondents did in fact confirm this strategy, with percentages ranging from 73% to 100% between the various sectors. Highest were the education sector and the 'energy utilities & technologies' industry, from which all of the respondents confirmed to have adopted the digitalisation strategy. However the 'digital communications & IT', 'professional services', and the transportation industries were quite similar as percentages ranged from 90% and upwards. Lowest were advanced manufacturing and the agro-food industries, where about three quarters of respondents confirmed this strategy.

In the same survey, half of the respondents said

to have accelerated automating tasks in a response to the pandemic[196]. Once again, looking to European countries and Japan specifically, we see a notably higher percentage. For instance, more than 60% of respondents from Italy, the Netherlands, Switzerland, Spain, the UK, and Japan confirmed to have relied on automation in adaption to the pandemic. When looking at the differences between industries, we again see the highest percentages in education, 'energy utilities & technologies', and 'transportation & storage' (64-70%)[196]. But these percentages were relatively high for advanced manufacturing and healthcare industries as well (57.7% and 56.25 respectively).

Another study by McKinsey that focusses on Europe, largely corroborates the previously mentioned findings. According to this mid 2020 survey, the average digital adoption rate in Europe increased from 81% to 94% during the early months of the pandemic[201]. However a much more interesting finding from this study, is the fact that during the pandemic, the 'digital gap' between European countries seemed to have shrunk. As mentioned earlier in this chapter, the 'digital divide', or the disproportion in availability of (or access to) new technologies, has been one of the main concerns in the digital transition. Some even feared the 'divide' even to be exacerbated by the pandemic. However, in the case of Europe at least, this fear seemed to have been unfounded.

On a final note, these summarised findings are not meant to highlight any disparities between different countries or industries, but merely meant to emphasise how far reaching the pandemic's effect has been in accelerating the adoption of new technologies. Because, despite of all the hardship and misery it has brought upon the world, the pandemic has without a doubt, been a major catalyst in the digital transition, and a massive step forward towards 'industry 4.0'. Another important takeaway is, how different the (admittedly dire) economic fallout from the pandemic is, when compared to the 2008 recession. Because, as the KPMG CIO Survey report highlights, the overall optimism, future outlook, and confident investments are very different from what was observed during the 2008 economic crisis[200]. Which, when put into perspective, is undoubtedly, a positive sign.

The Way We Work

A survey conducted by Gartner among 800 HR executives worldwide in March 2020, showed that 88% of business organisations encouraged or required their employees to work from home in a response to the unfolding pandemic[202]. A finding largely in line with that from two other large surveys, namely the 2020 WEF survey and the KPMG CIO Survey 2020, which reported 83%[196] and 87%[200] of their respondents doing the same respectively. The shift to remote work was highest in the healthcare and 'energy utilities & technologies' sectors, where all of Gartner's respondents said to have increased opportunities for their employees to work remotely, followed by mining and metals (95%) and education (88%)[202]. Which is quite a difference with some of the other sectors like automotive and transportation (64% and 65% respectively), where business operations not necessarily allow for adopting remote working on a large scale. A McKinsey study underlines this issue by stating that about 70% of time of those in the 'computer-based office' arena could be effectively be done from home, while this is only 5-10% for most other types of work[203].

This sudden shift to remote work was undoubtedly the most quintessential (and most disruptive) change to our working routine, and one with a consequential impact on our professional and social lives. So much so in fact, that words like 'remotely', have become practically synonymous with the 2020 pandemic. In its 'word of the year 2020' publication, Oxford languages showed that use of the words 'remote' and 'remotely' saw a massive surge from March onward[204]. The word 'remotely' in particular, of which usage increased with 300% compared to the year before. More interesting in these findings, was the change in nouns that were used in collocation with 'remote' and 'remotely', which in 2020 were predominantly work and study related (e.g.; 'working', 'learning', 'studying', 'meeting')[204].

Working from home, also referred to as 'teleworking' or 'telecommuting', is of course nothing new. In fact, the term 'telecommuting' dates all the way back to the 1970's and has seen an increasing level of adoption since the 1990's[205]. Remote work is also one of the changes that, despite its initial disruptive nature, is expected to stick around (at the very least for the duration of recovery) across industries and regions. This might not be a bad development however, as the switch to remote work is said to actually be more cost effective than pre-crisis practices[195]. The effectiveness, or productivity benefits that resulted from the shift to working remotely, seem to coincide with (and possibly result from) an overall positive reception of the change among employees[206, 207, 208]. Results from the 'Global Work from Home Experience Survey' corroborate these findings, as they show that 62% of respondents say to be 'overall, very successful working from home' with a nearly equal level of 'activity performance' when compared to working from the office[202].

The Way We Buy

The economic uncertainty and restricted movement caused by the pandemic (not to mention the obvious health concerns), have had a significant impact on consumer behaviour as well. In fact, more than 60% of global consumers said to have changed their shopping behaviour since the start of the pandemic[209]. A lot of these changes can be attributed to (e.g.) certain goods temporarily being unavailable through the usual channels, or the consumer becoming more cautious in their spending, and are therefore most likely only temporary in nature. Not to mention the phenomenon of 'panic-buying' like we saw in the early stage of the pandemic[210], which drastically affected buying behaviour and[211], as a result, disrupted the retail market to great extent[211]. However the changes that is expected to have a more significant (and lasting) effect, is the consumer collectively switching to online channels[195].

Of course the growing use of ecommerce and share of online channels in overall consumer sales is not a new development. Online shopping, starting from its most rudimentary form, has been around for about 40 years, however it was not until the turn of the century when really took flight (in the form we know today) with the introduction of several game changing online platforms and services[213]. Even though global e-commerce has been growing rapidly ever since the early 2000's[214], the last couple of years the growth of retail ecommerce sales did actually seem to cool down a bit. A 2019 prognosis by 'eMarketer' predicted the ecommerce retail sales would have come down to 19.2% in 2020, compared to the 28% in 2017[214]. However due to businesses forced to close down their physical stores, and the consumers (more or less) locked inside their homes, the use of online retail shopping surged to a 27.8% during 2020. An analysis of Google search interests in a selection of countries worldwide, performed by the OECD, shows an exponential increase in searches for "delivery" (or its equivalent in other languages) in the period from February to April 2020[215]. An interesting finding of the study, is that in some countries the increased interest in delivery preceded any government measures. This illustrates how quick consumers can react and change their behaviour in case of uncertainty and large, disrupting events.

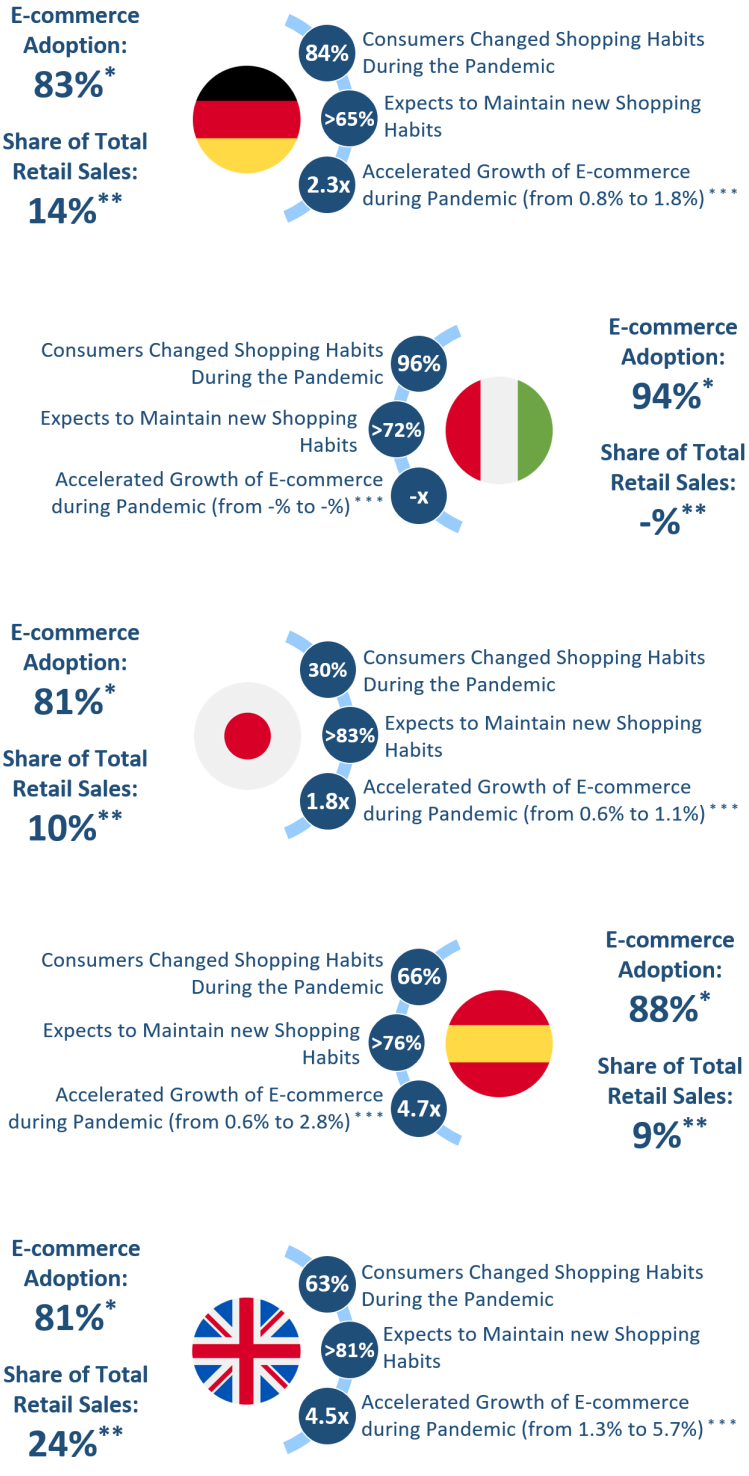
The pandemic has been estimated to account for an additional 10% growth of the overall global

Sources:
McKinsey / Statista

ecommerce market in 2020, and is expected to have a similar impact on 2021 growth as well[216]. Despite the overall growth, not all product categories saw an increase in sales, regardless whether or not they were available through online channels. Sales related to leisure and travel were (for obvious reasons) down for both on- and offline channels, but the same happened for sport related articles, (formal/ exclusive) clothing and apparel[209, 215]. The product categories which seem to have benefited the most from the shift to online channels (more or less equally across the world), are: groceries; food products; and medicines. Coincidentally the same sectors, for which the adoption of online channels has been relatively low[217]. Also, it is expected that it will be the SMEs in particular, which will continue to move to online sales channels[218].

As mentioned earlier, not all of these changes are necessarily permanent as they result from an ad hoc reaction to temporary uncertainties and limitations. That isn't to say however, that these changes will not have some sort of lasting effect on buying behaviour on the long run. For example, the 2002 SARS outbreak is often suggested to have been the main driver behind the digitalisation of Chinese retail[219]. Of course the COVID-19 pandemic (due to sheer scale alone) is quite different from the 2002 SARS outbreak, however the consumer and industry reactions to restricted movement do compare, so perhaps the long term effects will as well. Of course, as long as the uncertainties persist, so will (most likely) the current buying behaviour. However, even once the global situation stabilises, not everything will (or can) turn back to the pre-pandemic situation, because both the consumer, as well as the market itself, have permanently changed. From the perspective of the consumer, it is easy to understand why the transition to online channels was made during the height of the pandemic. However once

Shopping and E-commerce during the Pandemic:

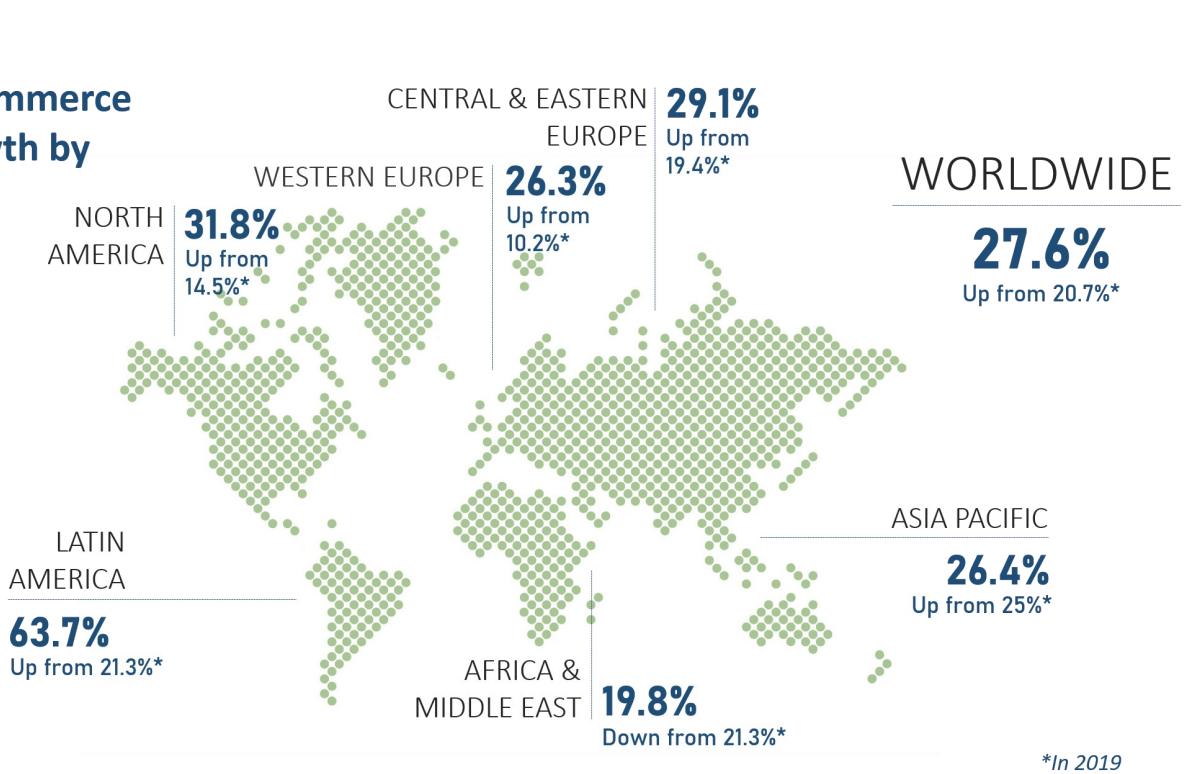


** In 2020, among industry respondents.*
*** 2020 E-commerce sales as a percentage of total retail sales.*
**** The accelerated growth of E-commerce as a percentage of total retail, comparing 2020 to 2015-19 average.*

Sources: WEF & McKinsey

adjusted, it is not unthinkable that many consumers will rely on online shopping for a much larger portion of their purchases than they did before the pandemic. After all, having lived with the pandemic for well over a year now (as of time of writing), consumers worldwide have gotten used to online shopping for an enormous range of purchases, for which they have found new shops and businesses[209, 215]. These new found habits, as well as loyalty, won't just disappear when the virus does (whenever that may be). Second, not only did the pandemic warm people to the idea of using online channels for purchases they previously made in brick-and-mortar stores, it has also pushed a large portion of the 'laggards' into adopting online shopping all together[209, 215]. These 'newcomers' to ecommerce did, in some cases, make up for more than half of 2020's growth in online sales. According to a McKinsey survey, the majority of global consumers actually believes that more of their purchases will be made online than before the crisis, for nearly all product groups in the categories; groceries, apparel, household items, entertainment, and wellness products[220]. Interestingly, the survey (conducted twice during 2020) shows that respondents in countries that were less certain of increasing their online purchases after the pandemic in the first survey (e.g., Japan and Germany), showed more positive towards this idea in the second survey held later in the year[220]. This could suggest that, the longer the pandemic lasts, the more consumers will warm to the idea of relying on digital channels for more and more of their purchases.

Of course, the market itself has undergone quite some changes as well, not all of which, are likely (or even possible) to be reversed. For starters, in their shift to online channels, businesses were forced to make significant investments to either expand their existing online presence, or in some cases, build them up from scratch[221]. It would therefore make a lot of sense for businesses to want to capitalise on these investments, even after the pandemic has subsided. Furthermore, in their transition, organisations might have overcome hurdles (e.g. technological, organisational, or customer expectations) that might have prevented them from developing their online presence before the pandemic. Something that is corroborated by the



McKinsey survey mentioned earlier[195]. Finally, there is the harsh reality that business that couldn't (or failed to) adapt quickly enough, simply disappear from the market, leaving their share to those who could and did.

The 2020 WEF survey mentioned earlier, shows that 77% of respondents, across regions and industries, expect to adopt ecommerce and digital trading technologies by the year 2025[196], which is a 2-18% increase over the results from the 2018 survey[222]. The survey also shows that European countries and Japan are quite a bit ahead of the global expectation, as the 2020 adoption rate in these countries ranged between 71% and 94% already[196]. As far as the overall adoption rate in the industry, this was the highest in the financial services sector (90%), followed by manufacturing, 'transportation and storage', 'digital communications & IT', and the consumer goods sector (82-87%)[196].

The shift to online channels, at the expense of brick-and-mortar outlets is a development that started well before the pandemic[223]. The reason that E-commerce is given such a prominent coverage in a research on technological advancements, is that it has played a very significant role in both the adoption and development of several very important technological domains. In fact, as will be explained in the next chapters, the sudden growth of E-commerce was made possible by, as well as contributing to, emerging technologies like Big Data, AI & Machine Learning, Internet-of-Things, and Cyber Security.

3

Frontier Technologies, or Fleeting Fads?

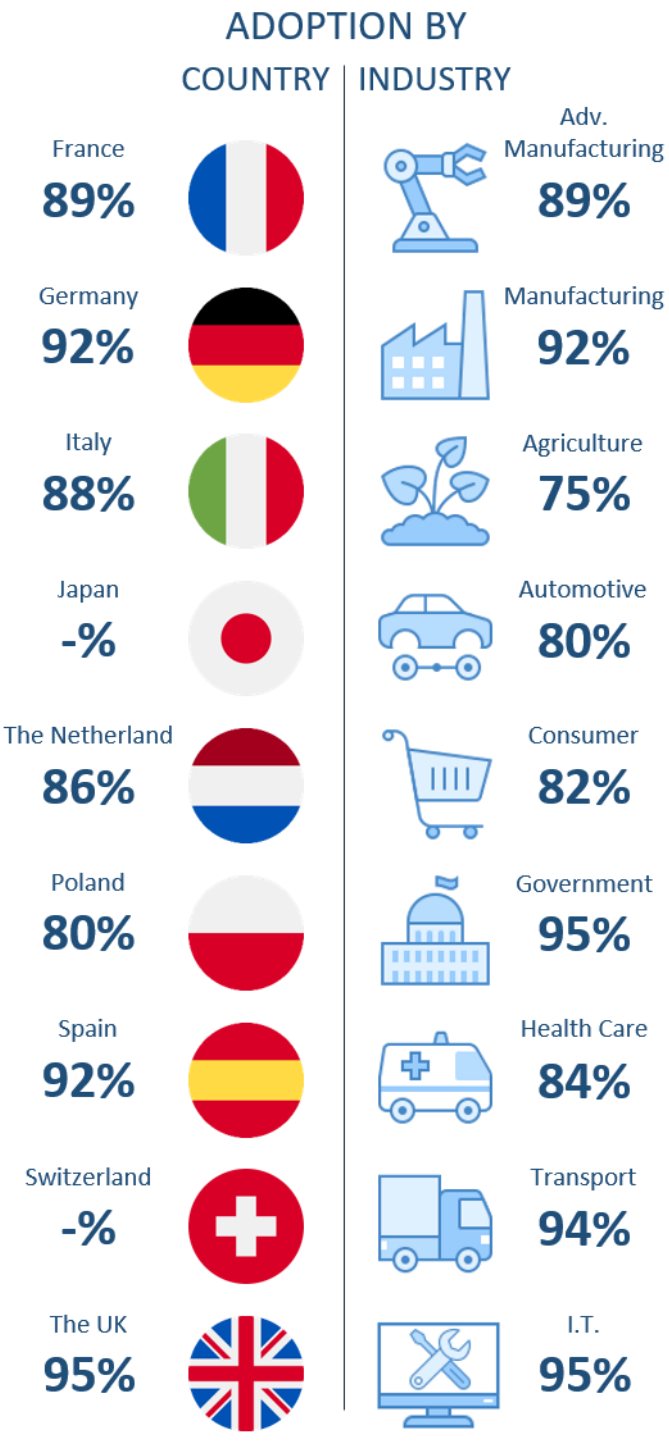
Returning to the matter of the fourth industrial revolution, the question remains, of what technologies will be making up this 'industry 4.0'. Often referred to as 'emerging' or 'frontier' technologies, there are a number of (relatively) new technological developments that have had an increasingly large industrial and societal impact in recent years. We have selected seven of these technologies to be highlighted, based on their (anticipated) significance and impact, or those of which the adoption process was accelerated by the pandemic the most. As it happens to be, more often than not, these technologies are in fact interrelated in the sense of both the technological as well as their applications. This chapter will look at the current state of these technologies, and how the pandemic has impacted their use and adoption.

Cloud Computing

Cloud computing, the delivery of digital services (like software or storage) over the internet, is perhaps the best example of a technology of which the adoption was drastically accelerated due to the pandemic[224]. According to Microsoft for example, based on the use of their cloud based services, they claim the pandemic caused two years of digital transformation in only two months[225]. A survey by Flexera shows that 90% of their global respondents expected to be making more use of cloud services due to the pandemic[226]. The fact that this isn't a short lived development, is shown by the fact that 24% of their respondents said their 2021 expenditure on cloud to be over budget, and 39% expected to exceed their initial budget for 2022[226]. Similarly, a survey by Gartner showed that 70% of the respondents that already used cloud computing, will increase spending in this area due to the pandemic[227]. Gartner expects the 2021 global end-user expenditure on cloud computing services to increase with 18% over 2020, to nearly US$305 billion. They also forecast this industry to maintain its growth until 2024, by when they expect cloud computing to make up for 14.2% of global enterprise IT spending (up from 9.1% in 2020)[227].

As with all the technologies mentioned, the transition to, and adoption of, cloud computing dates back from well before the COVID-19 outbreak. Providing access to solutions or capabilities otherwise out of reach, cloud based services offer their users more benefits than merely saving them from having to make substantial investments[228]. While cost savings are always welcome, and even more so during times of economic uncertainty, there are several reasons for the rapid adoption of cloud based solutions during the pandemic.

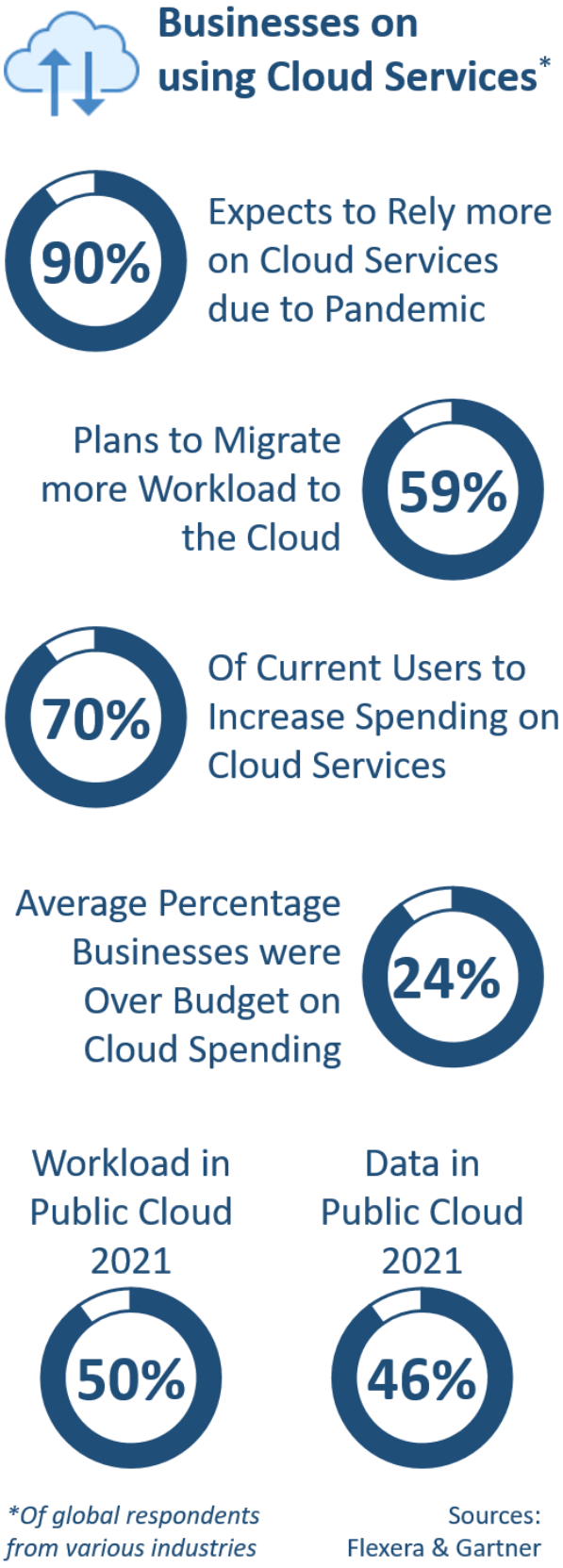
For starters, the shift to working from home meant that employees needed remote access to everything they require to conduct their daily work activities. Cloud based solutions made this transition possible. Second, the flexibility (and scalability) of cloud services makes them very appropriate in times of



*of respondents per country
**of global respondents per industry

Source: WEF: Future of Jobs Report 2020

uncertainty, where rapid adaptability is of great importance. Having important parts of business operations outsourced as a service, gives the flexibility to adapt on short notice to your current (or anticipated) needs. In case of the pandemic, these were solutions that facilitated remote work or the increased use of online channels, but also



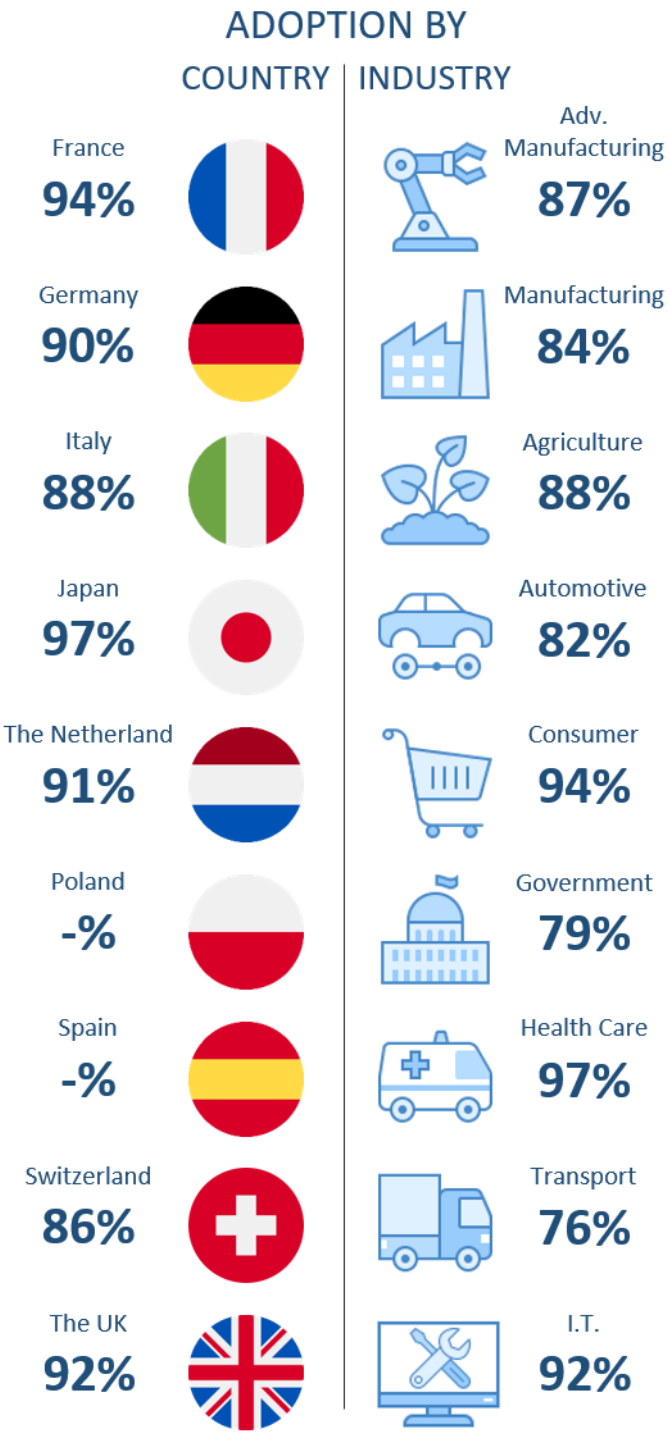
advanced AI driven technologies to aid in digitising business operations to name some examples.

Like mentioned, the adaption of cloud computing is likely to continue for the coming years. Flexera's survey shows that nearly 60% of the respondents (representing nine industries) says to focus on 'cloud migration' and plans to migrate more workload to the cloud in the coming years[226]. A significant percentage of respondents (39-44% depending on current 'adoption maturity') plans to adopt a 'cloud-first' strategy. Another important finding from this survey, is the fact that cloud based services seem to have really particularly enabled SMEs in adapting to the current situation. For example, respondents currently are, in average, running 50% of their workload in public clouds and 46% of their data. While SMEs have 64% of their workload, and 59% of their data in public clouds, and are expecting to increase this with 5% and 8% respectively in the next 12 months[226]. This presumably, due to the benefits of flexibility and cost saving that cloud services offer, which, in challenging times, are particularly valuable to smaller businesses. Of course there are some challenges in the adoption of cloud services as well. Currently, the main concern seems to be security, as it is mentioned by 81% of Flexera's respondents, with minimal difference between large businesses and SMEs[226]. However more on this further on in this chapter.

The Internet-of-Things

Perhaps the hallmark technology of 'Industry 4.0', the Internet-of-Things (IoT) is the expansive field of connecting hardware (i.e., 'things'), equipped with sensor and software technologies, to connect and share data via the internet[229]. While the term will probably have most people think of smart fridges or smart microwaves (or any home appliance incorporating the word 'smart'), the number of IoT applications is truly endless. The name was coined around the turn of the century to introduce the idea of using RFID technology to track products throughout the supply chain[230]. From there on, the term was used for the growing trend of connecting devices over the internet. Currently, IoT applications can be found anywhere, including home appliances, health care, agriculture and manufacturing[229, 231]. The technology has even found military applications and is used in infrastructure projects (like 'smart cities')[231, 232].

The Internet-of-Things can, for the sake of simplicity, be divided in three main domains, being: the one for consumers, the one for enterprises, and the one for public spaces[233]. During the pandemic, it was enterprise IoT that has played a significant role in particular. In Vodafone's IoT Spotlight Report 2020, for which they surveyed 1.639 businesses worldwide, they show the benefits IoT offers businesses, and what role it has played during the pandemic. The main areas in which IoT offer benefits in the enterprise domain are 1) by improving operational efficiency, and 2) by creating new connected products and services[234]. Regarding the improved operation efficiency, half of the respondents said that IoT solutions have improved employee productivity, and 42% said asset uptime to be one of the main benefits of having adopted IoT solutions. Also, 55% of respondents said IoT to have enabled them to reduce operating costs (up to 21% on average). While in the area of products and services, 34% of respondents reported newly generated revenue streams thanks to IoT, and an equal 34% said to have seen an increased revenue from existing revenue streams by 24% on average.

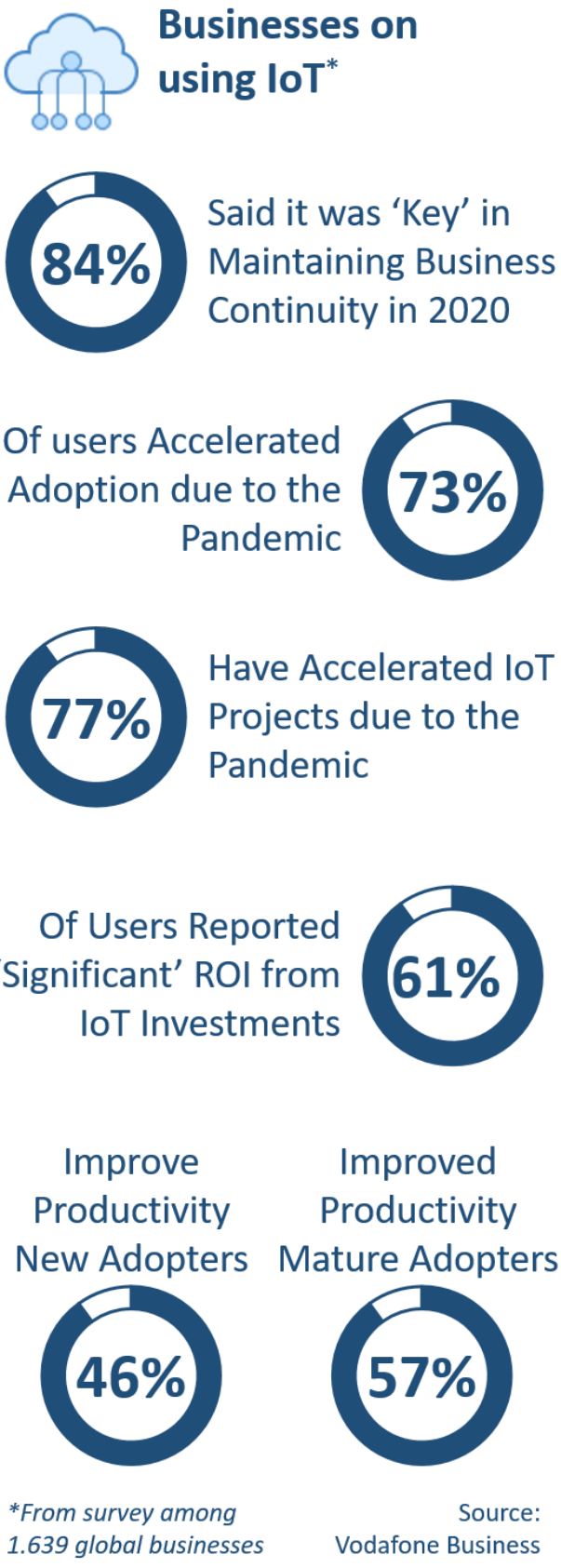


**of respondents per country*
***of global respondents per industry*

Source: WEF: Future of Jobs Report 2020

Altogether, 82% of respondents said to have seen increased revenue and market share since adopting IoT. More than half of the respondents said the return on investments from IoT solutions are significant, particularly in businesses that have been using the technology for three years or longer.

One of the most significant changes brought about



by the adoption of IoT, is the drastic increase in generated data. In fact, 86% of the respondents interviewed for the 2020 IoT Spotlight Report said that the adoption of IoT has changed how they approach analytics and value data[224]. For example, 81% of respondents use IoT data to drive innovation, and 84% says to use it for meeting their sustainability goals. Many also mentioned that IoT data to have made customer service more effective and flexible (39%), as it provided new insights in customer wants and needs. Overall, businesses said that IoT data allows them to better plan for the future and more effectively respond to unexpected changes. It is therefore not surprising that nearly all respondents admitted data has become much more important with the use of IoT solutions.

These same benefits attributed to IoT solutions, are likely the reason that 84% of the respondents from the Vodafone study said that IoT was a key factor in maintaining business continuity during the 2020 pandemic. Scrambling to adapt to social distancing and lockdowns, IoT solutions have enabled businesses to automate tasks, or made it possible for them to be carried out remotely. It has also been used to significantly reduce the workload of (vital) manual tasks, allowing for work to continue under the challenging circumstances. Over three quarters of the businesses surveyed, said to have accelerated specific IoT project in response to the pandemic. However this was also due to a shift in prioritisation, as some projects were actually put on hold (or cancelled) as priority was given to the more urgent matters. So for some applications, the pandemic has actually slowed down the advancements in IoT.

Besides enterprise projects being delayed due to a (temporary) change in priorities, the consumer IoT market suffered from manufacturing and supply chain disruptions[235]. But, within the consumer market, demand for IoT products was not affected proportionally by the pandemic either, showing the great disparities in how the pandemic has affected the overall IoT domain, depending on application and end market[233]. However this 'dip' following the pandemic, is likely to be short lived as predictions indicate the market to recover as soon as the economy stabilises[236]. In fact, once the world

reaches the 'post-pandemic' stadium, the market is expected to grow even faster than was predicted before the pandemic due to pent-up demand and investments to 'future proof'[235]. Projections also suggest that the industrial IoT market is to show an average annual growth of 16.7% till 2027, when the market will reach $263.4 billion[237].

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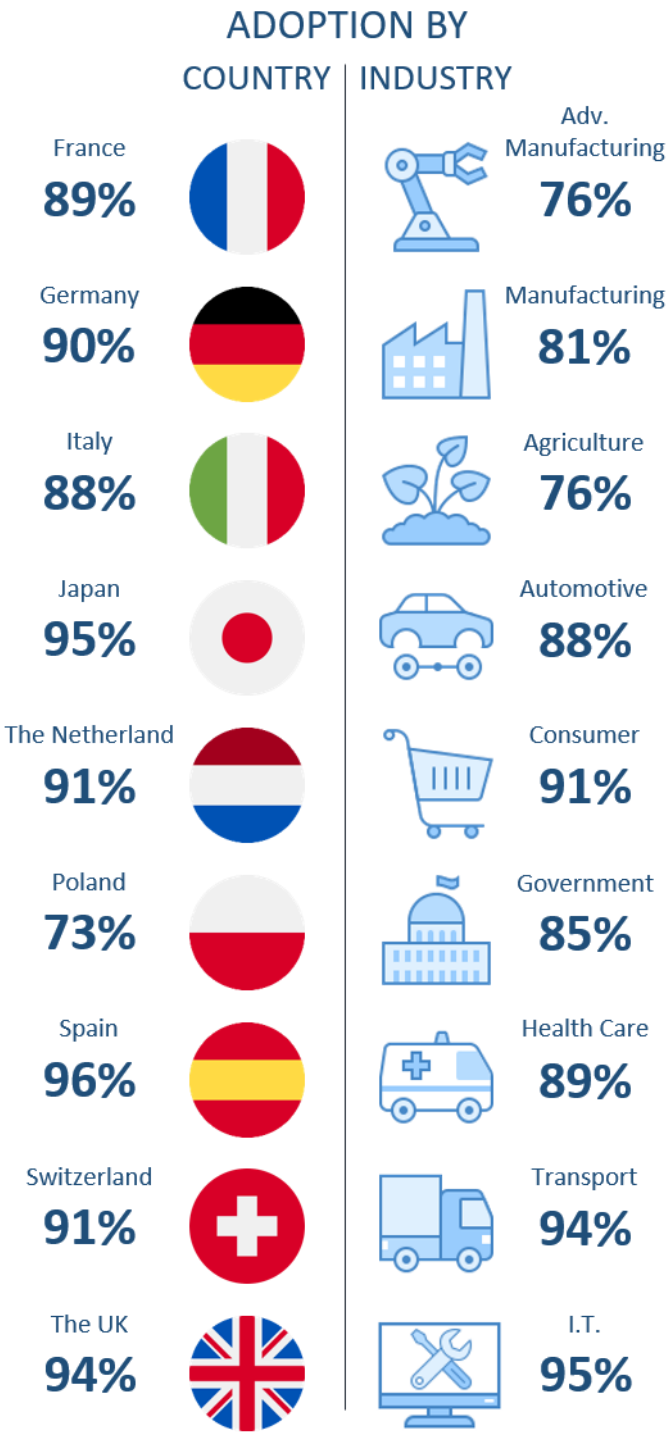
In addition, the consumer IoT market suffered from significant manufacturing and supply chain disruptions[235]. However within the consumer market, demand for IoT products was not affected proportionally by the pandemic either, showing the great disparities in how the pandemic has affected the overall IoT domain, depending on application and end market[233]. However this 'dip' following the pandemic, is likely to be short lived as predictions indicate the market to recover as soon as the economy stabilises[236]. In fact, once the world reaches the 'post-pandemic' stadium, the market is expected to grow even faster than was predicted before the pandemic due to pent-up demand and investments to 'future proof'[235]. Projections also suggest that the industrial IoT market is to show an average annual growth of 16.7% till 2027, when the market will reach $263.4 billion[237].

Big Data

As mentioned earlier as well, we are generating increasing amounts of increasingly complex data, from an increasing number of sources. This trend, is why we are in what is often referred to as 'the data age'. Data which, in terms of size or type, is beyond what is possible to capture, manage, and process with traditional relational databases, is commonly called 'big data'[238]. More simply put, what differentiates 'big data' from 'traditional data' is a superabundant volume, velocity, and/or variety. Both the before mentioned cloud computing and IoT have (amongst others) contributed to the growth of big data. The growth of the IoT industry has meant an enormous increase in generated data, while cloud solutions have enabled the storage and processing of these vast amounts of data[239].

Just like the data itself, the number of applications are enormous and ever increasing. However overall, big data allows for more complete (detailed) insights, meaning a higher level of reliability, and ultimately better and faster decision making[238, 240]. To illustrate, 80% of the respondents from the earlier mentioned Vodafone Future Ready Report said that the amount of data collected by businesses is increasing, and nearly as many agreed that data is becoming an increasingly important strategic asset[199]. About three quarters of respondents also agree that data has become essential in day-to-day business operations, and is in fact 'key' in making the best commercial decisions.

In a similar way, big data found an additional use during the pandemic. Hidden in massive amounts of available data, were vital insights that allowed scientists, epidemiologists, and policy makers to make well informed decisions in their efforts of constraining the virus outbreak[241]. Continuous data streams from all over the world made it possible to monitor developments on both a global and local level in near real-time, available to everyone. This, as well as other uses of 'big data' during the pandemic, were a great showcase of its potential when used synergistically with technologies like artificial intelligence and machine learning for

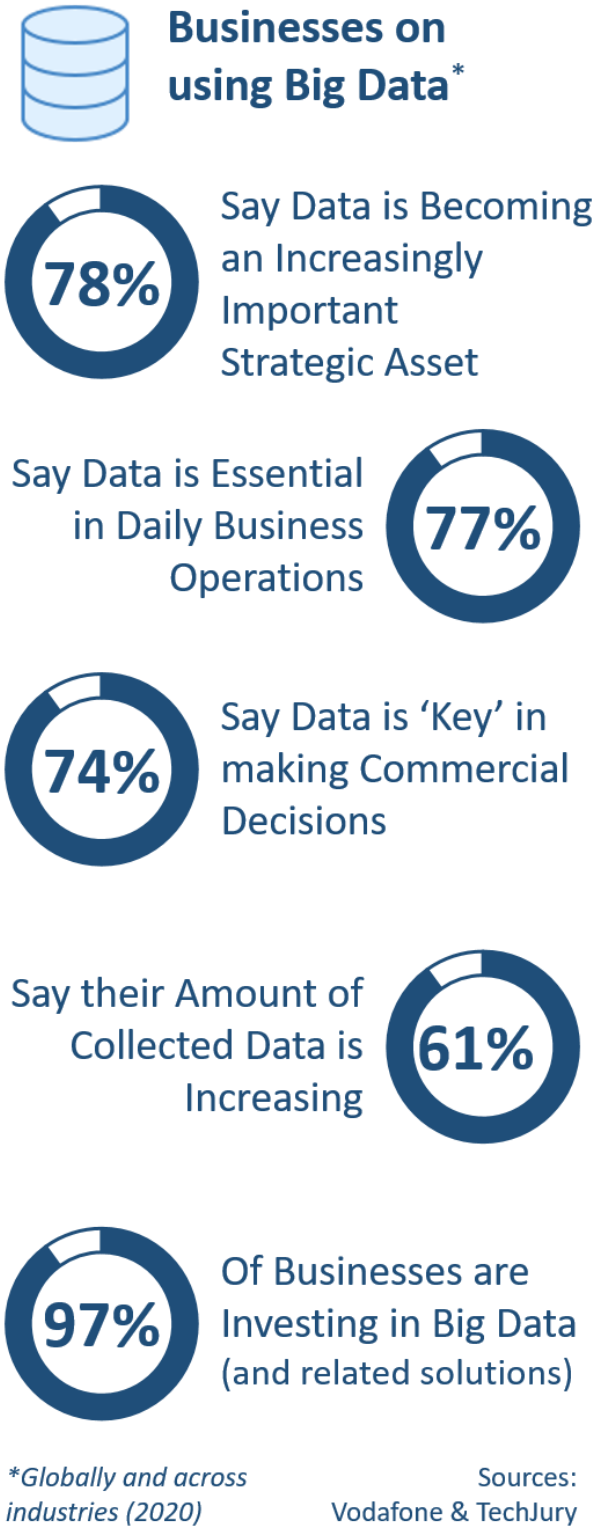


*of respondents per country
**of global respondents per industry

Source: WEF: Future of Jobs Report 2020

example (more on which later)[241, 242].

Most recent developments aside, 'big data' has, without a doubt, been one of the major tech buzzwords of the last decade[243]. However up until now, not everyone felt it has lived up to the hype (or rather, it's true potential)[244]. The 2021 NVP Big Data and AI Executive survey, conducted among



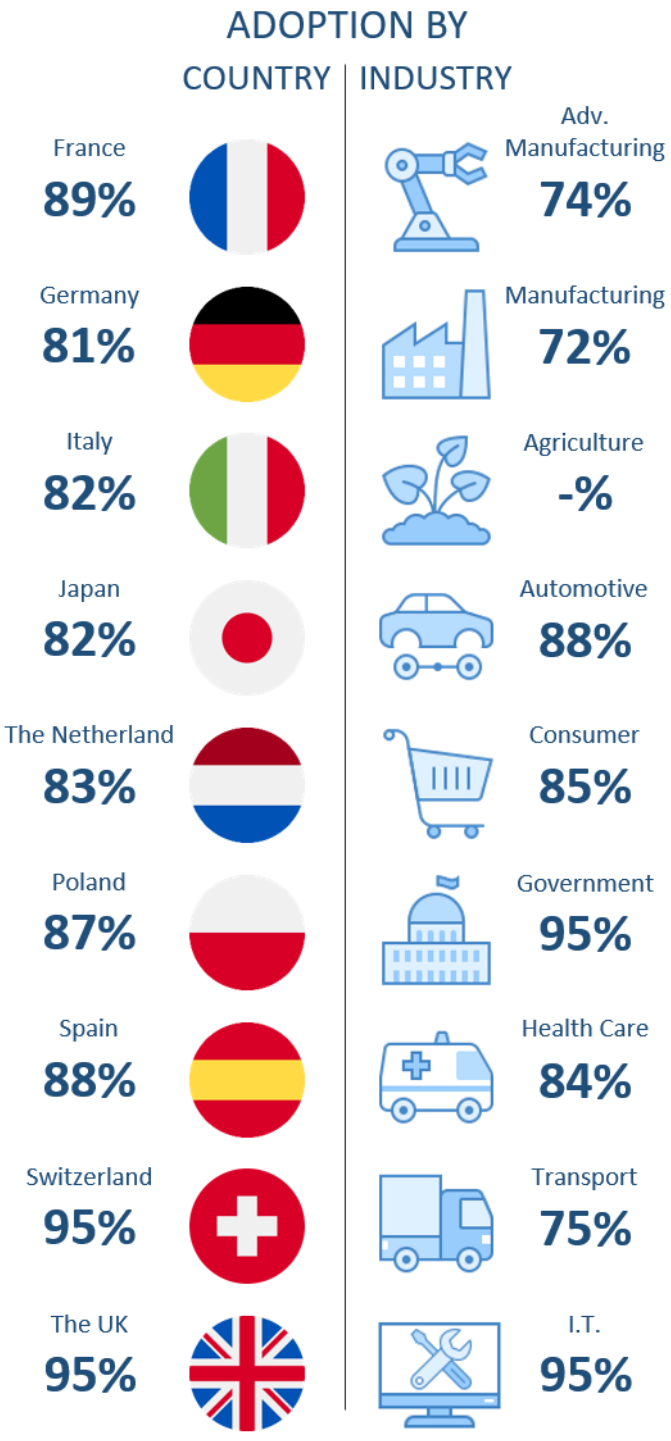
respondents representing eighty-five Fortune 1000 firms, provides some interesting insights in this regard. For example, it shows that while practically all firms are investing in big data and AI solutions, and nearly all (91.9%) say investments to be increasing[245]. However despite of these investments, less than half of the businesses involved says to drive their innovation through data, or are competing on analytics. In fact, less than 40% are managing data as a 'business asset'. Even more telling, is the fact that less than a quarter of the firms say to have "forged a data culture" or "created a data-drive organisation". Interestingly, the NVP study shows that in only 8% of cases, the respondents say technological boundaries are the main obstacle in the transition to a 'data-driven' organisation. The other 92% say the main obstacles are (organisational) culture, people, or business process related. This finding is, very much, in line with findings from the previously mentioned McKinsey[195] and WEF[196] studies, which showed it was rarely technological limitations or boundaries hampering the adoption of new technologies. Yet more important, these studies also suggest the 'cultural' or 'organisational' boundaries to be (largely) taken away by the pandemic[195, 196].

This could indicate an accelerated adoption of big data (and data-driven organisations) in the years to come. In fact, the 2021 NVP study, shows the percentage of firms reporting accelerated investments in big data and AI solutions to be up by 40% from their 2020 survey, possibly indicating a new impetus in big data adoption[245]. Market analyses by the Business Research Company, speculate about a possible 5.3% growth for the 2021 global market big data and analytics[246], and 3.9% for big data and analytics services[247].

Cyber Security

The technologic fields discussed up till this point, have all seen a significant increase in use and adoption during the pandemic. Each one, offered specific solutions (often synergistically with each other) to the challenges that came with the restrictions of movement and other precautionary measures. However, while the shift to digital was a welcome solution to the situation at the time, it did have a particular unwanted side effect (apart from the substantial investments and steep learning curve). In March of 2020, the WEF warned about the vulnerabilities that came with the increasing dependency on digital infrastructures[248]. They argued, that the increased use of digital channels itself, as well as the larger number of people using them, businesses and governments would become more vulnerable to cyber criminals. A worry that, was in fact proven very much justified, over the months that followed. It was only April, when the WHO reported a fivefold increase in cyber attacks[249]. Both Interpol and Microsoft would issue warnings on the issue later that same month[250, 251]. Of course, cyber security was a growing concern before the pandemic as well, as it is simply a concomitant of digitalisation[252]. However, just as the pandemic accelerated the adoption of new technologies, it accelerated their exploitation by opportunistic criminals as well. In addition to this, there is was the forced transition to working from home, which created a whole new multitude of security challenges[253].

The main growth drivers for the cyber security market were, and are, the adoption of e-commerce, cloud computing, IoT, and AI[254, 255]. In 2020, the average cyber security budget in businesses was equal to 0.48% of total revenue, and 10.9% of the IT budget[256]. Estimations of the global market for cyber security in 2020 range between US$153.2 billion[241] and US$162.5 billion[257] in size, with an estimated growth of 7.6% over 2019[254]. However, predictions for the coming years are even more promising, with an expected growth of 10% for



*of respondents per country
**of global respondents per industry

Source: WEF: Future of Jobs Report 2020

2021[258], and with estimated compound annual growth rates between 11.2%[255] and 14.5%[259] until 2026[254, 255, 257, 259]. The fastest growing segments in these estimations are BFSI, healthcare, government, and manufacturing[254].

For 'The Insight 2021 Report', Insight conducted a survey among 200 C-level IT and IT security executives from large firms across a variety of

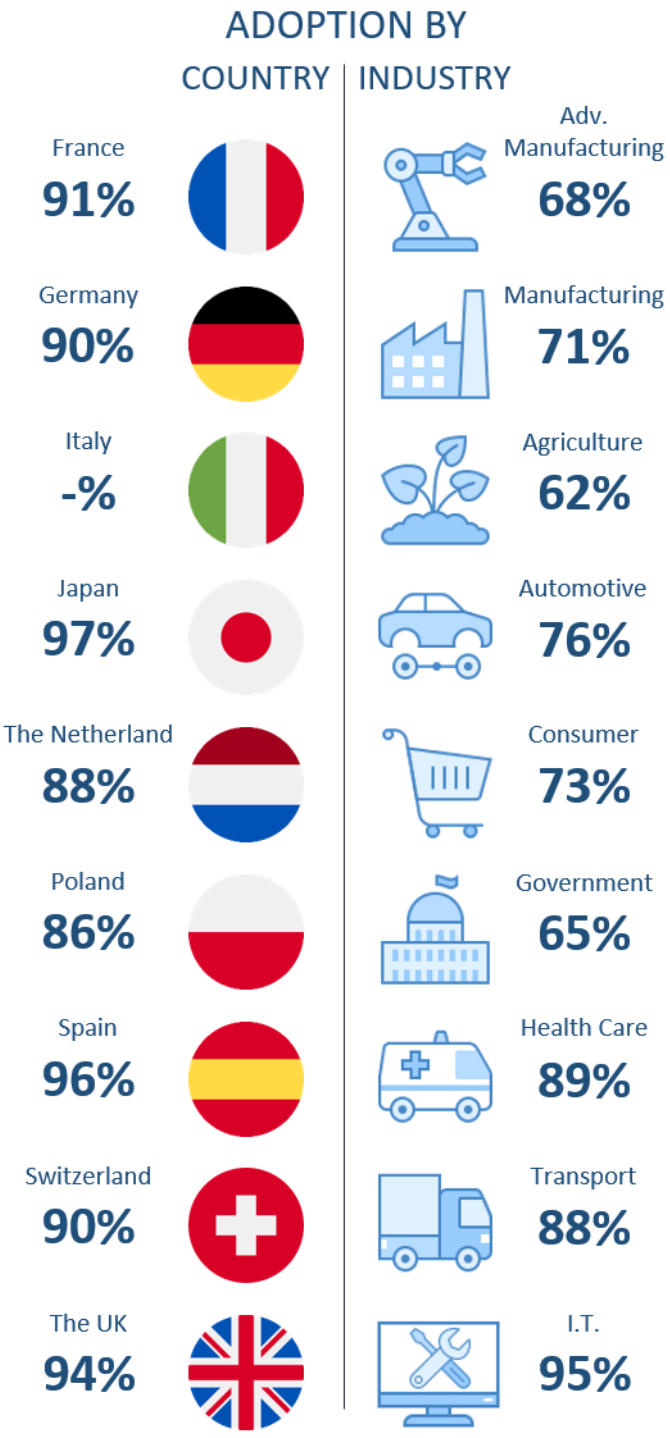
industries. The survey findings show that all of the respondents said their executive team to have become more focussed on their security posture, and nearly all respondents said to have increased their cyber security spending in 2020 (96%), and are expecting to do so again in 2021 (91%)[260]. Despite of this, 78% of the surveyed executives said to still have low confidence in their organisation's security posture, indicating that despite current developments, adoption is still lagging. This is underlined by the fact that 67% of respondents said to be seeking assistance in developing an IT security strategy.

Artificial Intelligence

As mentioned in the beginning of this chapter, the technological fields covered here are, in many ways, interrelated. Artificial Intelligence (AI), and its subfields like Machine Learning (ML), are great examples of synergistic relations between frontier technologies. As concepts alone, both 'Artificial Intelligence' and 'Machine Learning' have been two of the most popular tech buzzwords of recent years. This is with good reason however, as their applications are actually greatly facilitating both the development and adoption of other emerging technologies (like the ones covered in this chapter). Do note that this facilitation, does go both ways, hence the emphasis on 'interrelation'. AI and Big Data for example, are a great example of a synergistic relationship as AI solutions make it possible to handle and process the massive amounts of data, while it is the access to 'big data' that allows AI to evolve and improve[261, 262]. Similar examples could be made with IoT, Cloud Computing, Cyber Security, or Robotics as well.

As such, AI applications have found many uses since the start of the pandemic. Examples of such uses, are how AI (ML in particular) allowed for fast processing of large amounts of complex data, which gave incredibly valuable insights in (e.g.) disease detection or drug discovery, but also in the detection and prediction of outbreaks[263, 264]. In the private sector as a whole however, AI also provided countless valuable solutions, for all business activities, in adapting to the pandemic.

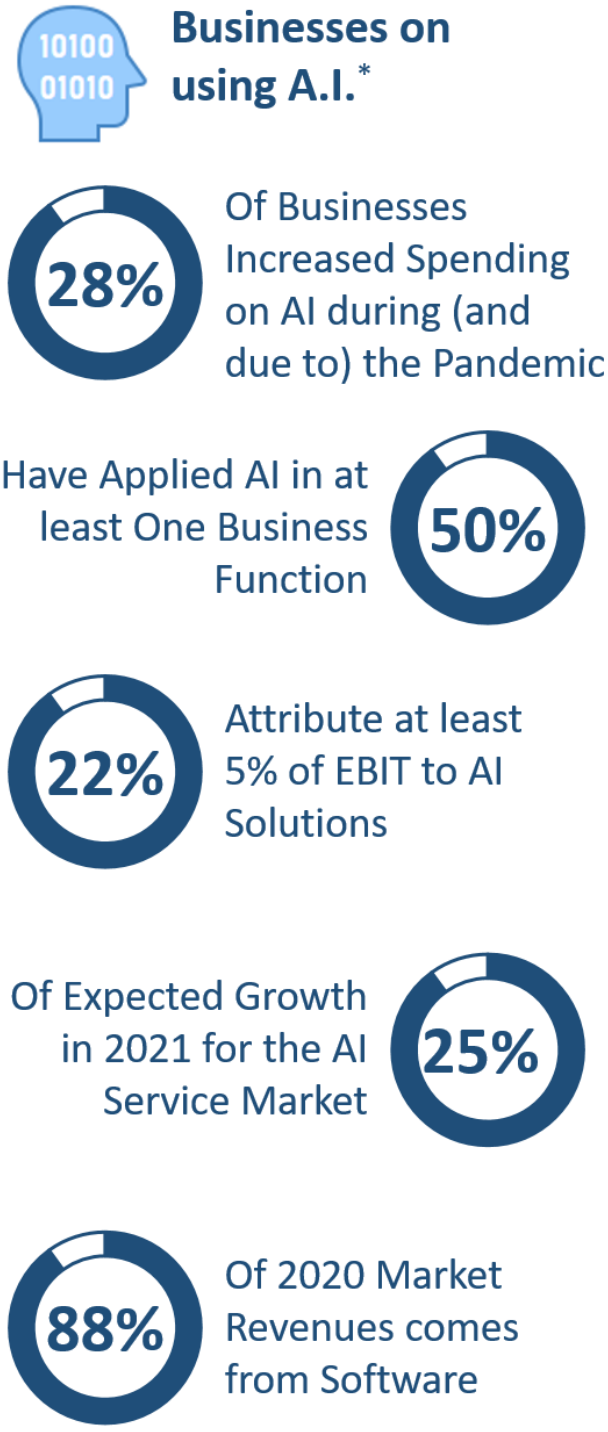
For example, it greatly facilitated the transition to remote work by taking over some of the more simple and repetitive tasks, reducing the workload[184]. In addition, AI solutions were used to negate some of the HR and managerial challenges that came with the transition process[265, 266]. Moreover, it where AI implementations that enabled many businesses to make the sudden shift to E-commerce[267]. Some good examples, being the applications found in customer service, supply chain management, marketing & sales, and cyber security[268].



*of respondents per country
**of global respondents per industry

Source: WEF: Future of Jobs Report 2020

So it should come as no surprise that the AI market is doing well. In fact, the global AI market (including software, hardware, and services) is expected to grow with 16.4% in 2021, to US$327.5 billion[269]. Software currently makes up the largest part (88%) of the market. That said however, the market for AI services is expected to grow with 24.7% in 2021 and is expected to reach US$554.3 billion by 2024, at a



CAGR of 17.5%. While other estimates differ quite a bit due to a different definition of the total market, they all foresee a significant growth in the coming years[270, 271]. Some specific markets where AI implementations are expected to grow at a significantly high CAGR, are healthcare (45.3% till 2025)[272], retail (29.6% till 2027)[273], wearables (26.9% till 2027)[274], and agriculture (30.5% till 2030)[275].

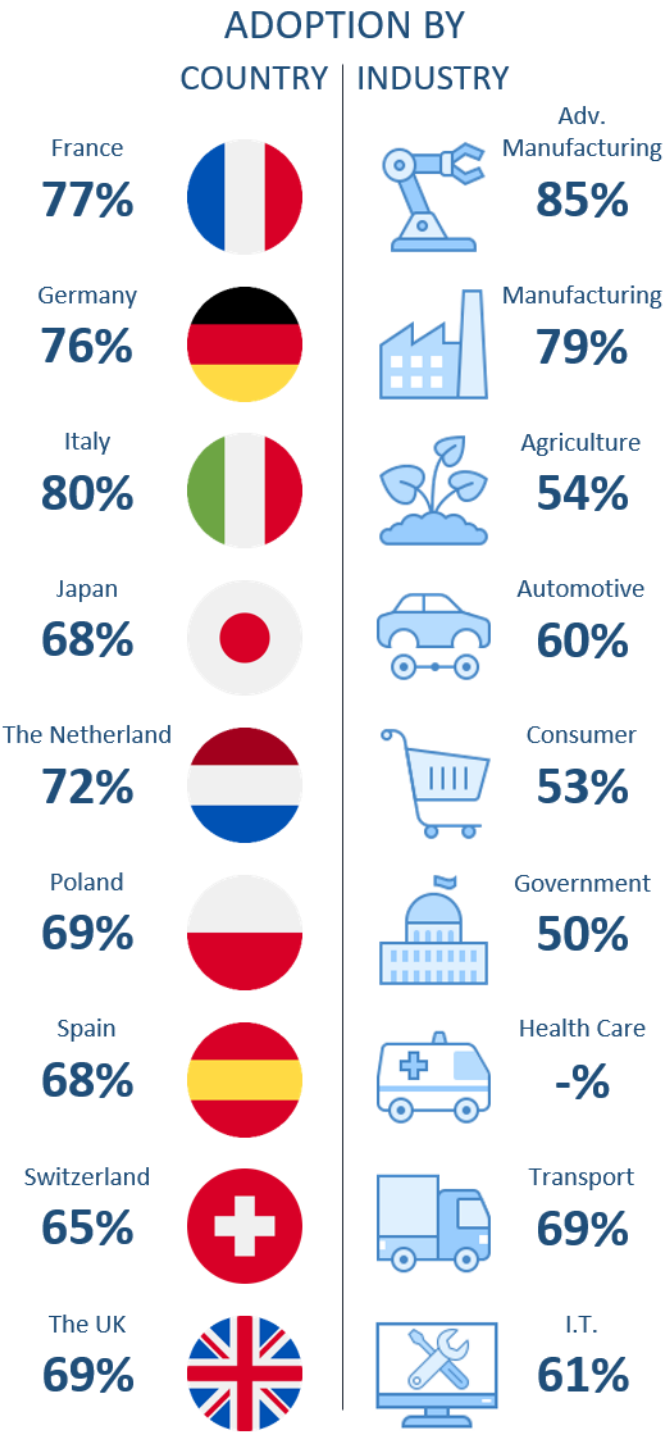
The McKinsey 'state of AI 2020' survey, showed that currently about half of their global respondents has implemented AI solutions in at least one of their business functions[276]. Of the ones that have, 22% says that at least 5% of their EBIT can be attributed to the AI implementations, suggesting a significant ROI. In average, about 28% of their respondents said to have increased investments in AI solutions in reaction to the pandemic, however this percentage was highest in the healthcare/pharma industries (44%) and the automotive/assembly industries (42%).

Robotics

In this list of emerging technologies, 'robotics' is somewhat of an odd one out, since the concept (depending on the exact definition used) dates back centuries[264]. The robotic technology as we know it today, dates back to the early 1950's and has made great strides since. This advancement, as well as the incredible potential of synergetic applications with other emerging technologies like AI[265] and Cloud computing[266], make that robotics could not be omitted from this chapter.

Before the pandemic the overall robotics industry was doing well. However due to uncertainties in the automotive and electronics industries, as well as the ongoing trade war between China and the US, sales of industrial robotics saw a slight (12%) decrease in 2019[280]. Because the automotive industry and electronics industry are the main sales verticals for industrial robotics (28% and 24% respectively). The market for service robots on the other hand, has been performing quite a bit better. That said, this sector is broader than the industrial robot industry, as it includes a much wider variety in levels of automation. In 2019, the market for service robots grew 32%, and so far, seems not to be affected negatively by the pandemic[281]. If anything, some submarkets have even shown growth, like solutions for disinfection, factories, warehousing, and home delivery. The sale of professional service robots in 2020 is estimated to have increased by 38%, and those for domestic and household tasks by 16%[281]. Both markets, are expected to grow at a CAGR of 31% until 2023. The overall robotics market in 2020 is valued at US$23.7 billion, and is expected to reach US$74 billion in 2027 at a 20.4% CAGR[282]. The main growth driving industries in 2021 will remain to be the automotive, electronics, and F&B[283].

So while the future of robotic technologies already looked quite promising, the pandemic does appear to have had a positive effect on the overall industry. Besides the practical examples of how robotic technologies offered much needed solutions to the challenges following the pandemic, it might in fact (once more) be the overall acceptance of the technology that will have the largest impact on the long run. Just like with other technologies covered in this chapter, the pandemic has taken away resistance (or reluctance) to adopting robotic technologies, which has led to a broad range of adoption, including among smaller companies[284]. This does indicate an even stronger move towards automation than already was the case, a development substantiated by the increased level of investments observed in developed economies like Japan and the EU[285].



*of respondents per country
**of global respondents per industry

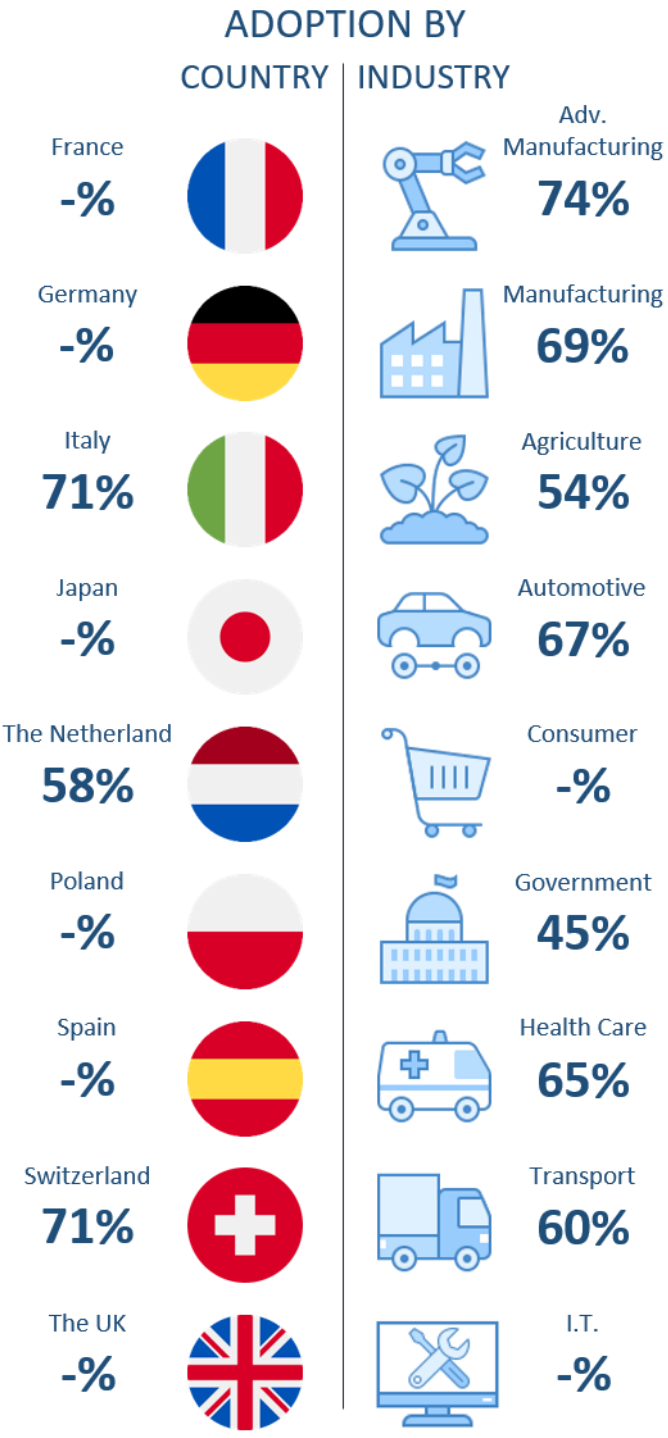
Source: WEF: Future of Jobs Report 2020

3D Printing

3D printing, also known as additive manufacturing (AM), is perhaps one of the most widely discussed among emerging technologies. This, is for a large part due to its rapidly increasing number of applications across various industries[286]. Whether it is new techniques[287, 288], new materials[289, 290], or new applications with existing materials[291, 292], 3D printing and its creative applications receive frequent media attention. The process of AM, typically offers industrial users the benefit of producing highly complex parts in low volume, while saving material (and thus, weight)[293]. As such, the highest level of adoption can be found in the automotive, aviation, and space industries, with an increasing use in the medical world[286, 293].

The market for additive manufacturing in 2020 was valued at US$ 13.7 billion, compared to US$ 10.4 billion in 2019[294, 295]. The global 3D printing market is expected to reach US$ 63.5 billion by 2026, at a CAGR of 29.48%[294]. Others foresee the volume of industrial 3D printers sold by the year 2028 to reach 15.3 million units, compared to the 2.1 million units shipped in 2020[296]. Roughly two thirds of the current market made up by polymer AM, with metal AM being less than half of that[297]. That said however, the metal AM is expected to grow at a 29.2% CAGR until 2025, compared to a 15.4% of polymer AM. Hardware sales were responsible for the majority of the 2020 market revenue (63%), followed by software (29%) and services (8%)[296].

Overall, the 3D printing market is expected to perform well the coming years and so far, does not seem to have experienced much slowdown from the pandemic. While there was a notable fall in hardware shipments in the first quarter of 2020, most likely due to the struggling aviation industry, this seem to have only been temporary[298]. In fact, many of the industry's large players did report significant growth in 2020. Furthermore, a survey by Essentium among manufacturing companies that are using AM solutions, showed that 90% of respondents believe the pandemic has affected their organisation's adoption of 3D printing, and



*of respondents per country
**of global respondents per industry

Source: WEF: Future of Jobs Report 2020

more than half said it has led to a significant increase in use of 3D printed production parts[299]. Half of the respondents also said to have increased investments in AM in response to the pandemic. The main drivers in the industry continue to be automotive, aerospace, defence, and medical industries[296]. As mentioned, the adoption of 3D printing in the healthcare industry is relatively

Businesses on using 3D Printing*

Of Users Increased Investment in 3D Printing due to the Pandemic

Say the Pandemic Influenced the Use of 3D Printed Parts

Of Users say Pandemic Affected Adoption of 3D Printing

Of Users saw an Increase in 3D Printing Operations due to Pandemic

Say to Increase Investments in 3D Printing in 2021

**Among global users (2020)*

Sources: Essentium & Sculpteo

recent, however this market is forecasted to grow at a CAGR of 19.1%, reaching US$4.3 billion by 2025[300].

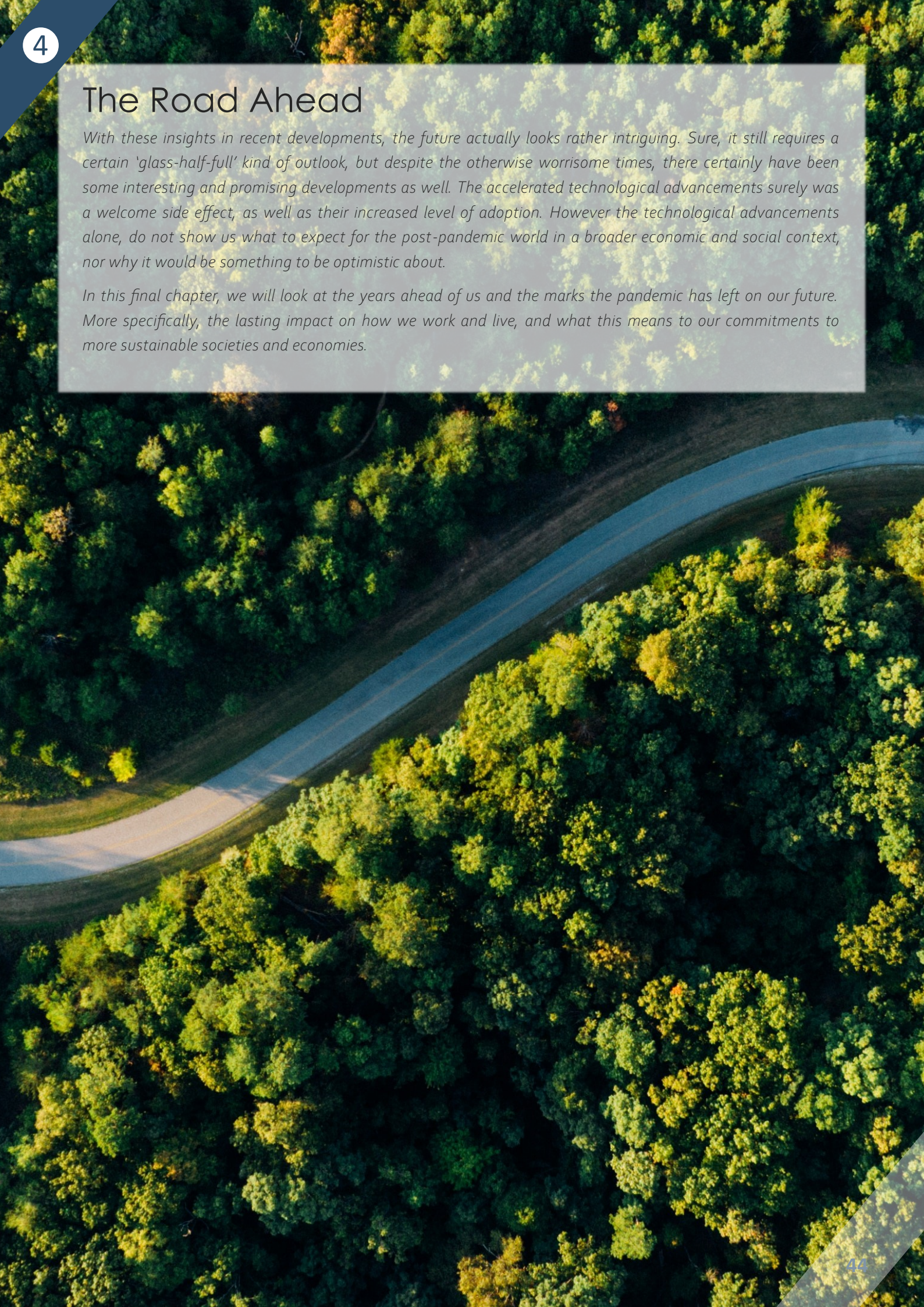
One important addition to the potential of 3D printing technologies in the post-pandemic economy, is how it could facilitate localised production and manufacturing. Besides the sustainability benefits this would offer, it could drastically improve supply chain resilience as well. The before mentioned Essentium survey showed that 83% of respondents believes that AM will increasingly drive more localised manufacturing[299]. While traditionally the main use of the 3D printing has been R&D and prototyping, a survey by Sculpteo shows that, unlike the year before, the technology is now generally accepted as a real production tool[301]. This, most likely due to the solutions 3D printing has offered in adjusting to the pandemic. According to the survey, 52% of AM adopters used the technology for end-use mechanical parts, and 27% for end-use consumer goods. While calls for 'reshoring' and 'supplier diversification' are nothing new, the pandemic, as well as certain geopolitical developments, have highlighted the fragility of (conventional) global supply and value chains. Thanks to its increasing adoption rate and technical maturity, AM could aid the transition to more resilient supply and value chains[302].

4

The Road Ahead

With these insights in recent developments, the future actually looks rather intriguing. Sure, it still requires a certain 'glass-half-full' kind of outlook, but despite the otherwise worrisome times, there certainly have been some interesting and promising developments as well. The accelerated technological advancements surely was a welcome side effect, as well as their increased level of adoption. However the technological advancements alone, do not show us what to expect for the post-pandemic world in a broader economic and social context, nor why it would be something to be optimistic about.

In this final chapter, we will look at the years ahead of us and the marks the pandemic has left on our future. More specifically, the lasting impact on how we work and live, and what this means to our commitments to more sustainable societies and economies.



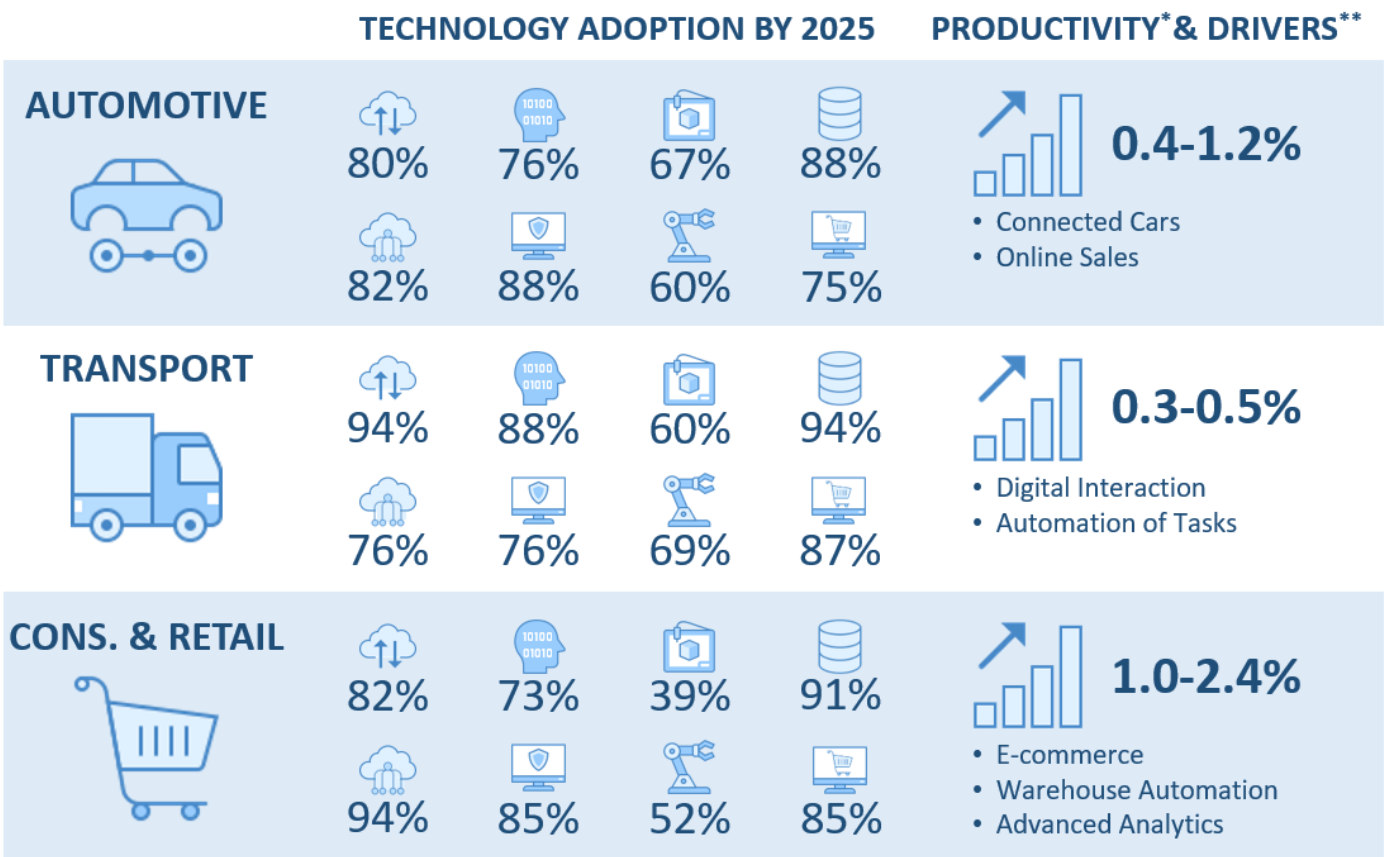
The Years to Come: Technology Adoption

Roughly a year later, the enormous boost the pandemic brought to the adoption of new and/or digital technologies is clear. However what to expect next? Surely, the long term effect of this massive disruption will reach beyond a simple leap forward in our use and implementation of technologies alone. As mentioned earlier, the switch to (digital) technologies was a necessary one, but it also served as an eye opener to C-level decision makers of the potential benefits and ROI of said solutions[189, 190, 193]. One effect this appears to have, is the intention to increase future investments in technological solutions as is shown by a McKinsey survey among North American and European businesses. This survey showed that 75% of respondents expect to invest more in new technologies in the years up to 2024[303], opposed to the 55% of an earlier survey from before 2019[304]. This expectation corresponds with the expectation of technological adaption over the coming years, concluded from the WEF survey mentioned before. The WEF survey shows that the 2020 expectation for the level of adoption by the year 2025 are significantly higher than compared to the expectations from 2018[190]. For example, the number of respondents expecting to adopt cyber security solutions by 2025 grew with 29% from 2018 to 2020. Less drastic, but still significant, the expected adoption of cloud computing increased 17%, and robotics and 3D printing both 10%[190]. In fact, all of the emerging technologies covered in the previous chapter are predicted to see a larger level of adoption by 2025 than was previously the expected. Of course the adoption level will vary from industry to industry. According to the WEF survey, the sectors for 'Digital

75%

of executives foresee higher investments in technologies in the years up to 2024

McKinsey[290]



** that can be attributed to the pandemic (CAGR 2019-2024)*
*** driving factors in the 'technology' domain*

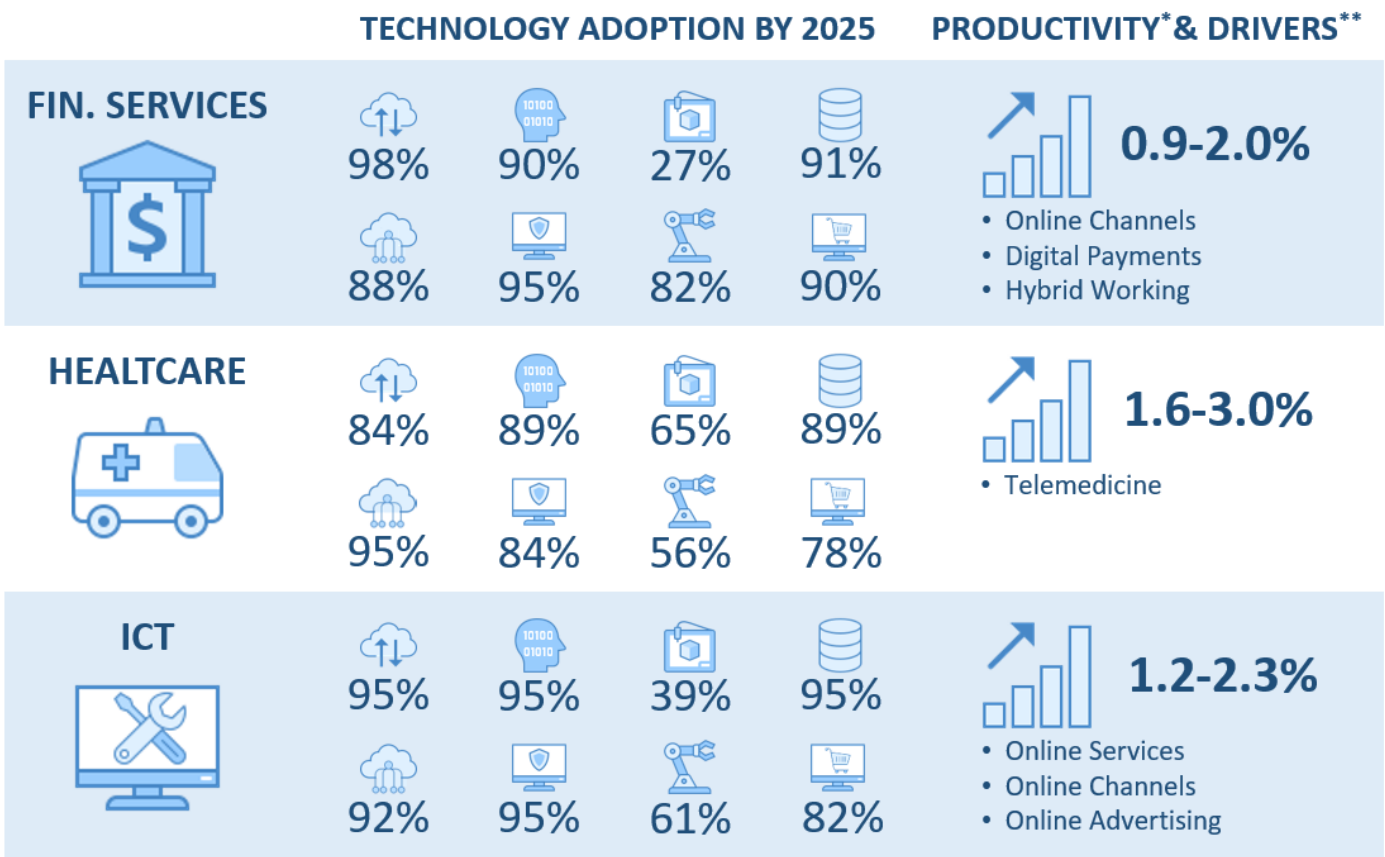
Sources: WEF & McKinsey

Communication and Information Technology' and 'Financial Services' in particular, will see high adoption levels of technologies like AI, big data, cloud computing, cyber security and IoT[190]. Some technologies are projected to find a wide level of adoption across all major industries. Big data analytics for example, ranges from 76% at its lowest, to 95% at its highest across industries[190]. Similarly, cloud computing ranges from 75% to 98% and AI from 62% to 95%.

E-commerce, previously covered in a separate subchapter, is also expected to see a high degree of adoption across industries. The number of respondents from the selected industries planning to make more use of E-commerce in the years up to 2024 ranges between 75% and 90%, suggesting this could be the most far-reaching development within the digital transition over the coming years. At the very least, it will have a significant impact on our economies.

This means that the accelerated adoption and increased investments observed during the pandemic will likely continue over the next few years. Considering the impact this development has already had on efficiency, it would make sense to expect a change in output. In fact, a McKinsey study, covering eight industries, shows a possible 1% growth in annual labour productivity every year till 2024[304]. This would be, hypothetically, double that of what was achieved after the 2008 financial crisis[305]. Of course it does require a stable demand, but as will be covered later on in this chapter, this will most likely not be an issue. This potential is in fact, largely attributed to the efficiency gains resulting from

> **Industries could experience a potential 0.7-1.5% additional annual productivity growth a year until 2024**
>
> *McKinsey*[290]



** that can be attributed to the pandemic (CAGR 2019-2024)*
*** driving factors in the 'technology' domain*

Sources: WEF & McKinsey

rethinking product/business/and operating models in response to the pandemic. As shown earlier, it was the adoption of technological solutions that made these efficiency gains possible. Of course the potential productivity gains do vary between industries, however each of the included industries showed a potential for growth. The strongest growth is expected in the sector of healthcare, ranging from 1.6-3.0% a year. One of the main drivers mentioned for this potential is the adoption of telemedicine, as well as overall operational efficiency gains. The ICT sector is also expected to see productivity gains, ranging from 1.2-2.3% a year. For this sector the main drivers named are all related to the switch to online services and channels. The consumer market (incl. retail) is predicted see increased productivity driven by e-commerce, automation and advanced analytics. Potentially resulting in 1.0-2.4% of additional productivity growth a year. Looking at the driving factors, it seems likely that the technology adoption and investments made during the pandemic, will have a significant and positive long term impact.

The Years to Come: Work, Life, and Work-life

Of course, the accelerated technological adoption was both the response, as well as the means to the drastic changes in the workplace. The most disrupting of measures, working remotely, is also the one raising the most questions regarding the future of the workplace. In many cases, management is eager to bring people back to the office, resulting in mixed reactions from their employees[306, 307, 308]. While some of this resistance is still COVID related, a large part of people have in fact come to prefer working from home over working in the office[307]. Considering how effective remote work has proven itself to be and the substantial investments already made to facilitate it (not to mention investments and adjustments by employees themselves), it is very likely WFH to become one of the lasting changes to our (work) lives. In fact, 'home nesting', the idea of investing in one's living space to accommodate activities otherwise done outside (like work or exercise) became really popular during the pandemic. Now having gotten accustomed to being able doing everything from the comfort of one's home could have made some people to reconsider how and where they want to spend their time from now on.

24%

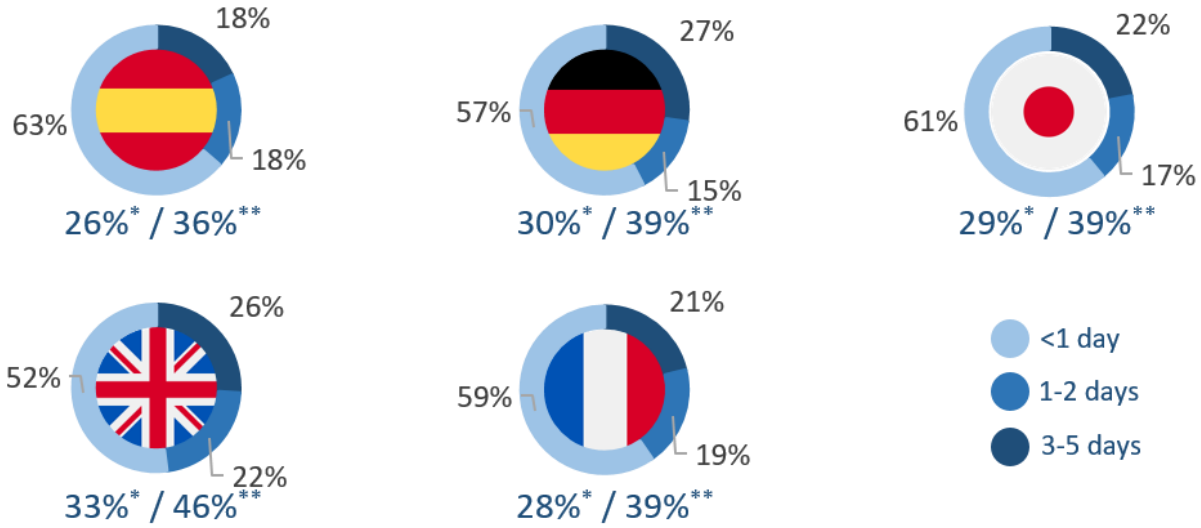
of CEOs says their business has changed forever

KPMG[296]

According to a recent KPMG survey among global executives, one quarter says that their business has "changed forever"[309]. This, somewhat, corresponds to the 30% saying they will have the majority of employees working partially from home in the future.

Of course, not every type of work allows for remote work, and so the level of WFH implemented over the coming years will differ wildly between industries and economies. Subsequently, the expected effects of this development will vary just as well. Just to give an example of the differences between various economies, the McKinsey study referred to earlier noted that in the advanced economies, the potential share of workers that would be able to telework for 3-5 days a week is between 20% and 25%[197]. In the less developed economies however, in this case China and India, that potential was only 11% and 5% respectively[197]. Estimates on this subject by the WEF suggest that the percentage of jobs that can be performed remotely in high-income economies is 38%, 25% in upper-middle income economies, 17% in lower-middle economies, and 13% in low-income

Percentage of Workforce with Potential for Working Remotely



* Effective potential of time spent working remotely
** Theoretical maximum

Source: McKinsey

economies[190]. However when accounting for disparities in internet access, the divergence grows significantly. In this case the number of jobs would be 33.6% in high income economies, 17.8% in upper -middle income economies, 10% lower-middle income economies, and 5% in low income economies. This means, that in well developed, high income economies like Europe and Japan, more than a third of workers would be able to perform their activities remotely[190]. Another McKinsey report shows that in Japan and large European economies (i.e.: the UK, Germany, France and Spain), the share in time that workers could potentially do remotely without any loss in productivity varies between 26-33%[310]. The theoretical maximum in these countries is estimated to lie between 36-46%. Subsequently, the sectors that have the highest potential for remote work are Finance & Insurance (76% of effective potential), Management (68%), Professional/Scientific/ Technical Services (62), and IT (58%)[310].

All considered, a more general adaption of (at least some hybrid form of) remote work seems very likely, especially in the more advanced economies like Japan and the EU. However, this change will likely coincide with a shift in the job market as well. For one, the growing adoption of (and reliance on) advanced technological solutions is bound to cause an increasing demand for specialists. The WEF survey mentioned before, also asked executives about the jobs that they identified as being in 'high demand'. Looking at the results for the same European countries plus Japan as before, we see that the top five for each of them solely mention jobs related to emerging technologies like data analysis and AI[190]. 'Data Analysts' and 'Data

Post-Pandemic Job Market

Top 5 Emerging Job Roles
1. IoT Specialists
2. Data Analysts & Scientists
3. Big Data Specialists
4. AI & ML Specialists
5. Digital Transformation Specialist

Employment Change 2018 -2030*
STEM Professionals: **0.9%**
Transport Services: **0.3%**

Top 5 Emerging Job Roles
1. Data Analysts & Scientists
2. AI & ML Specialists
3. Big Data Specialists
4. IoT Specialists
5. Software & App Developers

Employment Change 2018 -2030*
STEM Professionals: **1.0%**
Transport Services: **0.3%**

Top 5 Emerging Job Roles
1. Data Analysts & Scientists
2. AI & ML Specialists
3. Digital Transformation Specialist
4. Big Data Specialists
5. IoT Specialists

Employment Change 2018 -2030*
STEM Professionals: **1.2%**
Transport Services: **0.6%**

Top 5 Emerging Job Roles
1. Data Analysts & Scientists
2. AI & ML Specialists
3. IoT Specialists
4. Dig. Marketing & Strategy Specialist
5. Software & App Developers

Employment Change 2018 -2030*
STEM Professionals: **1.0%**
Transport Services: **0.1%**

Top 5 Emerging Job Roles
1. Data Analysts & Scientists
2. AI & ML Specialists
3. Big Data Specialists
4. IoT Specialists
5. Digital Transformation Specialist

Employment Change 2018 -2030*
STEM Professionals: **1.0%**
Transport Services: **0.1%**

* Estimated change (%) in share of total employment from 2018 to 2030

Sources: WEF & McKinsey

Scientists' in particular, are in very high demand, as are AI and 'Machine Learning Specialists'. However the fact that for three of these countries a 'Digital Transformation Specialist' is mentioned in the top five, is very clear indicator that the digitalisation process is still very much in progress.

Predictions in the 'Future of Jobs' report by the WEF corroborate this development as well, by predicting a shift in the labour force over the years up to 2030. Looking at the same four European countries plus Japan, each of these economies shows a clear increase in demand for STEM professionals as a share of the total workforce[311]. This difference (around 1%) is mostly attributed to the digitalisation and automation that took place during the pandemic. Another interesting development is the increasing demand for workers in the Transport Services sector, which, as is suggested, is mostly linked to the growing E-commerce market. When comparing the post-pandemic predictions to the pre-pandemic predictions, there definitely is a (positive) change in the demand for STEM professionals. However, the biggest overall difference is the one in the Transport Service sector, where the pre-pandemic demand was in fact expected to fall with 2-12% rather than increase[311]. Again, this development is most likely to be the result of the rapid growth of E-commerce during the pandemic. A trend that apparently, is expected to carry on over the coming years.

The Years to Come: E-commerce and Consumer Behaviour

The previous chapter emphasised, once more, the pivotal role of E-commerce in the digitalisation process. It is important to note however, that for the purpose of this report, coverage on the developments around 'E-commerce' constitutes the general shift of services to online channels. This, because the collective shift to online channels is expected to have broad, and lasting affect on consumer behaviour.

A global McKinsey survey mentioned earlier showed that more than half of their (consumer) respondents expected to continue shopping online after the pandemic[212]. A more recent survey however, conducted among consumers from (amongst others) Europe and Japan, gives a more detailed insight in what online services/activities are likely to remain in the coming years. The delivery of groceries for example, is one of the services that became much more popular during the pandemic, and is expected to be continued to be used after the pandemic by more than 55% of respondents[311]. The expectations for restaurant deliveries after the pandemic are slightly lower (although still over 50%), which is to be expected as the physical experience of eating in a restaurant cannot be compared to eating at home. A particularly interesting find from the survey, is that not only over 40% of respondents tried using a new restaurant or store app during the pandemic, but more than 60% of respondents expect to keep using such application post-pandemic. Similarly interesting, is the fact that more than 60% of respondents expects to keep using social media for their purchases. These are very clear signs that, both buyers and seller, are ready and willing to fully adopt digital channels for their Business. As such, it's a good indication for what to expect the coming years.

Other interesting insights are those related to the earlier mentioned trend of 'home nesting', as it seems that global consumer have come accustomed to using certain services from the comfort of their own home. For example, telemedicine grew with more than 110% during the pandemic and,

Number of People Expecting to Remain Using Online Services After the Pandemic*

Telemedicine
>45%

E-learning
>50%/>55% (Kids/Adults)

Restaurant Delivery
>50%

Grocery Delivery
>55%

Buying from Social Media
>60%

Mobile Restaurant/Store Apps
>60%

Online Fitness
>60%

Streaming Services
>65%

*Among respondents from 8 large economies

Sources: WEF & McKinsey

according to the survey, almost half of respondents seems to expect (at least in part) doing so after the pandemic subsides[311]. Similarly, remote learning services saw a drastic spike in users during the pandemic, in particular for children (>110%).

Projections for Q4 2022

	Consumer[A]	GDP Per Capita
	Spending: 105% Confidence: +2pt	Projection[B]: 102% Recovery[C]: Q4 '22
	Spending: 105% Confidence: +6pt	Projection[B]: 103.1% Recovery[C]: Q1 '22
	Spending: 101% Confidence: -5pt	Projection[B]: 100.6% Recovery[C]: Q3 '22
	Spending: 104% Confidence: +8pt	Projection[B]: 101.6% Recovery[C]: Q4 '21
	Spending: 109% Confidence: +3pt	Projection[B]: 100.7% Recovery[C]: Q3 '23
	Spending: 108% Confidence: +11pt	Projection[B]: 102.7% Recovery[C]: Q3 '22

A. Comparing the projections for Q4 2022, to the situation for Q1 2021
B. Q4 2019 = 100
C. Estimated recovery till pre-pandemic level

Sources: OECD & TRADING ECONOMICS

However, many respondents are apparently open to the idea of these services remaining to be offered online (>50% for children and >55% for adults). Online fitness is another service that saw its use grow with >50% during the pandemic, but now more than 60% of respondents say they expect to keep using online fitness services in the future. Of course, the willingness to, or expectation of using these online services after the pandemic (and all related worries) is over, doesn't necessarily mean it being at the expense of these services being provided in person. Although at the very least, it indicates that perhaps more of the services that were traditionally offered in person and at dedicated locations, can just as well (if not better) be provided through online channels.

While these findings are definitely interesting, actual consumer behaviour in the coming years will, of course, largely depend on the economical situation. The pandemic was an unusually harsh disruption of economic activities, causing many hurdles and uncertainties. However with vaccination programs in full progress all over the world, we can carefully look ahead to an economic recovery, and perhaps even a modest growth.

In fact, the OECD, recently made drastic upward revisions to its projections for this year's global economic growth. Earlier projections, made late 2020, showed a 4.2% growth for 2021[313]. While still being lower than what was projected before the pandemic started, current expectations for 5.8% growth are still significantly more positive. This revision is largely attributed to the vaccine rollouts and fiscal stimulus packages in most of the advanced economies. As such, similar revisions were made for most of the European economies, as well as Japan. Just as an example, the projections for Germany were changed from 1.6% to 3.2%, and for Japan they went from 0.2% to 1.6%[313]. The speed as to which developed economies recover to a pre-pandemic level however, do vary a bit from country to country. Germany's GDP per capita for example is expected to return to the level it was at

the end of 2019 by the first quarter of 2022, while Spain is expected to do so by the third quarter of 2023. Japan's recovery is expected to be particularly quick, as it is estimated to reach a pre-pandemic level by the end of 2021.

Of course, these economic expectations are one thing, but what is important is that they (according to 'Trading Economic') are largely in line with the expectations for consumers. More specifically, consumer spending and confidence. Comparing the projections for the second quarter of 2022 to the first of 2021, we see a clear improvement for European countries as well as Japan. For the EU as a whole, consumer spending in this period would increase with 3%[314]. Projections do of course vary somewhat between the individual countries. Spain and the UK are expected to see 9% and 8% for example, while for Germany and France if would be 5%[314]. Consumer spending in Japan in this period is expected to grow 4%. As for consumer confidence, the projections vary even more. Looking again at the same period, the overall consumer confidence in the EU stays more or less the same[315]. In Germany and the UK however, consumer confidence is expected to increase with six and eleven points respectively, while in Italy on the other hand, it is expected to drop with five points[315]. The consumer confidence in Japan could make a strong recovery as well, as it is expected to gain eight points by the second quarter of 2022.

So as it looks for now, we can expect some economic recovery over the coming months, and with that, a recovery of consumer activity. This later however, as was pointed out earlier, could look quite a bit different than it did before the pandemic. But a change in consumer behaviour does not necessarily have to be a bad thing, in fact, it could even turn out to have some benefits.

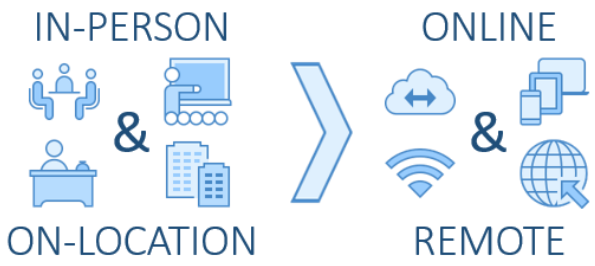
5

The Epilogue

If anything, the main take-away from the previous chapters is how incredibly far reaching the pandemic's effects has been, going way beyond the (already quite severe) health crisis. The impact is, so we have seen, noticeable in practically every aspect of our economy, in some cases leading to drastic, and possibly lasting changes. Having looked into the past, present, and future, we now arrive at the part where gather the findings and decide what this means moving forward. Businesses, be they large or small, can take the suggestion in this chapter as inspiration for their future endeavors.

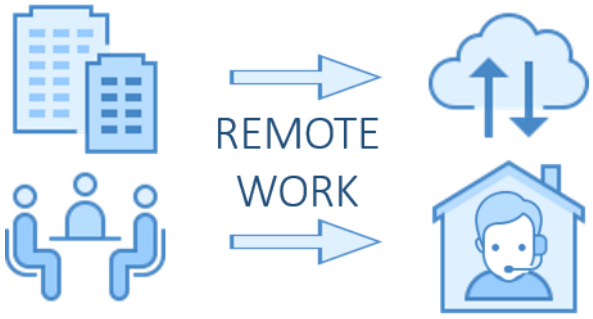
Key Findings & Conclusions

Looking back at the many ways the pandemic has affected our lives, economies and industries, it feels more reasonable to state this period will enter the history books as one of modern history's main pivotal moments. After all, in the addition to its momentous impact so far, the pandemic will leave the world (whenever this may be) in a far different state than when it entered it. The lasting changes, or changes that are likely to be lasting, can be found in various aspects of our societies. For the purpose of this report, we of course focus on the economic/ business side of the matter, including how to account for these insights in strategic planning.



Coming to the point directly, the overarching theme among findings covered in this report is the accelerated transition from physical to digital. While this development has, of course, been in progress since long before the pandemic came around, the pandemic turned it into a means of survival. In other words, the pandemic made the digitalisation process a revolution, rather than the evolution it was before. The 'digitalisation process' in this sense however, does include the overall adoption of emerging technologies such as those covered in earlier chapters. The pandemic forced the transition to the digital domain, and along the way, removed (or reduced) obstacles and biases that were hampering the adoption of new technologies before. Now the steps have been made (notably, the investments and implementations) and we have become accustomed to their benefits, there is, in many cases, little reason to return to pre-pandemic practices. As the earlier chapters have pointed out, the adoption (as well as the benefits) were not equal among economies or industries. However, those business for whom the investments are still not justifiable, thanks to the pandemic they can look forward to the trickle-down-effect bringing (previously) unobtainable solutions within reach much sooner.

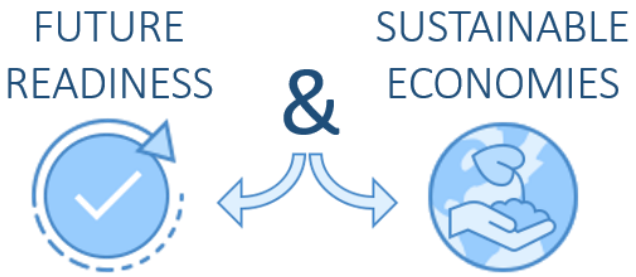
What this has meant so far, and what it will to a greater extent in the near future, is that a large share of the interactions, activities, and services that used to be 'on location' or 'in person', now will take place online. Most notably of course, is the rise of E-commerce (used here in the broadest sense of the concept). The number of services offered online, and the frequency to which we use them is expected to keep increasing after the pandemic, resulting in drastic changes in how we do business. Of course, some services and interactions will, for a large part, return back to the old situation. Education and restaurant visits are the most obvious examples services for which the online solutions were mostly a temporary necessity that can (for now) not realistically replace the 'in person'



and 'on location' offerings. However overall, it cannot be denied that the move to online is happening, and happening fast.

In a similar way, it appears that work activities will increasingly shift to online (and cloud), partially to

facilitate for a larger part of our activities to be carried out from home. Depending on the type of work, remote working seems to be one of the changes (particularly in developed economies like in Europe and Japan) that will have a far larger place in the post-pandemic world than it had in the pre-pandemic one. This, due to the many benefits it offers both employee and employer. Subsequently, it will also be one of the most substantial societal and economic changes brought about by the pandemic.



This brings us to the following. It is certain that the pandemic will leave behind its imprints on the world, one of which in the form of a drastically accelerated digitalisation and adoption of new technologies. This will, arguably, be looked back at as one of the pandemic's very few favourable by-products, as it sped up a process critical for creating a more sustainable future. After all, the reason governments and businesses alike, are committed to digitalisation is that is an essential step for achieving 'future readiness' in terms of efficiency, adaptiveness, and resilience (and thus, competitiveness). But in addition, it certainly is a very important process for realising our collective sustainability and environmental ambitions, provided it is inclusive in nature.

Recommendations & Suggestions

With the summation of the findings, we proceed with what this, in more concrete terms, means for those looking to prepare for the coming years in (hopefully) a post-pandemic world. These suggestions and recommendations are meant to be non-industry, country, or business specific, and will therefore apply to the majority of situations. Of course, due to the target audience of this report, the recommendation are most relevant to developed economies, like those of Europe and Japan.

Do Not Fall Behind in the Digitalisation Process

The first take-away, and urgent recommendation, is to not make the mistake of underestimating the speed as to which the digitalisation process is taking place. Also, one should not underestimate the potential risk of falling behind in this transition, as it will become more and more difficult to catch up. Therefore, make sure to (continually) educate one's self on the technological developments in ones industry (and adoption by customers/partners/employees), and prepare to quickly adapt whenever necessary. We have come to a point where it could be considered the norm, to have thoroughly incorporate 'digital' into one's business strategy. In addition, the pandemic has (if anything) illustrated the importance of a 'Business Continuity Strategy', which of course should incorporate digital solutions.

Take the Opportunity to Assess and Adjust

Current chaotic times are also one that create the opportunity for some self-reflection and rethinking of the way we operate. The crisis following the pandemic has for many been a harsh confrontation with reality, as it highlighted all their weaknesses and shortcomings. Therefore, taking what we have learned over this period and making use of the latest insights, could help with establishing a more effective and 'future proof' strategy. As for digitalisation, the rapid developments we currently see, can be a great opportunity for testing and trying new things for one's business. In fact, depending on the industry, this could be the perfect (if not only) moment for making some drastic changes, and completely change course to better fit the market of tomorrow.

Make use of the Transition to 'Online' & 'Remote'

In the same way (depending on the situation), do not let the opportunity to be an early adapter in this momentous move to E-commerce, online services, and remote solutions go by. Again, do not underestimate the current speed of this development, nor the strategic benefits of being a forerunner in this movement. The transition gives businesses the opportunity to revamp their operations, update or expand their services, and create new ways of interacting with their stakeholders. As such, it could give a great competitive advantage to those making good use of this opportunity over those that don't.

Do Not Give up on Sustainability Goals & Efforts

With all the uncertainties at the moment, it might seem that the climate and environmental issues are less of a priority, and related efforts should therefore be put on hold. However, not only is the current opportunity for reshaping one's business and strategy, it is just as much an opportunity to asses one's sustainability and environmental plans. In fact, one of the benefits of digitalisation are the possibilities it offers to make business operations more sustainable. Besides, considering the unhampered determination shown by world and business leaders to maintain their climate and sustainability targets, it suggests that partaking in these efforts will be the norm in the 'new normal'. Failing to conform to expectations could therefore become a threat.

The closing words and final advise, is to look towards the coming years, knowing the post-pandemic world is on its way, and with it, many

References:

1) FluTrackers.com, via RTHK.hk *"Mainland reports suspected SARS outbreak"** 30/12/2019, MH Sub I, LLC dba vBulletin (*original source deleted) https://flutrackers.com/forum/forum/-2019-ncov-new-coronavirus/china-2019-ncov/821830-china-original-2019-ncov-news-thread-weeks-1-4-december-30-2019-january-25-2020

2) Reuters, *"Chinese officials investigate cause of pneumonia outbreak in Wuhan"* 31/12/2019, Thomson Reuters (Reuters Staff) https://www.reuters.com/article/us-china-health-pneumonia-idUSKBN1YZ0GP

3) The Wall Street Journal, *"New Virus Discovered by Chinese Scientists Investigating Pneumonia Outbreak"* 08/01/2020, Dow Jones (N. Khan) https://www.wsj.com/articles/new-virus-discovered-by-chinese-scientists-investigating-pneumonia-outbreak-11578485668

4) AP News, "*South Korea reports 1st possible case of viral pneumonia*" 08/01/2020, The Associated Press (*NM*) https://apnews.com/article/30c5bf016c52748eebc6371fe3b17321

5) WHO.int "*WHO Statement regarding cluster of pneumonia cases in Wuhan, China*" 09/01/2020, World Health Organisation (*NM*) https://www.who.int/china/news/detail/09-01-2020-who-statement-regarding-cluster-of-pneumonia-cases-in-wuhan-china

6) Think Global Health, "*UPDATED: Timeline of the Coronavirus*" 01/07/2021, Council on Foreign Relations (C. Kantis, S. Kiernan & J. S. Bardi) https://www.thinkglobalhealth.org/article/updated-timeline-coronavirus

7) The Guardian, "*China confirms human-to-human transmission of coronavirus*" 21/01/2020, Guardian News & Media Ltd. (L. Kuo) https://www.theguardian.com/world/2020/jan/20/coronavirus-spreads-to-beijing-as-china-confirms-new-cases

8) WHO.int, "*Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV)"* 30/01/3030, World Health Organisation (*NM*) https://www.who.int/news/item/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)

9) France24, via AFP "*Iran neighbours close their borders as coronavirus toll rises*" 23/02/2020, France 24 (*NM*) https://www.france24.com/en/20200223-iran-neighbours-close-their-borders-as-coronavirus-toll-rises

10) SCMP.com, "*Coronavirus: Russia to ban Chinese citizens from entry amid outbreak fears*" 19/02/20, South China Morning Post Publishers Ltd. (*NM*) https://www.scmp.com/news/world/russia-central-asia/article/3051240/coronavirus-russia-ban-chinese-citizens-entry

11) CNN, "*February 4 coronavirus news*" 04/02/2020, CNN Worldwide (J. Yeung, S. George & A. Woodyatt) https://edition.cnn.com/asia/live-news/coronavirus-outbreak-02-04-20/index.html

12) Aljazeera, "*Iran confirms three more coronavirus cases*" 20/02/2020, Al Jazeera Media Network (A. Ibrahim) https://www.aljazeera.com/news/2020/2/20/iran-confirms-three-more-coronavirus-cases

13) The New York Times, "*To Tame Coronavirus: Mao-Style Social Control Blankets China*" 15/02/2020, The New York Times Company (R. Zhong & P. Mozur) https://www.nytimes.com/2020/02/15/business/china-coronavirus-lockdown.html

14) The Guardian, "*Italy imposes draconian rules to stop spread of coronavirus*" 23/02/2020, Guardian News & Media Ltd. (A. Giuffrida & L. Cochrane) https://www.theguardian.com/world/2020/feb/23/italy-draconian-measures-effort-halt-coronavirus-outbreak-spread

15) CNN, "*February 4 coronavirus news*" 02/03/2020, CNN Worldwide (J. Berlinger, J. Yeung, A. Renton, M. Hayes, M. Wagner & A. Vera) https://edition.cnn.com/asia/live-news/coronavirus-outbreak-03-02-20-intl-hnk/h_0b9ad2a9445609ceb3466b0c5edc5162

16) Wikipedia, "*Timeline of the COVID-19 pandemic in March 2020*" Wikimedia Foundation, Inc. (*NM*) https://en.wikipedia.org/wiki/Timeline_of_the_COVID-19_pandemic_in_March_2020#Summary

17) Arcgis.com, "*JHU CSSE COVID Dashboard*" [accessed: 20/02/2021], JHU CSSE (*NM*) https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6

18) NCLS.org, "*President Trump Declares State of Emergency for COVID-19*" 25/03/2020, National Conference of State Legislatures (*NM*) https://www.ncsl.org/ncsl-in-dc/publications-and-resources/president-trump-declares-state-of-emergency-for-covid-19.aspx

19) The Straits Times, "*Thailand declares state of emergency to curb spread*" 27/03/2020, Singapore Press Holdings Ltd. Co. (H.Techakitteranun) https://www.straitstimes.com/asia/se-asia/thailand-declares-state-of-emergency-to-curb-spread

20) Reuters, *"Mexico declares health emergency as coronavirus death toll rises"* 31/03/2020, Thomson Reuters (Reuters Staff) https://www.reuters.com/article/us-health-coronavirus-mexico/mexico-declares-health-emergency-as-coronavirus-death-toll-rises-idUSKBN21I05K

21) Reuters, *"Spain extends state of emergency until April 12 as coronavirus crisis worsens"* 26/03/2020, Thomson Reuters (Reuters Staff)

https://www.reuters.com/article/health-coronavirus-spain-emergency/spain-extends-state-of-emergency-until-april-12-as-coronavirus-crisis-worsens-idUSL8N2BI9OF

22) The Washington Post, "*South Africa enters lockdown as known covid-19 cases surpass 1,000*" 27/03/2020, Nash Holdings (M. Bearak) https://www.washingtonpost.com/world/africa/south-africa-enters-lockdown-as-known-covid-19-cases-surpass-1000/2020/03/27/d6092194-6f7d-11ea-a156-0048b62cdb51_story.html

23) Reuters, *"Nigeria orders 14-day cessation of movement in Lagos, Abuja to fight coronavirus"* 30/03/2020, Thomson Reuters (Reuters Staff) https://www.reuters.com/article/us-health-coronavirus-nigeria-buhari/nigeria-orders-14-day-cessation-of-movement-in-lagos-abuja-to-fight-coronavirus-idUSKBN21G0UA

24) The Guardian, "*UK coronavirus: Boris Johnson announces strict lockdown across country – as it happened*" 24/03/2020, Guardian News & Media Ltd. (A. Sparrow, L. Campbell & K. Rawlinson) https://www.theguardian.com/politics/live/2020/mar/23/uk-coronavirus-live-news-latest-boris-johnson-minister-condemns-people-ignoring-two-metre-distance-rule-in-parks-as-very-selfish

25) BBC, "*Coronavirus: New Zealand announces lockdown*" 23/03/2020, BBC (*NM*) https://www.bbc.com/news/av/world-52001578

26) BBC, "*Coronavirus: a third of the world's population now under lockdown*" [broadcast] 25/03/2020, BBC (*NM*) https://www.bbc.co.uk/programmes/w172wpksnxdfvk5

27) JHU.edu, "Coronavirus Resource Center" [accessed: 26/03/2021], Johns Hopkins University & Medicine (*N/A*) https://coronavirus.jhu.edu/

28) The New York Times, "*Japan Declared a Coronavirus Emergency. Is It Too Late?*" 07/04/2020, The New York Times Company (M. Rich, H. Ueno & M. Inoue) https://www.nytimes.com/2020/04/07/world/asia/japan-coronavirus-emergency.html

29) Reuters, *"Spain sees slowing coronavirus toll, holds virtual Easter parades"* 10/04/2020, Thomson Reuters (I. Landauro & G. Keeley) https://www.reuters.com/article/us-health-coronavirus-spain/spain-sees-slowing-coronavirus-toll-holds-virtual-easter-parades-idUSKCN21S0ZJ

30) Reuters, *"Austria reopens thousands of shops in first loosening of coronavirus lockdown"* 14/04/2020, Thomson Reuters (L. Niesner & F. Murphy) https://www.reuters.com/article/us-health-coronavirus-austria/austria-reopening-thousands-of-shops-in-first-loosening-of-lockdown-idUSKCN21V25G

31) MarketWatch, "*Germany to lift coronavirus closure of small shops on April 20*" 15/04/2020, MarketWatch, Inc. (*NM* https://www.marketwatch.com/story/germany-to-lift-coronavirus-closure-of-small-shops-on-april-20-2020-04-15

32) STAT News, "*Trump announces a formal freeze on WHO funding, pending an investigation*" 14/04/2020, STAT (N. Florko) https://www.statnews.com/2020/04/14/trump-announces-a-formal-freeze-on-who-funding-pending-an-investigation/

33) Statista, "*Number of cumulative cases of coronavirus (COVID-19) worldwide from January 22, 2020 to March 16, 2021, by day*" [accessed: 01/04/2021], Statista Inc. (N/A) https://www.statista.com/statistics/1103040/cumulative-coronavirus-covid19-cases-number-worldwide-by-day/

34) WFP.org, "*Coronavirus puts 14 million people at risk of missing meals in Latin America and the Caribbean*" 27/05/2020, World Food Programme (*NM*) https://www.wfp.org/stories/coronavirus-puts-14-million-people-risk-missing-meals-latin-america-and-caribbean

35) Bloomberg, "*Latin America Now Accounts for 40% of Daily Coronavirus Deaths*" 28/05/2020, Bloomberg L.P. (D. Cancel) https://www.bloomberg.com/news/articles/2020-05-28/latin-america-now-accounts-for-40-of-daily-coronavirus-deaths

36) Wikipedia, "*Responses to the COVID-19 pandemic in May 2020*" [accessed: 10/04/2020], Wikimedia Foundation, Inc. (*NM*)https://en.wikipedia.org/wiki/Responses_to_the_COVID-19_pandemic_in_May_2020

37) Reuters, *"WHO says pandemic 'far from over' as daily cases hit record high"* 09/06/2020, Thomson Reuters (S. Nebehay & E. Farge) https://www.reuters.com/article/us-health-coronavirus-who/who-says-pandemic-far-from-over-as-daily-cases-hit-record-high-idUSKBN23F23E

38) AA.com.tr, "*Philippines eases lockdown in capital Manila*" 01/06/2020, Anadolu Agency (R. Khaliq) https://www.aa.com.tr/en/asia-pacific/philippines-eases-lockdown-in-capital-manila/1860560

39) Aljazeera, "*India lifts lockdown measures despite COVID-19 surge*" 08/06/2020, Al Jazeera Media Network (E. Puranam) https://www.aljazeera.com/videos/2020/6/8/india-lifts-lockdown-measures-despite-covid-19-surge

40) BBC, "*New Zealand lifts all Covid restrictions, declaring the nation virus-free*" 08/06/2020, BBC (*NM*) https://www.bbc.com/news/world-asia-52961539

41) Reuters, *"France to reopen restaurants, bars and beaches from June 2: PM"* 29/05/2020, Thomson Reuters (Reuters Staff) https://www.reuters.com/article/us-health-coronavirus-france-restaurants/france-to-reopen-restaurants-bars-and-beaches-from-june-2-pm-idUSKBN2342TL

42) France24, "*Jordan reopens mosques for socially distanced prayers*" 03/06/2020, France 24 (*NM*) https://www.france24.com/en/20200603-italy-reopens-to-tourists-from-europe-after-economically-crippling-lockdown

43) Reuters, *"France to reopen restaurants, bars and beaches from June 2: PM"* 05/06/2020, Thomson Reuters (Reuters Staff) https://www.reuters.com/article/us-health-coronavirus-jordan-mosques/jordan-reopens-mosques-for-socially-distanced-prayers-idUSKBN23C24M

44) Expressandstrar.com, "Egypt to Reopen Tourist Destinations Less Hard Hit by Coronavus" 11/06/2020, Express & Star (*NM*)https://www.expressandstar.com/news/world-news/2020/06/11/egypt-to-reopen-to urist-destinations-less-hard-hit-by-coronavirus/

45) AP News, "President 'worried' as South Africa's virus cases rise fast" 09/06/2020, The Associated Press (*G. Imray*) https://apnews.com/article/045646190b3f3d92907596fb5d81e621

46) MEMO Middle East Monitor, "*Coronavirus cases surge in Libya after repatriations*" 10/06/2020, Ardi Associates Ltd. (*NM*) https://www.middleeastmonitor.com/20200610-coronavirus-cases-surge-in-libya-after-repatriations/

47) The Wall Street Journal, "*New Coronavirus Cases Climb in More Than a Dozen States*" 15/06/2020, Dow Jones (J. Calfas) https://www.wsj.com/articles/coronavirus-latest-news-06-15-2020-11592209998

48) Reuters, *"Beijing imposes curbs as coronavirus returns to Chinese capital"* 15/06/2020, Thomson Reuters (R. Woo & C. Qian) https://www.reuters.com/article/us-health-coronavirus-china/beijing-imposes-curbs-as-coronavirus-returns-to-chinese-capital-idUSKBN23M0A8

49) WHO, "*WHO Coronavirus (COVID-19) Dashboard*" [accessed: 20/04/2021], World Health Organisation (*NM*) https://covid19.who.int/

50) Reuters, *"Tokyo confirms more than 100 coronavirus cases on Thursday, NHK says"* 02/07/2020, Thomson Reuters (Reuters Staff) https://www.reuters.com/article/health-coronavirus-japan/tokyo-confirms-more-than-100-coronavirus-cases-on-thursday-nhk-says-idUST9N2DL00F

51) BBC, "*Coronavirus Australia: Melbourne locks down tower blocks as cases rise*" 04/07/2020, BBC (*NM*)https://www.bbc.com/news/world-australia-53289616

52) The New York Times, "*U.S. Hits Another Record for Coronavirus Cases*" 09/07/2020, The New York Times Company (*NM*) https://www.nytimes.com/2020/07/09/world/coronavirus-updates.html

53) Reuters, *"Uzbekistan to introduce second lockdown from July 10"* 08/07/2020, Thomson Reuters (Reuters Staff) https://www.reuters.com/article/us-health-coronavirus-uzbekistan-lockdow/uzbekistan-to-introduce-second-lockdown-from-july-10-idUSKBN2491HL

54) Aljazeera, "*Iran reports highest one-day COVID-19 death toll since outbreak*" 08/07/2020, Al Jazeera Media Network (*NM*) https://www.aljazeera.com/videos/2020/7/8/iran-reports-highest-one-day-covid-19-death-toll-since-outbreak

55) CNN, "*Coronavirus cases soar by more than 1 million over 5 days*" 14/07/2020, CNN Worldwide (E. Reynolds & H. Pettersson) https://edition.cnn.com/2020/07/14/world/million-coronavirus-cases-five-days-intl/index.html

56) WHO, "*Coronavirus disease (COVID-19) Situation Report – 179*" 17/07/2020, World Health Organisation (*N/A*) https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200717-covid-19-sitrep-179.pdf?sfvrsn=2f1599fa_2

57) WHO, "*Coronavirus disease (COVID-19) Situation Report – 180*" 17/07/2020, World Health Organisation (*N/A*) https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200718-covid-19-sitrep-180.pdf?sfvrsn=39b31718_2

58) Reuters, *"COVID-19 cases hit 5.9 million in Americas, half in Latin America, Caribbean: WHO"* 08/07/2020, Thomson Reuters (Reuters Staff) https://www.reuters.com/article/us-health-coronavirus-latam/covid-19-cases-hit-5-9-million-in-americas-half-in-latin-america-caribbean-who-idUSKBN24829O

59) CNBC, "*WHO says U.S. and Brazil accounted for half of new daily coronavirus cases: 'Too many countries are headed in the wrong direction'*" 13/07/2020, CNBC LLC. (B. Lovelace Jr.) https://www.cnbc.com/2020/07/13/who-says-us-and-brazil-accounted-for-half-of-new-daily-coronavirus-cases.html

60) Reuters, *"Mexico surpasses Italy to post world's fourth-highest coronavirus death toll"* 13/07/2020, Thomson Reuters (D. Jorgic) https://www.reuters.com/article/us-health-coronavirus-mexico/mexico-surpasses-italy-to-post-worlds-fourth-highest-coronavirus-death-toll-idUSKCN24D0NP

61) Reuters, *"Africa urged to test more as coronavirus cases exceed 500,000"* 09/07/2020, Thomson Reuters (O. Bulutsa) https://www.reuters.com/article/us-health-coronavirus-africa/africa-urged-to-test-more-as-coronavirus-cases-exceed-500000-idUSKBN24A156

62) AFDB.org, "*Post COVID-19: Africa's growth stands to rebound to 3% in 2021, African Development Bank says in African Economic Outlook 2020 Supplement*" 07/07/2020, African Development Bank Group (*NM*) https://www.afdb.org/en/news-and-events/press-releases/post-covid-19-africas-growth-stands-rebound-3-2021-african-development-bank-says-african-economic-outlook-2020-supplement

-36768

63) EWN.co.za, "*AFRICA'S CONFIRMED COVID-19 CASES EXCEED 750,000 - REUTERS TALLY*" 22/07/2020, Eyewitness News (*NM*) https://ewn.co.za/2020/07/22/africa-s-confirmed-covid-19-cases-exceed-750-000-reuters-tally

64) BBC, "*Coronavirus: Mexico's death toll becomes world's third highest*" 01/08/2020, BBC (*NM*) https://www.bbc.com/news/world-latin-america-53618808

65) Reuters, *"Colombia passes half a million coronavirus cases as deaths approach 16,000"* 20/08/2020, Thomson Reuters (Reuters Staff) https://www.reuters.com/article/us-health-coronavirus-colombia/colombia-passes-half-a-million-coronavirus-cases-as-deaths-approach-16000-idUSKCN25F2UN

66) Reuters, *"Brazil reports nearly 50,000 new coronavirus cases, deaths top 111,000"* 20/08/2020, Thomson Reuters (Reuters Staff) https://www.reuters.com/article/health-coronavirus-brazil/brazil-reports-nearly-50000-new-coronavirus-cases-deaths-top-111000-idUSS0N2F2027

67) Kyodonews.net, "*Philippine cases of COVID-19 top 100,000*" 02/08/2020, Kyodo News, (*NM*) https://english.kyodonews.net/news/2020/08/804c756fe1f4-philippine-cases-of-covid-19-top-100000.html

68) The New York Times, "*AP*" 01/08/2020, The New York Times Company (*NM*) https://www.nytimes.com/aponline/2020/08/01/business/ap-virus-outbreak-the-latest.html

69) AAP, "*S.Korea records rise in COVID-19 cases*" 24/08/2020, Australian Associated Press (C. Kim) https://www.aap.com.au/s-korea-records-rise-in-covid-19-cases/

70) France24, "*France records more than 6,000 new Covid-19 cases, highest figure since March*" 27/08/2020, France 24 (*NM*) https://www.france24.com/en/20200827-france-records-more-than-6-000-new-covid-19-cases-highest-figure-since-april

71) The Guardian, "*Italy sees 1,000 new cases for first time since May – as it happened*" 24/08/2020, Guardian News & Media Ltd. (J. Otte, M. Weaver, M. Boseley & J. Taylor) https://www.theguardian.com/world/live/2020/aug/22/coronavirus-live-news-global-deaths-near-800000-australian-state-of-queensland-brings-in-new-restrictions

72) UPI, "*COVID-19: Germany reports largest daily spike in cases since April*" 22/08/2020, United Press International Inc. (S. Brokaw) https://www.upi.com/Top_News/World-News/2020/08/22/COVID-19-Germany-reports-largest-daily-spike-in-cases-since-April/8221598106125/

73) Financial Times, "*Coronavirus: Spain reports highest level of new Covid-19 deaths since May —as it happened*" THE FINANCIAL TIMES LTD (*NM*) https://www.ft.com/content/f638c7f3-dabb-3b62-87f3-695f4c23d632

74) Reuters, *"Coronavirus cases in Latin America pass 7 million: Reuters tally"* 28/08/2020, Thomson Reuters (D. Desantis) https://www.reuters.com/article/us-health-coronavirus-latam-idUSKBN25N368

75) CNN, "*August 13 coronavirus news*" 13/08/2020, CNN Worldwide (J. Hollingsworth, A. Renton, Me. Macaya, E. Upright & Z. Rahim) https://edition.cnn.com/world/live-news/coronavirus-pandemic-08-13-20-intl/

76) Nature.com, "*Russia's fast-track coronavirus vaccine draws outrage over safety*" 11/08/2020, Springer Nature Limited (E. Callaway) https://www.nature.com/articles/d41586-020-02386-2

77) TASS, "*Russia begins production of COVID-19 vaccine*" 15/08/2020, ITAR-TASS News Agency (*NM*) https://tass.com/society/1189989

78) BBC, "*Coronavirus: Global Covid-19 death toll passes one million*" 29/09/2020, BBC (*NM*) https://www.bbc.com/news/world-54334496

79) WHO, "*WHO Coronavirus (COVID-19) Dashboard*" [accessed: 27/05/2021], World Health Organisation (*NM*) https://covid19.who.int/

80) Reuters, *"COVID-19 cases in Europe back to March level, EU health body says"* 02/09/2020, Thomson Reuters (Reuters Staff) https://www.reuters.com/article/uk-health-coronavirus-eu-ecdc-idUKKBN25T244

81) NPR.org, "*40 Million Coronavirus Cases Are Now Reported Worldwide*" 19/10/2020, NPR (B. Chappell) https://www.npr.org/sections/coronavirus-live-updates/2020/10/19/925325563/40-million-coronavirus-cases-are-now-reported-worldwide

82) The Hill, "*WHO: Europe again 'the epicenter' of coronavirus pandemic with 10 million cases*" 29/10/2020, CAPITOL HILL PUBLISHING CORP. (C. Jenkins) https://thehill.com/homenews/news/523456-who-europe-again-the-epicenter-of-coronavirus-pandemic-with-10-million-cases

83) The Wall Street Journal, "*Facing Resistance, Spain Declares State of Emergency to Stem Madrid's Covid-19 Outbreak*" 09/10/2020, Dow Jones (M. Martinez) https://www.wsj.com/articles/facing-resistance-spain-declares-state-of-emergency-to-stem-madrids-covid-19-outbreak-11602263159

84) GOV.uk, "(COVID-19) Coronavirus restrictions: what you can and cannot do" 29/03/2021, [Cabinet Office] https://www.gov.uk/guidance/local-covid-alert-levels-what-you-need-to-know

85) The Washington Post, "*Italy imposes harshest coronavirus restrictions since spring lockdown as second wave sweeps Europe*" 27/10/2020, WP Company LLC (R. Mellen) https://www.washingtonpost.com/world/europe/coronavirus-europe-italy-second-wave-lockdown/2020/10/25/6c011306-16df-11eb-82db-60b15c874105_story.html

86) The Guardian, "*France imposes four-week national lockdown to combat coronavirus*" 28/10/2020, Guardian News & Media Ltd. (K. Wilsher) https://www.theguardian.com/world/2020/oct/28/france-expected-to-impose-four-week-national-lockdown-covid

87) Politico Europe, "*Belgium announces second coronavirus lockdown*" 30/10/2020, POLITICO LLC (C. Gijs) https://www.politico.eu/article/belgium-announces-second-coronavirus-lockdown/

88) Reuters, *"Global coronavirus cases exceed 50 million after 30-day spike"* 09/11/2020, Thomson Reuters (A. Maan, S. Ahluwalia, K. B.) https://www.reuters.com/article/us-health-coronavirus-global-cases/global-coronavirus-cases-exceed-50-million-after-30-day-spike-idUSKBN27O0IM

89) Nature.com, "*COVID vaccine excitement builds as Moderna reports third positive result*" 16/11/2020, Springer Nature Limited (E. Callaway) https://www.nature.com/articles/d41586-020-03248-7

90) Pfizer.com, "PFIZER AND BIONTECH CONCLUDE PHASE 3 STUDY OF COVID-19 VACCINE CANDIDATE, MEETING ALL PRIMARY EFFICACY ENDPOINTS" 18/11/2020, Pfizer Inc. (*NM*) https://www.pfizer.com/news/press-release/press-release-detail/pfizer-and-biontech-conclude-phase-3-study-covid-19-vaccine

91) Nature.com, "*The UK has approved a COVID vaccine — here's what scientists now want to know*" 03/12/2020, Springer Nature Limited (H. Ledford, D. Cyranoski & R. Van Noorden) https://www.nature.com/articles/d41586-020-03441-8

92) Aljazeera, "*Sao Paolo sets first date in Latin America to start vaccinations*" 07/12/2020, Al Jazeera Media Network [from Bloomberg] (J. Leite & A. Romani) https://www.aljazeera.com/economy/2020/12/7/bbsao-paolo-sets-first-date-in-latin-america-to-start-vaccination

93) The New York Times, "*Chinese Covid Vaccine Gets Key Push but Doubts Swirl*" 09/12/2020, The New York Times Company (*NM*) https://www.nytimes.com/2020/12/09/business/china-coronavirus-vaccine-united-arab-emirates.html

94) FDA.gov, "*FDA Takes Key Action in Fight Against COVID-19 By Issuing Emergency Use Authorization for First COVID-19 Vaccine*" 11/12/2020, FDA (*N/A*) https://www.fda.gov/news-events/press-announcements/fda-takes-key-action-fight-against-covid-19-issuing-emergency-use-authorization-first-covid-19

95) The New York Times, "*EU Approves Pfizer Vaccine, Setting Stage for High-Stakes Rollout* " 21/12/2020, The New York Times Company (*NM*) https://www.nytimes.com/2020/12/21/world/europe/eu-coronavirus-vaccine.html

96) The New York Times, "*Switzerland Begins Covid Vaccinations* " 23/12/2020, The New York Times Company (*NM*) https://www.nytimes.com/2020/12/23/world/switzerland-begins-covid-19-vaccinations.html

97) Reuters, *"Argentina begins COVID vaccination drive with Russia's Sputnik V"* 25/12/2020, Thomson Reuters (Reuters Staff) https://www.reuters.com/article/us-health-coronavirus-argentina-vaccine/argentina-to-launch-covid-19-vaccination-campaign-on-tuesday-idUSKBN28Y1GV

98) The New York Times, "*Mexico Begins Vaccinations Amidst virus Surge* " 24/12/2020, The New York Times Company (*NM*) https://www.nytimes.com/2020/12/24/world/americas/mexico-coronavirus-vaccine.html

99) Sciencemag.org, "*Mutant coronavirus in the United Kingdom sets off alarms, but its importance remains unclear*" 20/12/2020, AAAS (k. Kupferschmidt) https://www.sciencemag.org/news/2020/12/mutant-coronavirus-united-kingdom-sets-alarms-its-importance-remains-unclear

100) The Washington Post, "*Italy South Africa's second coronavirus wave is fueled by a new strain, teen 'rage festivals'*" 18/12/2020, WP Company LLC (M. Bearak) https://www.washingtonpost.com/world/africa/south-africa-coronavirus-second-wave/2020/12/18/d4a51aec-3ff7-11eb-b58b-1623f6267960_story.html

101) NPR.org, "*French Officials Announce 1st Confirmed Case Of New Coronavirus Variant*" 25/12/2020, NPR (R. Treisman) https://www.npr.org/2020/12/25/950351681/french-officials-announce-first-confirmed-case-of-new-coronavirus-variant

102) Euronews, "*Several EU countries detect first cases of new coronavirus variant* " 26/12/2020, Euronews / The Associated Press (*NM*) https://www.euronews.com/2020/12/26/france-detects-first-case-of-new-coronavirus-variant

103) The Washington Post, "*First case of highly infectious coronavirus variant detected in Colorado"* 29/12/2020, WP Company LLC (J. Achenbach, B. Guarino, L. H. Sun & I. Stanley-Becker) https://www.washingtonpost.com/health/coronavirus-variant-colorado-us/2020/12/29/8e6379fc-4a01-11eb-a9f4-0e668b9772ba_story.html

104) Business Insider South Africa, "*Ireland suspends visa-free travel from South Africa – and arrivals must stay in 'quarantine hotel'*" 27/01/2021, Business Insider Inc. (*NM*) https://www.businessinsider.co.za/south-african-travellers-banned-from-entering-these-countries-as-new-covid-variant-takes-hold-2020-12

105) AP News, "*More EU nations ban travel from UK, fearing virus variant*" 21/12/2020, The Associated Press (*K. Grieshaber & S. Hui*) https://apnews.com/article/europe-england-united-kingdom-coronavirus-pandemic-germany-06a35eb02ce885ae7b80b2e1851ab893

106) Forbes, "*2 Million People Worldwide Died Of Covid—U.S. Contributed Heavily To Total*" 15/01/2021, Forbes Media LLC (N. Reimann) https://www.forbes.com/sites/nicholasreimann/2021/01/15/2-million-people-worldwide-died-of-covid-us-contributed-heavily-to-total/?sh=271b7ad84f9a

107) Ourworldindata.org, "*Coronavirus (COVID-19) Cases*" [accessed: 27/04/2021], GCDL (*N/A*) https://ourworldindata.org/covid-cases?country=IND~USA~GBR~CAN~DEU~FRA

108) Ourworldindata.org, "*Coronavirus (COVID-19) Stay-at-Home Restrictions*" [accessed: 27/04/2021], GCDL (*N/A*) https://ourworldindata.org/covid-stay-home-restrictions

109) ECDC, "*Threat Assessment Brief: Pneumonia cases possibly associated with a novel coronavirus in Wuhan, China*" 09/01/2020, ECDC (*NM*) https://www.ecdc.europa.eu/en/publications-data/pneumonia-cases-possibly-associated-novel-coronavirus-wuhan-china

110) CNN, "*March 3 coronavirus news*" 02/03/2020, CNN Worldwide (J. Berlinger, J. Yeung, A. Renton, M. Hayes, M. Wagner & A. Vera) https://edition.cnn.com/asia/live-news/coronavirus-outbreak-03-02-20-intl-hnk/index.html

111) Wikipedia, "Responses to the COVID-19 pandemic in March 2020" Wikimedia Foundation, Inc. (*NM*) https://en.wikipedia.org/wiki/Responses_to_the_COVID-19_pandemic_in_March_2020#Reactions_and_measures_outside_mainland_China

112) Wikipedia, "Responses to the COVID-19 pandemic in April 2020" Wikimedia Foundation, Inc. (*NM*) https://en.wikipedia.org/wiki/Responses_to_the_COVID-19_pandemic_in_April_2020#Reactions_and_measures_in_Europe

113) Wikipedia, "Responses to the COVID-19 pandemic in May 2020" Wikimedia Foundation, Inc. (*NM*) https://en.wikipedia.org/wiki/Responses_to_the_COVID-19_pandemic_in_May_2020#Reactions_and_measures_in_Europe

114) EC.Europa.eu, "*Spring 2020 Economic Forecast: A deep and uneven recession, an uncertain recovery*" 06/05/2020, [European Commission] https://ec.europa.eu/commission/presscorner/detail/en/ip_20_799

115) Reuters (via: web.archive.org), "*Spain to extend furlough schemes by three months until Sept 30*" 25/06/2020, Thomson Reuters (B. Carreño, N. Allen & I. Landauro) https://web.archive.org/web/20200626134008/https://uk.reuters.com/article/uk-health-coronavirus-spain-furlough/spain-to-extend-furlough-schemes-by-three-months-until-sept-30-idUKKBN23W2JA

116) RTE (via: web.archive.org), "*All sport to return on 29 June, €70m in government grants to be made available*" RTÉ Sport (*NM*) https://web.archive.org/web/20200620083636/https://www.rte.ie/sport/other-sport/2020/0619/1148457-all-sport-set-to-resume-from-29-june/

117) El Pais, "Spain announces €4.25 billion plan to aid tourism industry" 18/06/2020, EL PAÍS S.L. (H. Gutierrez) https://english.elpais.com/economy_and_business/2020-06-18/spain-announces-425-billion-plan-to-aid-tourism-industry.html

118) New York Times (via: web.archive.org), "*Portugal Parliament Approves Amended Budget for Coronavirus Crisis*" 17/06/2020, The New York Times Company (*NM*) https://web.archive.org/web/20200618085147/https://www.nytimes.com/reuters/2020/06/17/world/europe/17reuters-health-coronavirus-portugal-budget.html

119) Techxplore, "*France pledges 15 bn euros for stricken aviation firms*" 09/06/2020, Tech Xplore (M. Rabechault) https://techxplore.com/news/2020-06-france-pledges-bn-euros-aviation.html

120) France24 (via: web.archive.org), "*EU nears deal on opening borders that is likely to exclude US, Russia, Brazil*" 27/06/2020, France24 (*NM*) https://web.archive.org/web/20200628085443/https://www.france24.com/en/20200627-eu-nears-deal-on-opening-borders-that-is-likely-to-exclude-us-russia-brazil

121) Thelocal.com, "UPDATE: EU agrees to reopen borders to 15 countries but excludes US from safe travel list" 29/06/2020, The Local Europe AB (*NM*) https://www.thelocal.com/20200629/eu-to-allow-visitors-from-14-safe-countries-but-not-the-us#:~:text=EU%20countries%20have%20finally%20agreed,number%20of%20Covid%2D19%20cases.

122) Consilium.Europa.eu, "*A recovery plan for Europe*" 28/06/2021, European Commission (*N/A*) https://www.consilium.europa.eu/en/policies/eu-recovery-plan/

123) Ec.Europa.eu, "*European Commission secures EU access to Remdesivir for treatment of COVID-19*" 29/06/2002, European Commission (*N/A*) https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1416

124) Reuters, *"COVID-19 cases in Europe back to March level, EU health body says"* 02/09/2020, Thomson Reuters (Reuters Staff) https://www.reuters.com/article/uk-health-coronavirus-eu-ecdc-idUKKBN25T244

125) Thinkglobalhealth.org, "*UPDATED: Timeline of the Coronavirus*" [accessed: 12/06/2021], Council on Foreign Relations (*N/A*) https://www.thinkglobalhealth.org/article/updated-timeline-coronavirus

126) BBC (via: web.archive.org), "*Covid: Spain imposes national night-time curfew to curb infections*" 26/10/2020, BBC (*NM*)https://web.archive.org/web/20201026085404/https://www.bbc.co.uk/news/world-europe-54682222

127) Expats.cz, "*State of emergency extended in the Czech Republic until November 20*" 02/11/2020, Howlings s.r.o. (ČTK)https://www.expats.cz/czech-news/article/extended-state-of-emergency-approved-by-czech-government

128) The New York Times, "*EU Approves Pfizer Vaccine, Setting Stage for High-Stakes Rollout* " 21/12/2020, The New York Times Company (*NM*) https://www.nytimes.com/2020/12/21/world/europe/eu-coronavirus-vaccine.html

129) CNN, "*January 28 coronavirus news*" 28/01/2020, CNN Worldwide (H. Regan, S. George, A. Renton, A. Woodyatt & M. Wagner) https://edition.cnn.com/asia/live-news/coronavirus-outbreak-01-28-20-intl-hnk/

130) Japan Today, "*Japan bars entry of foreign travelers from China's Hubei Province*" 01/02/2020, GPlusMedia Inc. (*NM*)https://japantoday.com/category/national/Japan-bars-entry-of-foreign-travelers-from-China%27s-Hubei-Province

131) The Asahi Shimbum, "[Japanese News]" [accessed: 20/07/2021], The Asahi Shimbun Company (*NM*) http://www.asahi.com/ajw/articles/13097027

132) NHK.or.jp (via: web.archive.org), "*Japan screening cruise ship for coronavirus*" 04/02/2020, NHK (*NM*) https://web.archive.org/web/20200204002815/https://www3.nhk.or.jp/nhkworld/en/news/20200204_03/

133) CNBC, "*Japan unveils $4 billion coronavirus package, not yet eyeing extra budget*" 10/03/2020, CNBC LLC. (*NM*) https://www.cnbc.com/2020/03/10/japan-unveils-4-billion-coronavirus-package-but-not-yet-planning-extra-budget.html

134) The New York Times, "*I.O.C. and Japan Agree to Postpone Tokyo Olympics*" 24/03/2020, The New York Times Company (*NM*) https://www.nytimes.com/2020/03/24/sports/olympics/coronavirus-summer-olympics-postponed.html

135) The New York Times, "*Japan Declared a Coronavirus Emergency. Is It Too Late?*" 07/04/2020, The New York Times Company (*NM*) https://www.nytimes.com/2020/04/07/world/asia/japan-coronavirus-emergency.html

136) Aljazeera, "*France coronavirus death toll tops 10,000: Live updates*" 07/04/2020, Al Jazeera Media Network (K. Mayberry, S. Aziz & R. Allahoum) https://www.aljazeera.com/news/2020/4/7/france-coronavirus-death-toll-tops-10000-live-updates

137) Aljazeera (via: web.archive.org), "*US could see 3,000 daily deaths as economy reopens : Live updates" 04/05/2020,* Al Jazeera Media Network (K. Mayberry, F. Najjar & R. Allahoum) https://web.archive.org/web/20200505142628/https://www.aljazeera.com/news/2020/05/confirmed-coronavirus-cases-exceed-35m-worldwide-live-updates-200503234441560.html

138) Aljazeera, "*Global coronavirus death toll exceeds 300,000: Live updates*" 14/05/2020, Al Jazeera Media Network (T. Regencia, S. Aziz & J. Stepansky) https://www.aljazeera.com/news/2020/5/14/global-coronavirus-death-toll-exceeds-300000-live-updates

139) Aljazeera (via: web.archive.org), "*Coronavirus could kill 190,000 in Africa, WHO warns: Live updates*" Al Jazeera Media Network (Z. Rasheed, M. Gadzo & J. Stepansky) https://web.archive.org/web/20200508000307/https://www.aljazeera.com/news/2020/05/brazil-minister-floats-idea-coronavirus-lockdown-live-updates-200506233629569.html

140) The New York Times (via: web.archive.org), "*Japan Lifts Coronavirus Travel Curbs*" 20/06/2020, The New York Times Company (*NM*) https://web.archive.org/web/20200620084721/https://www.nytimes.com/video/us/100000007200240/japan-coronavirus-curbs.html

141) Kyodonews.net (via: web.archive.org), "*Japan to ease travel curbs on Australia, N.Z., Thailand, Vietnam: Abe*" 19/06/2020, Kyodo News (*NM*) https://web.archive.org/web/20200619081757/https://english.kyodonews.net/news/2020/06/bc5f2c258fa5-urgent-japan-to-ease-travel-curbs-on-australia-nz-thailand-vietnam-abe.html

142) Kyodonews.net, "*Tokyo raises coronavirus alert level to highest as infections resurge*" 15/07/2020, Kyodo News (*NM*)https://english.kyodonews.net/news/2020/07/8befabada678-tokyo-reports-165-new-coronavirus-cases-below-200-for-3rd-day.html

143) Aljazeera, "*Global coronavirus deaths pass 650,000: Live updates*" 14/05/2020, Al Jazeera Media Network (T. Regencia, L. Alsaafin & R. Allahoum) https://www.aljazeera.com/news/2020/7/27/global-coronavirus-deaths-pass-650000-live-updates

144) CNA, "*Japan's Okinawa declares state of emergency as COVID-19 cases soar*" 01/08/2020, Mediacorp Pte Ltd (*NM*) https://www.channelnewsasia.com/news/asia/covid-19-japan-okinawa-declares-state-emergency-explosive-spread-12982774

145) MarketWatch, "*Japan's Abe officially resigns, clearing way for new prime minister*" 15/09/2020, MarketWatch, Inc. (*NM*)https://www.marketwatch.com/story/japans-abe-officially-resigns-clearing-way-for-new-prime-minister-2020-09-15

146) Reuters, *"Japan tops 100,000 coronavirus cases, daily infections creep up "* 29/10/2020, Thomson Reuters (Reuters Staff) https://www.reuters.com/news/picture/japan-tops-100000-coronavirus-cases-dail-idUSKBN27E2OZ

147) Voyapon.com, "*Coronavirus: Japan reopens its borders. Which travelers are concerned?" 02/04/2021, VOYAPON (T. Sakurai))* https://voyapon.com/coronavirus-japan-reopening-borders-travelers-concerned/

148) ABC.net.au, "*Tokyo on highest restrictions as Japan announces record COVID-19 cases*" 19/11/2020, ABC (*NM*) https://

www.abc.net.au/news/2020-11-19/tokyo-highest-restrictions-japan-announces-record-covid-19/12902192

149) The Japantimes, "*Japan sets daily COVID-19 record as cases top 3,000 for first time ever*" 12/12/2020, The Japantimes LTD (*NM*) https://www.japantimes.co.jp/news/2020/12/12/national/japan-record-coronavirus-tokyo/

150) the Japantimes, "*Who is affected by Japan's tightened travel controls?*" 29/12/2020, The Japantimes LTD (*NM*) https://www.japantimes.co.jp/news/2020/12/29/national/japan-travel-controls-coronavirus/

151) OECD.org, "*Flattening the COVID-19 peak: Containment and mitigation policies*" 24/03/2020, OECD (*N/A*) http://www.oecd.org/coronavirus/policy-responses/flattening-the-covid-19-peak-containment-and-mitigation-policies-e96a4226/

152) WHO, "*WHO global influenza preparedness plan*" -/04/2005, WHO (N/A) https://www.who.int/csr/resources/publications/influenza/WHO_CDS_CSR_GIP_2005_4/en/

153) The New York Times, "*Presidential Election Results: Biden Wins*" 03/11/2020, The New York Times Company (*NM*) https://www.nytimes.com/interactive/2020/11/03/us/elections/results-president.html

154) Ec.europa.eu, "*Brexit: Withdrawal Agreement to be fully operational on 1 January 2021*" 17/12/2020, European Commission (*N/A*) https://ec.europa.eu/commission/presscorner/detail/en/ip_20_2478

155) WHO, "*Timeline: WHO's COVID-19 response*" [accessed: 12/06/2021], World Health Organisation (N/A) who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline?gclid=Cj0KCQjwxJqHBhC4ARIsAChq4atyvQttd2WUG-cZ9CyqORcNmyGDVXjathFgrBLZFqp7UUWP0EtwsdYaAuzVEALw_wcB#event-115

156) BBC, "*Coronavirus variants and mutations: The science explained*" 06/01/2021, BBC (H. Briggs) https://www.bbc.com/news/science-environment-55404988

157) NOAA, "Global Climate Report - April 2021" -/04/2021, NCDC/NOAA (N/A) https://www.ncdc.noaa.gov/sotc/global/202104#:~:text=According%20to%20a%20statistical%20analysis,five%20warmest%20years%20on%20record.&text=The%20January%E2%80%93April%20period%20was,across%20much%20of%20the%20globe.

158) Weforum.org, "*How the great COVID-19 reset can help firms build a sustainable future*" 15/05/2020, World Economic Forum (CB. Bhattacharya) https://www.weforum.org/agenda/2020/05/the-covid-19-reset-sustainability/

159) OECD.org: "*Building a coherent response for a sustainable post-COVID-19 recovery*" 23/11/2020, OECD (*NM*) https://www.oecd.org/coronavirus/policy-responses/building-a-coherent-response-for-a-sustainable-post-covid-19-recovery-d67eab68/

160) UNep.org: "*In battling COVID-19, countries shouldn't lose sight of sustainable development: new report*" 17/12/2020, UN Environment Programme (*NM*) https://www.unep.org/news-and-stories/story/battling-covid-19-countries-shouldnt-lose-sight-sustainable-development-new

161) IMF: "*Green Recovery"* [List of Publications] [accessed 05/05/2021], International Monetary Fund (*NM*) https://www.imf.org/en/Topics/climate-change/green-recovery

162) IISD: "*WORLD LEADERS PLEDGE TO PUT BIODIVERSITY AND CLIMATE AT THE HEART OF RECOVERY*" 30/09/2020, International Institute for Sustainable Development (*NM*) https://www.iisd.org/sustainable-recovery/news/world-leaders-pledge-to-put-biodiversity-and-climate-at-heart-of-recovery/

163) Prnewswire.com: "*P4G Seoul Summit unites world leaders for inclusive green recovery, serves as stepping stone for next climate COP*" 09/06/2021, Cision US Inc. (*NM*) https://www.prnewswire.com/news-releases/p4g-seoul-summit-unites-world-leaders-for-inclusive-green-recovery-serves-as-stepping-stone-for-next-climate-cop-301308753.html

164) Greenpeace.org: "15 European governments call for green recovery plan" 09/04/2020, Greenpeace (NM) https://www.greenpeace.org/eu-unit/issues/climate-energy/2708/ten-european-governments-call-for-green-recovery-plan/

165) Climateactiontracker.org: "*EU: Pledges and Targets*" [accessed: 05/05/2021], Climate Action Tracker (*NM*) https://climateactiontracker.org/countries/eu/pledges-and-targets/

166) Climateactiontracker.org: "*Japan: Pledges and Targets*" [accessed: 05/05/2021], Climate Action Tracker (*NM*) https://climateactiontracker.org/countries/japan/pledges-and-targets/

167) op.europa.eu: "*The EU's 2021-2027 long-term budget & NextGenerationEU*" 29/04/2021, European Commission (*NM*) https://op.europa.eu/en/publication-detail/-/publication/d3e77637-a963-11eb-9585-01aa75ed71a1/language-en

168) ec.europa.eu: "*Recovery plan for Europe*" -/-/2021, European Commission (*NM*) https://ec.europa.eu/info/strategy/recovery-plan-europe_en

169) ec.europa.eu: "*NextGenerationEU: European Commission endorses Germany's recovery and resilience plan*" 22/06/2021, European Commission (*NM*) https://ec.europa.eu/commission/presscorner/detail/en/ip_21_3133

170) ec.europa.eu: "*Questions and answers: European Commission endorses Italy's €191.5 billion recovery and resilience plan*" 22/06/2021, European Commission (*NM*) https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_3128

171) ec.europa.eu: "*NextGenerationEU: NextGenerationEU: European Commission endorses France's €39.4 billion recovery and resilience plan*" 23/06/2021, European Commission (*NM*) https://ec.europa.eu/commission/presscorner/detail/en/ip_21_3153

172) ec.europa.eu: "*NextGenerationEU: European Commission endorses Spain's €69.5 billion recovery and resilience plan*" 16/06/2021, European Commission (*NM*) https://ec.europa.eu/commission/presscorner/detail/en/ip_21_2987

173) Kyodo News: "*Japan Cabinet OKs 73.6 tril. yen new stimulus to fight virus*" 08/12/2020, KYODO NEWS (K. Nakamura) https://english.kyodonews.net/news/2020/12/8a909b0c27bb-urgent-japan-to-compile-73-tril-yen-new-stimulus-package.html

174) Reuters: "*Japan unveils $708 billion in fresh stimulus with eye on post-COVID growth*" -/08//2020, Reuters (L. Kihara & T. Kajimoto) https://www.reuters.com/article/us-japan-economy-stimulus-idUSKBN28I02Y

175) Reuters: "*Japan vows deeper emission cuts as Biden holds climate summit*" 22/04/2021, Reuters (K. Takenaka, Y. Takemoto & Y. Obayashi) https://www.reuters.com/business/environment/japan-government-propose-new-target-cutting-greenhouse-gases-by-46-nikkei-2021-04-22/

176) Euractiv.com: "*US vows to cut its emissions at least 50% by 2030 ahead of climate summit*" 22/04/2021, EURACTIV MEDIA NETWORK BV. (O. Milman) https://www.euractiv.com/section/climate-environment/news/us-vows-to-cut-its-emissions-at-least-50-by-2030-ahead-of-climate-summit/

177) Financial Times: "*South Korea vows 'bold' climate policy after accusations of inaction*" 17/05/2021, THE FINANCIAL TIMES LTD (E. White) https://www.ft.com/content/fcf5d06f-9612-4e29-92c9-20d3b8aef39e

178) Adda247, "*World Economic Forum to host Unique Twin Summit in 2021*" 05/06/2020, Adda247 (D. Kaushik) https://currentaffairs.adda247.com/world-economic-forum-to-host-unique-twin-summit-in-2021/

179) Weforum.org, "*The Great Reset: A Unique Twin Summit to Begin 2021*" 03/06/2020, World Economic Forum (A. Monck) https://www.weforum.org/press/2020/06/the-great-reset-a-unique-twin-summit-to-begin-2021/

180) Time, "*The Great Reset*" -/-/-, TIME USA, LLC. (*NM*) https://time.com/collection/great-reset/

181) Weforum.org, "*Yes, companies can save capitalism and the planet: this week's Great Reset podcast*" 16/10/2020, World Economic Forum (R. Pomeroy) https://www.weforum.org/agenda/2020/10/how-capitalism-can-save-itself-this-weeks-great-reset-podcast/

182) Weforum.org, "*Now is the time for a 'great reset'*" 03/06/2020, World Economic Forum (K. Schwab) https://www.weforum.org/agenda/2020/06/now-is-the-time-for-a-great-reset/

183) Weforum.org, "*The Fourth Industrial Revolution: what it means, how to respond*" 14/01/2016, World Economic Forum (K. Schwab) https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/

184) Web.archive.org, "*The Digital Revolution*" 07/10/2008, Steven E. Schoenherr https://web.archive.org/web/20081007132355/http://history.sandiego.edu/gen/recording/digital.html

185) TechTarget, "*Information Age*" -/-/-, TechTarget (L. Tucci) https://searchcio.techtarget.com/definition/Information-Age

186) Foreignaffairs.com, "*The Fourth Industrial Revolution*" 12/12/2015, Council on Foreign Relations (K. Schwab) https://www.foreignaffairs.com/articles/2015-12-12/fourth-industrial-revolution

187) PwC, "*Industry 4.0: Building the digital enterprise*" -/04/2016, PwC (*NM*) https://www.pwc.com/gx/en/industries/industries-4.0/landing-page/industry-4.0-building-your-digital-enterprise-april-2016.pdf

188) Intelligence.weforum.org, "*Industry 4.0*" -/-/-, World Economic Forum (*N/A*) https://intelligence.weforum.org/topics/a1Gb0000001RIhBEAW?tab=publications

189) UCLG.org, "*Digital Technologies and the COVID19 pandemic "* 15/04/2020, UCLG CGLU (*NM*) https://www.uclg.org/sites/default/files/eng_briefing_technology_final_x.pdf

190) The New York Times, "*As Coronavirus Surveillance Escalates, Personal Privacy Plummets*" 23/03/2020, The New York Times Company (*NM*) https://www.nytimes.com/2020/03/23/technology/coronavirus-surveillance-tracking-privacy.html

191) TechCrunch, "*AI can battle coronavirus, but privacy shouldn't be a casualty*" 26/05/2020, Verizon Media (P. Howard & L.M. Neudert) https://techcrunch.com/2020/05/26/ai-can-battle-coronavirus-but-privacy-shouldnt-be-a-casualty/

192) OECD.org, "*Ensuring data privacy as we battle COVID-19*" 14/04/2020, OECD (*NM*) https://www.oecd.org/coronavirus/policy-responses/ensuring-data-privacy-as-we-battle-covid-19-36c2f31e/

193) MOF.gov.jp, "*Supply Chain Disruptions: Evidence from the Great East Japan Earthquake*" -/12/2016, Research Department Policy Research Institute, MOF (V. M. Carvalho, M. Nirei, Y. U. Saito, A.Tahbaz-Salehi) https://www.mof.go.jp/pri/research/

discussion_paper/ron287.pdf

194) Forbes, "*Businesses Spent $15 Billion More A Week On Technology During Pandemic*" 22/09/2020, Forbes (S. Shah) https://www.forbes.com/sites/soorajshah/2020/09/22/businesses-spent-15bn-more-a-week--on-technology-during-pandemickpmg-harvey-nash/?sh=1f7b67d4c3b0

195) McKinsey, "*How COVID-19 has pushed companies over the technology tipping point—and transformed business forever*" 05/10/2020, McKinsey & Company (*NM*) https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/how-covid-19-has-pushed-companies-over-the-technology-tipping-point-and-transformed-business-forever

196) Weforum.org, "*The Future of Jobs Report 2020*" 20/10/2020, World Economic Forum (*NM*) https://www.weforum.org/reports/the-future-of-jobs-report-2020/digest

197) McKinsey, "*The case for digital reinvention*" 09/02/2017, McKinsey & Company (*NM*) https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/the-case-for-digital-reinvention

198) Deloitte, "*The Acceleration of Digitization as a Result of COVID-19*" 30/07/2020, Deloitte Touche Tohmatsu Limited. (J. H. Caldwell & D. Krishna) https://www2.deloitte.com/global/en/blog/responsible-business-blog/2020/acceleration-of-digitization-as-result-of-covid-19.html

199) Vodafone, "*Vodafone Business Future Ready Report 2020*" -/-/2020, Vodafone Limited (*NM*) https://www.vodafone.com/business/explore-future-ready-report/

200) KPMG, "*HARVEY NASH / KPMG: CIO Survey 2020*" -/-/2020, Harey Nash / KPMG (*NM*) https://www.hnkpmgciosurvey.com/

201) McKinsey, "*Europe's digital migration during COVID-19: Getting past the broad trends and averages*" 24/07/2020, McKinsey & Company (*NM*) https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/europes-digital-migration-during-covid-19-getting-past-the-broad-trends-and-averages#:~:text=Digital%20adoption%20concertinaed%20from%20years,at%20pre%2Dpandemic%20growth%20rates.&text=This%20gives%20the%20current%20adoption%20rate.

202) Globalworkplacenalytics.com, "*Global Work-from-home Experience Survey*" 05/05/2020, GWA (A. Kamouri & K. Lister) https://globalworkplaceanalytics.com/wp-content/uploads/edd/2020/05/Global-Work-from-Home-Experience-Survey-Report-FINAL.pdf

203) McKinsey, "*The future of work after COVID-19*" 18/02/2021, McKinsey & Company (*NM*) https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-work-after-covid-19

204) Oxford Languages, "*Words of an Unprecedented Year*" -/-/2020, Oxford Languages (*NM*) https://v.fastcdn.co/u/2014a5b7/54382502-0-Words-of-an-Unpreced.pdf

205) Allied, "*The History of Telecommuting*" -/-/-, Allied Telecom Group, LLC. (*NM*) https://www.alliedtelecom.net/the-history-of-telecommuting/#:~:text=The%20term%20%E2%80%9Ctelecommuting%E2%80%9D%20was%20first,and%20the%20phrase%20was%20born.

206) BCG, "*What 12,000 Employees Have to Say About the Future of Remote Work*" 11/08/2020, Boston Consulting Group (A. Dahik, D. Lovich, C. Kreafle, A. Bailey, J. Kilmann, D. Kennedy, P. Roongta, F. Schuler, L. Tomlin & J. Wenstrup) https://www.bcg.com/publications/2020/valuable-productivity-gains-covid-19

207) Ijooes.fe.up.pt, "*Analysing the Sentiments towards Work-From-HomeExperience during COVID-19 Pandemic*" 01/08/2020, Journal of Innovation Management (A. D. Dubey & S. Tripathi) https://ijooes.fe.up.pt/index.php/jim/article/view/2183-0606_008.001_0003/399

208) OWL Labs, "*State of Remote Work 2019*" -/09/2019, Owl Labs (*NM*) https://resources.owllabs.com/state-of-remote-work/2019

209) McKinsey, "*A global view of how consumer behavior is changing amid COVID-19*" 07/07/2020, McKinsey & Company (*NM*) https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Marketing%20and%20Sales/Our%20Insights/A%20global%20view%20of%20how%20consumer%20behavior%20is%20changing%20amid%20COVID%2019/20200707/covid-19-global-consumer-sentiment-20200707.pdf

210) Business Insider, "*The coronavirus outbreak has prompted people around the world to panic buy toilet paper. Here's why." 11/03/2020*, Insider Inc. (M. Jankowickz) https://www.businessinsider.com/coronavirus-panic-buying-toilet-paper-stockpiling-photos-2020-3#bidets-which-also-dont-require-toilet-paper-have-also-caught-on-one-of-australias-biggest-bidet-distributors-said-enquiries-had-tripled-since-the-toilet-paper-rush-7

211) ABC, "*Panic buying psychology and how the COVID-19 pandemic has changed consumer behaviour" 16/03/2021, ABC (J. Daly)* https://www.abc.net.au/news/rural/2021-03-16/how-the-covid-19-pandemic-has-changed-consumer-behaviour/13250360

212) Yahoo!finance, "*The Effects of Coronavirus Panic-Buying*" 15/07/2020, Verizon Media (J. Anderson) https://finance.yahoo.com/news/effects-coronavirus-panic-buying-170000634.html

213) Big Commerce, "*Ecommerce*" -/-/-, Bigcommerce Pty. Lt. (*NM*) https://www.bigcommerce.com/articles/ecommerce/

#ecommerce-timeline

214) Emarketer, "*Global Ecommerce 2019*" 27/06/2019, Insider Intelligence (A. Lipsman) https://www.emarketer.com/content/global-ecommerce-2019

215) OECD Library, "*E-commerce in the times of COVID-19*" 07/10/2020, OECD (*NM*) https://read.oecd-ilibrary.org/view/?ref=137_137212-t0fjgnerdb&title=E-commerce-in-the-time-of-COVID-19

216) Statista, "*eCommerce Report 2021*" -/-/2021, Statista Inc. (*NM*) https://www.statista.com/study/42335/ecommerce-report/

217) OECD Library, "*Unpacking Ecommerce*" 06/07/2019, OECD (*NM*) https://www.oecd-ilibrary.org/science-and-technology/unpacking-e-commerce_23561431-en

218) CNBC, "*More people are doing their holiday shopping online and this trend is here to stay*" 14/12/2020, CNBC LLC. (S.R. Choudhury) https://www.cnbc.com/2020/12/15/coronavirus-pandemic-has-pushed-shoppers-to-e-commerce-sites.html

219) Deloitte, "*COVID-19 will permanently change e-commerce in Denmark*" -/-/2020, Deloitte Touche Tohmatsu Limited. (M. Nyrop, A. Nathan, M.B. Lindquist & J.T. Karlsen) https://www2.deloitte.com/content/dam/Deloitte/dk/Documents/strategy/e-commerce-covid-19-onepage.pdf

220) McKinsey, "*Consumer sentiment and behavior continue to reflect the uncertainty of the COVID-19 crisis*" 26/10/2020, McKinsey & Company (*NM*) https://www.mckinsey.com/business-functions/marketing-and-sales/our-insights/a-global-view-of-how-consumer-behavior-is-changing-amid-covid-19

221) McKinsey, "*The COVID-19 recovery will be digital: A plan for the first 90 days*" 14/05/2020, McKinsey & Company (*NM*) https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/the-covid-19-recovery-will-be-digital-a-plan-for-the-first-90-days

222) Weforum.org, "*The Future of Jobs Report 2018*" -/-/2018, World Economic Forum (*NM*) http://www3.weforum.org/docs/WEF_Future_of_Jobs_2018.pdf

223) McKinsey, "*The next normal arrives: Trends that will define 2021—and beyond*" 04/01/2021, McKinsey & Company (*NM*) https://www.mckinsey.com/featured-insights/leadership/the-next-normal-arrives-trends-that-will-define-2021-and-beyond

224) Forbes, "*How The Pandemic Has Accelerated Cloud Adoption*" 15/01/2021, Forbes Media LLC (G. Aggarwal) https://www.forbes.com/sites/forbestechcouncil/2021/01/15/how-the-pandemic-has-accelerated-cloud-adoption/?sh=7775b3436621

225) Microsoft, "*2 years of digital transformation in 2 months*" 30/04/2020, Microsoft Corporation (J. Spataro) https://www.microsoft.com/en-us/microsoft-365/blog/2020/04/30/2-years-digital-transformation-2-months/

226) Flexera, "*Flexera 2020 State of the Cloud Report*" 28/04/2020, Flexera (*NM*) https://info.flexera.com/SLO-CM-REPORT-State-of-the-Cloud-2020

227) Gartner, "*Gartner Forecasts Worldwide Public Cloud End-User Spending to Grow 18% in 2021*" 17/11/2020, Gartner Inc. (K. Costello & M. Rimol) https://www.gartner.com/en/newsroom/press-releases/2020-11-17-gartner-forecasts-worldwide-public-cloud-end-user-spending-to-grow-18-percent-in-2021

228) IBM, "*Benefits of Cloud Computing*" 10/10/2018, IBM Cloud Education https://www.ibm.com/cloud/learn/benefits-of-cloud-computing

229) Weforum.org, "*What is the Internet of Things*" 31/03/2021, World Economic Forum (M. Marchant) https://www.weforum.org/agenda/2021/03/what-is-the-internet-of-things/

230) Smithsonianmag.com, "Kevin Ashton Describes: "*The Internet of Things*"" -/01/2015, Smithsonian Magazine (A. Gabbai) https://www.smithsonianmag.com/innovation/kevin-ashton-describes-the-internet-of-things-

231) Breadware, "*50 IoT Applications & Examples*" 27/07/2020, Breadware (*NM*) https://breadware.com/2020/07/50-iot-applications-examples/#:~:text=Examples%20of%20IoT%20Assistive%20Technology%20%23Toyota%20Project%20BLAID,can%20be%20programmed%20to%20shine%20in%20specific%20

232) Computer.org, "*Internet of Things Meets the Military and Battlefield*" -/-/-, IEEE (L. Cameron) https://www.computer.org/publications/tech-news/research/internet-of-military-battlefield-things-iomt-iobt

233) Weforum.org, "*State of the Connected World 2020 Edition* " -/12/2020, World Economic Forum (*NM*) http://www3.weforum.org/docs/WEF_The_State_of_the_Connected_World_2020.pdf

234) Vodafone, "*IoT Spotlight Report 2020*" -/-/2020, Vodafone Limited (*NM*) https://explore.vodafone.com/iot-spotlight-report-2020

235) Enterpriseiotinsights.com, "*IoT slumps 18% with Covid-19 impact – but rallies around 'new normal' in mid-term*" 29/05/2020, Enterprise IoT insights (J. Blackman) https://enterpriseiotinsights.com/20200529/channels/news/iot-slumps-with-covid-impact-rallies-around-new-normal

236) Businesswire.com, "*Strategy Analytics: Post-COVID Smart Home Device Markets Set to Rebound in 2021*" 14/07/2020, Business

Wire, Inc. (B. Ablondi & J. Narcotta) https://www.businesswire.com/news/home/20200714005194/en/Strategy-Analytics-Post-COVID-Smart-Home-Device-Markets

237) Globenewswire.com, "*Industrial IoT (IIoT) Market Worth $263.4 billion by 2027*" 19/06/2020, GlobeNewswire, Inc. (K. Bombe) https://www.globenewswire.com/news-release/2020/06/19/2050758/0/en/Industrial-IoT-IIoT-Market-Worth-263-4-billion-by-2027-Exclusive-Report-Covering-Pre-and-Post-COVID-19-Market-Analysis-and-Forecasts-by-Meticulous-Research.html

238) IBM, "*Big data analytics*" -/-/-, IBM (*NM*) https://www.ibm.com/analytics/hadoop/big-data-analytics#:~:text=Big%20data%20is%20a%20term%20applied%20to%20data,data%20has%20one%20or%20more%20of%20the%20following

239) Bigdataframework.org, "*Business Drivers for Big Data*" 28/02/2019, Enterprise Big Data Framework (*NM*) https://www.bigdataframework.org/business-drivers-for-big-data/

240) Oracle, "*What is Big Data*" -/-/-, Oracle (*NM*) https://www.oracle.com/big-data/what-is-big-data/

241) Forbes, "*Big Data in the time of Coronavirus (Covid-19)*" 30/03/2020, Forbes Media LLC (R. Bean) https://www.forbes.com/sites/ciocentral/2020/03/30/big-data-in-the-time-of-coronavirus-covid-19/?sh=56bab6fc58fc

242) Techopedia, "*6 Examples of Big Data Fighting the Pandemic*" 05/10/20, Techopedia Inc. (D. Partida) https://www.techopedia.com/6-examples-of-big-data-fighting-the-pandemic/2/34383

243) HBR.org, "*Big Data Hype (and Reality)*" 18/10/2012, Harvard Business Publishing (G. Piatetsky-Shapiro) https://hbr.org/2012/10/big-data-hype-and-reality

244) Forbes, "*Decade Of Investment In Big Data And AI Yield Mixed Results*" 03/01/2021, Forbes Media LLC (R. Bean)https://www.forbes.com/sites/randybean/2021/01/03/decade-of-investment-in-big-data-and-ai-yield-mixed-results/?sh=20a2c871409e

245) Newvantage.com, "*Big data and AI Executive Survey*" -/-/2021, New Vantage Partners (T. H. Davenport) https://www.newvantage.com/thoughtleadership

246) Openpr.com, "*Global Big Data and Analytics Market 2021: Size & Trends Shows a Rapid Growth by 2030*" 16/04/2021, openPR (*NM*) https://www.openpr.com/news/2271190/global-big-data-and-analytics-market-2021-size-trends-shows

247) Openpr.com, "*Big Data and Analytics Services Market Size, Key Company Profiles, Types, Applications and Forecast To 2025*" 15/04/2021, openPR (*NM*) https://www.openpr.com/news/2270551/big-data-and-analytics-services-market-size-key-company

248) Weforum.org, "*Why cybersecurity matters more than ever during the coronavirus pandemic*" 17/03/2020, World Economic Forum (A. Pipikaite & N. Davis) https://www.weforum.org/agenda/2020/03/coronavirus-pandemic-cybersecurity/

249) WHO, "*WHO reports fivefold increase in cyber attacks, urges vigilance*" 23/04/2020, World Health Organisation (*NM* https://www.who.int/news/item/23-04-2020-who-reports-fivefold-increase-in-cyber-attacks-urges-vigilance

250) Interpol, "*Cybercriminals targeting critical healthcare institutions with ransomware*" 04/04/2020, Interpol (*NM*) https://www.interpol.int/en/News-and-Events/News/2020/Cybercriminals-targeting-critical-healthcare-institutions-with-ransomware

251) Microsoft, "*Ransomware groups continue to target healthcare, critical services; here's how to reduce risk*" 28/04/2020, Microsoft Corporation (*NM*) https://www.microsoft.com/security/blog/2020/04/28/ransomware-groups-continue-to-target-healthcare-critical-services-heres-how-to-reduce-risk/?

252) Cybersecurity Ventures, "*2019/2020 Cybersecurity Almanac: 100 Facts, Figures, Predictions And Statistics*" 06/02/2019, Cybersecurity Ventures (S. Morgan) https://cybersecurityventures.com/cybersecurity-almanac-2019/

253) Journal of Electronic Science and Technology - Volume 19, Issue 1, "*Impact of coronavirus pandemic crisis on technologies and cloud computing applications*" -/03/2021, Elsevier B.V. (Z. R. Alashhaba, M. Anbara, M. M. Singh. Y.b. Leau, Z. A. Al-Saib & S. A. Alhayja'a) https://www.sciencedirect.com/science/article/pii/S1674862X20300665

254) Fortune Business Insights, "*Cyber Security Market Size, Share & Covid Impact Analysis*" -/03/2021, Fortune Business Insights (*NM*) https://www.fortunebusinessinsights.com/industry-reports/cyber-security-market-101165

255) Research Nester, "*Cyber Security Market Segmentation*" 01/03/2021, Research Nester (*NM*) https://www.researchnester.com/reports/global-cyber-security-market/2137

256) Deloitte, "*Reshaping the cyber security landscape*" 24/07/2020, Deloitte Touche Tohmatsu Limited (J. Bernard & M. Nicholson) https://www2.deloitte.com/us/en/insights/industry/financial-services/cybersecurity-maturity-financial-institutions-cyber-risk.html

257) Globenewswire.com, "*Global Cybersecurity Market Size to Grow at a CAGR of 12.5% from 2021 to 2028*" 17/03/2021, GlobeNewswire Inc. (*NM*) https://www.globenewswire.com/news-release/2021/03/17/2194254/0/en/Global-Cybersecurity-Market-Size-to-Grow-at-a-CAGR-of-12-5-from-2021-to-2028.html

258) Securitybrief.com.au, "*Worldwide cybersecurity spending to increase 10% in 2021 — Canalys*" 20/018/2021, Techday Ltd. (*NM*)

https://securitybrief.com.au/story/worldwide-cybersecurity-spending-to-increase-10-in-2021-canalys

259) Mordorintelligence.com, "*CYBERSECURITY MARKET - GROWTH, TRENDS, COVID-19 IMPACT, AND FORECASTS (2021 - 2026)*" -/-/-, Mordor Intelligence (*NM*) https://www.mordorintelligence.com/industry-reports/cyber-security-market

260) Insight.com, "*Cybersecurity at a Crossroads: The Insight 2021 Report* " -/-/-, Insight CDCT (*NM*) https://www.insight.com/content/dam/insight-web/en_US/pdfs/insight/cybersecurity-at-a-crossroads/cybersecurity-at-a-crossroads--the-insight-2021-report.pdf

261) Online.maryville.edu, "*Big Data and Artificial Intelligence: How They Work Together*" -/-/-, Maryville University (*NM*) https://online.maryville.edu/blog/big-data-is-too-big-without-ai/#:~:text=AI's%20ability%20to%20work%20so,rules%20for%20future%20business%20analytics.&text=%E2%80%9CData%20is%20the%20lifeblood%20of%20AI.

262) Ncube, "*How Big Data and AI Work Together*" 21/01/2020, Ncube (A. Melnichuk) https://ncube.com/blog/big-data-and-ai

263) Onlinelibrary.wiley.com, "*Artificial Intelligence during a pandemic: The COVID-19 example*" 20/05/2020, John Wiley & Sons, Inc. (S. Dananjayan) https://onlinelibrary.wiley.com/doi/full/10.1002/hpm.2987

264) Nature, "*Finding a role for AI in the pandemic*" 16/06/2020, Springer Nature Limited (*NM*) https://doi.org/10.1038/s42256-020-0196-z

265) Medium, "*Changing the Remote Work Landscape With AI: What You Need to Know*" 01/05/2020, Medium (J. Riley) https://medium.com/@joanna.riley/changing-the-remote-work-landscape-with-ai-what-you-need-to-know-cbcf526211d3

266) Technative.io, "*Working With Intelligence: How AI Will Reshape Remote Work*" 04/08/2020, TechNative (D. Cizmec) https://technative.io/working-with-intelligence-how-ai-will-reshape-remote-work/

267) Forbes, "*Understanding The AI/E-Commerce Connection In The Age Of Socially-Distanced Retail*" 03/02/2021, Forbes Media LLC (A. Brown) https://www.forbes.com/sites/anniebrown/2021/02/03/understanding-the-aie-commerce-connection-in-the-age-of-socially-distanced-retail/?sh=4a3714293b23

268) AIMultiple, "*Top 20 AI applications in e-commerce in 2021*" 05/07/2021, AIMultiple (C. Dilmengani) https://research.aimultiple.com/ai-ecommerce/

269) IDC, "*IDC Forecasts Improved Growth for Global AI Market in 2021*" 23/02/2021, IDC Corporate USA (M. Shirer) https://www.idc.com/getdoc.jsp?containerId=prUS47482321

270) Openpr.com, "*Artificial Intelligence Services Market 2021: Trends, Growth and Profit Analysis, Forecast by 2030*" 19/04/2021, openPR (NM) https://www.openpr.com/news/2271826/artificial-intelligence-services-market-2021-trends-growth

271) Emergen Research, "*Artificial Intelligence Market By Offering"* -0/09/2020, Emergen Research (NM) https://www.emergenresearch.com/request-sample/86

272) BusinessWire, "*Worldwide AI in Healthcare Industry to 2025 - Competitive Analysis and Impact of COVID-19*" 13/04/2021, Business Wire Inc. (*NM*) https://www.businesswire.com/news/home/20210413005648/en/Worldwide-AI-in-Healthcare-Industry-to-2025---Competitive-Analysis-and-Impact-of-COVID-19---ResearchAndMarkets.com

273) Fortune Business Insights, "*Artificial Intelligence (AI) in Retail Market to Reach $23.32 Bn by 2027; Combination of AI, Robotics, and Machine Learning in Retail to Stimulate Growth*" 28/09/2020, Fortune Business Insights (*NM*) https://www.fortunebusinessinsights.com/press-release/artificial-intelligence-ai-in-retail-market-9527

274) Globenewswire.com, "*Global Wearable AI Market to Reach $99.5 Billion by 2027*" 08/04/2021, GlobeNewswire Inc. (*NM*) https://www.globenewswire.com/news-release/2021/04/08/2206885/0/en/Global-Wearable-AI-Market-to-Reach-99-5-Billion-by-2027.html

275) PRnewswire.com, "*$11.2 Billion Artificial Intelligence in Agriculture Markets - Global Industry Analysis and Growth Forecast to 2030*" 11/02/2021, Cision US Inc. https://www.prnewswire.com/news-releases/11-2-billion-artificial-intelligence-in-agriculture-markets---global-industry-analysis-and-growth-forecast-to-2030--301226811.html

276) McKinsey, "*The state of AI in 2020*" 17/11/2020, McKinsey & Company (*NM*) https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/global-survey-the-state-of-ai-in-2020

277) Robotics.sites.stanford.edu, "*History of Robotics*" -/-/-, Stanford Robotics Center (*N/A*) https://robotics.sites.stanford.edu/about/history-robotics

278) Medium, "*AI in Robotics: Use of Artificial Intelligence in Robotics*" 14/10/2020, Medium (V. S. Bisen) https://medium.com/vsinghbisen/ai-in-robotics-use-of-artificial-intelligence-in-robotics-726a4e9ade18

279) Roboticsbiz.com, "*What happens when you mix Cloud Computing with Robotics*" 15/08/2020, RoboticsBiz (*NM*) https://roboticsbiz.com/what-happens-when-you-mix-cloud-computing-with-robotics/#:~:text=Mixing%20cloud%20computing%20with%20robotics%20is%20a%20new,processes%20and%20computation%2C%20and%20provide%20Technology%20Artificial%20Intelligence

280) Ifr.org, "*Executive Summary World Robotics 2020 Industrial Robots*" -/-/-, International Federation of Robotics (*N/A*) https://ifr.org/img/worldrobotics/Executive_Summary_WR_2020_Industrial_Robots_1.pdf

281) Ifr.org, "*Executive Summary World Robotics 2020 Service Robots*" -/-/-, International Federation of Robotics (*N/A*) https://ifr.org/img/worldrobotics/Executive_Summary_WR_2020_Service_Robots.pdf

282) Mordorintelligence.com, "R*OBOTICS MARKET - GROWTH, TRENDS, COVID-19 IMPACT, AND FORECASTS (2021 - 2026)*" -/-/-, Mordor Intelligence (*N/A*) https://www.mordorintelligence.com/industry-reports/robotics-market

283) Therobotreport.com, "*Interact Analysis releases 2021 robotics market data*" 23/03/2021, WTWH Media LLC. (M. Oitzman) https://www.therobotreport.com/interact-analysis-releases-2021-robotics-market-data/

284) National Geographic, "*The pandemic has been good for one kind of worker: robots*" 04/09/2020, National Geographic Partners, LLC. (D. Berreby) https://www.nationalgeographic.com/science/article/how-pandemic-is-good-for-robots

285) Financial Times, "*Pandemic boosts automation and robotics*" 19/10/2020, The Financial Times Ltd. (*V. Romei*) https://www.ft.com/content/358f6454-e9fd-47f3-a4b7-5f844668817f

286) AMFG, "*40+ 3D Printing Industry Stats You Should Know [2021]*" 14/01/2020, AMFG (*NM*) https://amfg.ai/2020/01/14/40-3d-printing-industry-stats-you-should-know-2020-redirect/

287) 3dprinting.com, "*Automated Vapor Smoothing for Post-Processing MJF Parts*" 04/05/2021, Strikwerda en Dehue (P. Keane) https://3dprinting.com/news/automated-vapor-smoothing-for-post-processing-mjf-parts/

288) 3dprinting.com, "*Military Eyes Topology Optimized Heat Exchangers*" 18/02/2021, Strikwerda en Dehue (P. Keane) https://3dprinting.com/company/3d-systems/military-eyes-topology-optimized-heat-exchangers/

289) 3dprinting.com, "*Concrete Additive Manufacturing Gets Intricate*" 05/05/2021, Strikwerda en Dehue (P. Keane) https://3dprinting.com/construction/concrete-additive-manufacturing-gets-intricate/

290) 3dprinting.com, "*3D Printed Supercapacitor for Space Exploration*" 22/04/2021, Strikwerda en Dehue (P. Keane) https://3dprinting.com/electronics/3d-printed-supercapacitor-for-space-exploration/

291) 3dprinting.com, "*3D Printed Compression Masks Treating Burns in Gaza*" 11/05/2021, Strikwerda en Dehue (P. Keane) https://3dprinting.com/medical/3d-printed-compression-masks-treating-burns-in-gaza/

292) 3dprinting.com, "*3D Printed Plastic Rebar Replacement Used to Make Greener Concrete*" 28/10/2020, Strikwerda en Dehue (P. Keane) https://3dprinting.com/construction/3d-printed-plastic-rebar-replacement-used-to-make-greener-concrete/

293) AMFG, "*Industrial Applications of 3D Printing: The Ultimate Guide*" -/-/-, AMFG (*NM*) https://amfg.ai/industrial-applications-of-3d-printing-the-ultimate-guide/

294) Mordorintelligence.com, "*3D PRINTING MARKET - GROWTH, TRENDS, COVID-19 IMPACT, AND FORECASTS (2021 - 2026)*" -/-/-, Mordor Intelligence (*N/A*) https://mordorintelligence.com/industry-reports/3d-printing-market

295) Fortune Business Insights, "Industrial 3D Printing Market Size, Share & Covid-19 Impact Analysis" -/12/2021, Fortune Business Insights (*NM*) https://www.fortunebusinessinsights.com/industry-reports/3d-printing-market-101902

296) Grand View Research, "*3D Printing Market Size, Share & Trends Analysis Report*" -/05/2021, Grand View Research Inc. (*NM*) https://www.grandviewresearch.com/industry-analysis/3d-printing-industry-analysis

297) AMPower Report, "*ADDITIVE MANUFACTURING MARKET 2021*" -/-/2021, AMPOWER GmbH & Co. KG. (*NM*) https://additive-manufacturing-report.com/additive-manufacturing-market-2021/

298) AMFG, "*The Fall and Rise of 3D Printing: How the Pandemic Has Impacted the Industry*" 16/09/2020, AMFG (*NM*) https://amfg.ai/2020/09/16/the-fall-and-rise-of-3d-printing-how-the-pandemic-has-impacted-the-industry/

299) Essentium, "*TRENDS IN 3D PRINTING AT SCALE*" -/12-2020, Essentium Inc. (*NM*) https://f.hubspotusercontent20.net/hubfs/5442420/Trends%20in%203D%20Printing%20at%20Scale%20Essentium%202020.pdf

300) Globenewswire.com, "*How Has COVID-19 Impacted The Global 3D Printer Market And The 3D Printing Industry*" 07/04/2021, GlobeNewswire Inc. (*NM*) https://www.globenewswire.com/news-release/2021/04/07/2206057/0/en/How-Has-COVID-19-Impacted-The-Global-3D-Printer-Market-And-The-3D-Printing-Industry.html

301) 3dprintingindustry.com, "*SCULPTEO PUBLISHES STATE OF 3D PRINTING 2021 SURVEY: 3D PRINTING SHOWS RESILIENCE AMID COVID-19*" 23/04/2021, 3DPI (H. Everett) https://3dprintingindustry.com/news/sculpteo-publishes-state-of-3d-printing-2021-survey-3d-printing-shows-resilience-amid-covid-19-189016/

302) 3dprintingindustry.com, "*WTO, SIEMENS, PROTOLABS ON HOW ADDITIVE MANUFACTURING BOLSTERS GLOBAL SUPPLY CHAIN*

RESILIENCE" 19/04/2021, 3DPI (H. Everett) https://3dprintingindustry.com/news/wto-siemens-protolabs-on-how-additive-manufacturing-bolsters-global-supply-chain-resilience-188795/

303) McKinsey: "*What's next for consumers, workers, and companies in the post-COVID-19 recovery*" -/05/2021, McKinsey & Company (J. Mischke, S. Lund, A. Madgavkar & J. Remes) https://www.mckinsey.com/featured-insights/future-of-work/whats-next-for-consumers-workers-and-companies-in-the-post-covid-19-recovery

304) McKinsey: "Will productivity and growth return after the COVID-19 crisis?" -/03/2021, McKinsey & Company (J. Mischke, J. Woetzel, S. Smit, J. Manyika, S. Ramaswamy, M. Birshan, E. Windhagen, J. Schuber, S. Hieronimus, F. Dagorret & M. Canal Nogurer) https://www.mckinsey.com/industries/public-and-social-sector/our-insights/will-productivity-and-growth-return-after-the-covid-19-crisis

305) Vosxeu.org: "*Pathways for productivity and growth after the COVID-19 crisis*" 03/05/2021, CEPR (H.-H. Kotz, J. Mischke & S. Smit) https://voxeu.org/article/pathways-productivity-and-growth-after-covid-19-crisis

306) The Wall street Journal: "*The Boss Wants You Back in the Office. Like, Now."* 24/07/2021, Dow Jones (C. Cutter) https://www.wsj.com/articles/return-to-work-the-boss-wants-you-back-in-the-office-11627079616

307) BBC.com: "*Some companies want staff back in the office for more time than employees had anticipated. Workers like their set-ups, and even doubt bosses' motives – so they're resisting." 22/06/2021, BBC (Brian O'Connor) https://www.bbc.com/worklife/article/20210618-the-workers-pushing-back-on-the-return-to-the-office*

308) Bloomberg.com: "*What Managers Are Telling Workers About Returning to the Office*" 14/05/2021, Bloomberg (S. Green Carmichael) https://www.bloomberg.com/news/articles/2021-05-14/return-to-the-office-what-managers-are-telling-workers-right-now

309) KPMG: "*2021 CEO Outlook Pulse Survey*" -/03/2021, KPMG (B. Thomas, J. Lawrie, C. Carande & G. Reader) https://home.kpmg/xx/en/home/insights/2021/03/ceo-outlook-pulse.html

310) McKinsey: "*What's next for remote work: An analysis of 2,000 tasks, 800 jobs, and nine countries*" 23/11/2020, McKinsey (*NM*) https://www.mckinsey.com/featured-insights/future-of-work/whats-next-for-remote-work-an-analysis-of-2000-tasks-800-jobs-and-nine-countries

311) McKinsey: "The Future of Work After COVID-19" -/02/2021, McKinsey, (*NM*) https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-work-after-covid-19

312) Reuters: "'*Home nesting' and telehealth spending to keep rising post-pandemic, McKinsey survey finds"* 18/03/2021, Reuters (G. Issa & V. Waldersee) https://www.reuters.com/article/us-health-coronavirus-consumer-idUSKBN2BA0FR

313) OECD: "*OECD ECONOMIC OUTLOOK, MAY 2021*" [Accessed: 20/05/2021], OECD (*NM*) https://www.oecd.org/economic-outlook/

314) Trading Economics: "*Consumer Confidence - Forecast 2020-2022*" [Accessed: 20/05/2021], Trading Economics (*NM*) https://tradingeconomics.com/forecast/consumer-confidence

315) Trading Economics: "*Consumer Spending - Forecast 2020-2022*" [Accessed: 20/05/2021], Trading Economics (*NM*) https://tradingeconomics.com/forecast/consumer-spending

Appendix 1

Main Events and Policy Responses in the EU and Japan 2020

JANUARY

- First cases in: France, Germany, Finland, Italy, Spain, and Sweden.
- The European Center for Disease Prevention and Control publishes its first risk assessment on the virus outbreak[109].
- Japan confirms its first cases of the virus[107].
- Japan evacuates its citizens from Wuhan, China[129].

FEBRUARY

- First cases in 14 more EU countries.
- The first restrictions of movement and travel are implemented in Europe[110].
- EU public events are cancelled[110].
- Japan implements travel restrictions for foreign nationals[130, 131].
- Japanese officials quarantine a cruise ship at the port of Yokohama[132].

MARCH

- Virus now in all EU countries.
- ECDC raises risk level to 'high'[110].
- EU countries start implementing increasingly strict measures.[110]
- Japan unveils a ¥430.8 billion support package to help SMEs that are hit by the virus outbreak[133].
- Japan announces postponing the 2020 Olympics[134].

APRIL

- Many European countries, regions and cities remain under lockdown.
- The initial state of emergency declared in some Japanese prefectures is extended to the whole country[135].
- The government unveils a ¥108.2 trillion economic stimulus plan[136].

MAY

- Across the EU, some restrictive measures are (partially) lifted[113].
- The European Commission predicts a "deep and uneven recession" with a reduced economic output of 7%[114].
- Japan lifts the 'state of emergency' for most of the country with the exception of Tokyo and Osaka[138].
- Japan approves 'remdesvir' as a treatment for COVID-19[139].

JUNE

- European governments increase their financial aid in efforts of easing the pandemic's economic burden[115, 116, 117, 118, 119].
- The EU considers (partially) opening its borders[120].
- The Japanese government lifts all domestic travel restrictions[140].
- The Japanese border reopens for some countries in the region[141].

JULY

- The EU reopens borders for 15 countries[121] and announces €750 billion recovery plan[122]
- The EU secures a €63 million supply of 'remdesvir'[123].
- Tokyo raises alert to highest level following infection surge[142].
- The Japanese minister of economy calls on employers to facilitate remote work and social distancing[143].

AUGUST

- Southern and Eastern European countries report drastic spikes in infections[107].
- The governor of the Japanese prefecture Okinawa declares a state of emergency[144].

SEPTEMBER

- The infection rates in Europe keep increasing and return to March levels[124].
- New measures and restrictions are announced across Europe [125].
- Yoshihide Suga officially takes over as Prime Minister of Japan after Shinzo Abe resigns due to health reasons[145].

OCTOBER

- Spain declares state of emergency[126].
- European countries increase restrictions on movement and other measures in effort of 'flattening the curve'[125].
- The number of confirmed cases in Japan surpasses the 100.000[146].
- Japan partially reopens its borders for business visits or those seeking mid– to long term residence status[147].

NOVEMBER

- Infections keep increasing at a staggering rate[107].
- The Czech Republic extends the state of emergency[127].
- Tokyo sees another drastic spike in infections and introduces new, stricter measures in response[148].

DECEMBER

- Various European countries impose further travel restrictions in reaction to the newly discovered COVID mutation in the UK[99, 105].
- The EUI approves the Pfizer-BioNTech vaccine [128].
- Japan reports a drastic increase in infections[149].
- Japan re-imposes entry restrictions to travelers from overseas[150].