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Automation, job market and future skills

How will automation affect the future job market and what are key skills in the future?

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The changes in the labour market will affect almost all of us somehow in the future. In European Union, the population is estimated to grow from between 2016 and 2070, while at the same time period amount of working-age population is estimated to decrease. Combined with the increasing automation in the labour markets and skill gap between jobs and employees creates a misbalance in the labour markets. The goal of this thesis is to answer two questions: how automation, robotics and artificial intelligence effect the future labour markets and what are the skills employees need in the future to avoid being replaced by robots.

Based on literature review on the effects of automation on labour markets and future skills needs, a secondary data analysis was conducted to find out how automation will effect labour markets and what are the possible skills needed in the future.

While automation does have an effect on labour markets, it is not likely to remove all the jobs from humans to robots. Only 5% of the jobs can be fully automated, while 60% of all occupations have at least 30% of activities that have the potential to be automated. Social and emotional skills will play an increasing role in the future skills, as well as high cognitive skills, that include skills such as creativity and decision making.

The results indicate that while automation will grow in the future, it is not likely that jobs would be wiped out because of it. Skills that are most needed in the future are ones requiring interpersonal skills, such as teamwork.

Keywords	Automation, AI, Job markets

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1 Introduction

There has been a time when the concept of automation was mostly associated with the use of robots in advanced manufacturing plants. While this still holds true to this day, automation today is much more than just robots in a manufacturing plant. Today, automation is present both in enterprises of all sizes, ranging from everyday software applications to some more obvious implementations, such as self-driving vehicles. Many of us are most likely also familiar with chatbots (Uzialko, 2019).

In future, all of us will be affected by changes to the labour market. In the European Union the population is estimated to increase from 511 million in 2016 to 520 million in 2070, but the dependency ratio will increase as the working-age population is forecast to decrease from 333 million to 292 million during the same period (European Commission, 2018). Developments such as automation, digitalization and robotics will all make an impact in the field of work in the future. Since we live in an economic system where continuous economic growth is a must, companies are forced to seek solutions to stay productive even when the working-age population is decreasing significantly.

But why does any of this matter? To begin with, it is estimated that more than 50 percent of the occupations today have at least some potential that can be technically automated (Manyika, 2017). Secondly, humans are becoming more expensive relative to robots. The average unit price of a robot fell by 11 percent between 2011 and 2016. This is attributable to smarter networks, growth in the processing power of microchip and extended battery lives, among other factors (Gonçlave, 2019). In the future it might not be completely unrealistic to have C-3PO kind of sidekick by your side while working.

Since it seems automation and other future technologies are affecting future job markets a lot, how can employees of today and tomorrow avoid being replaced by robots and artificial intelligence and still remain relevant part of future worklife? Already workers are witnesses to the unfolding transformation, as workplace innovations involving the use of robotics and other digital tools are being increasingly used (Moueddene et al., 2019). World Economic Forum has estimated that 50 percent of all employees will need reskilling by 2025 (Whiting, 2020).

Automation and related technologies will accelerate the shift in the demand for labour. Some skills will become increasingly redundant. More basic cognitive skills are estimated to decline by 15 percent. The demand for manual and physical work is also estimated to decline by 14 percent. However, despite the declining demand for manual and physical skills, it is most likely still going to be the largest category of workforce in 2030 in many countries. On the other hand, the competition for high-skilled workers will increase in the future (Bughin et al. 2018).

On this thesis the aim is to try and answer two questions:

1) How will automation, robotics, artificial intelligence (AI) and digitalization effect the labour markets in the future

2) What are the skills employees will need in future labour markets to avoid being replaced by robots?

The question regarding automation is now more current than ever. As the technological development moves faster every year, it is clear that the pace of automation can be expected to move forward faster and faster. This is also a timely subject as automation during the ongoing COVID-19 pandemic has surprisingly increased to the pace of automation (Gaskell 2020).

Since automation and technological advances are moving faster and faster, it is also interesting to understand what are skills that are going to be most valuable in the future. If robots are taking more and more low-skilled work away from humans, what then are the skills that are going to have an increasing demand in the workplace of tomorrow?

First in part 2 of this thesis we start with literature review and first look at what literature has to say about the future skills needs, what is meant when we talk about automation, robotics, and AI. In part 2.2 it is also defined what is meant by automation in this paper. In parts 2.3 and 2.4 we will take a look how automation will affect on the future job markets, and what are some of the factors that are affecting pace and extent of automation. In the third part we will discuss the findings of this thesis.

2 Literature Review

To gain a better understanding about the effects of automation, digitalization, AI and robotics and their effect on the future labour markets and what skills are seen most important for employees in the future, it is important to review some of the literature used in this paper.

2.1 Skill needs for future employees

A lot has been written on what are possibly the future skills that employees might need in the future. Kuatz et al. (2014) review the recent literature on measuring and fostering cognitive (such as literary or mathematics) and non-cognitive skills. The paper also points out that IQ tests do not adequately capture non-cognitive skills. These include motivations, personality traits, characters, goals and preferences that are valued in the labour market, as well as in school and in many other domains. Such skills are universally valued across all cultures, religions and societies.

In its paper *Skills for 2030*, the OECD (2019) talks about the skills that are needed in the future, and distinguishes three types of skills: cognitive and meta-cognitive, social and emotional skills, and practical and physical skills. The OECD also talks about how all of these three types of skills are needed in the future.

2.2 What Are Automation, AI, Robotics

Van der Zande et al. (2018) define automation as the process in which technologies are introduced that automatically execute tasks previously performed by humans or impossible for humans to perform. The field of automation is similar to mechanization, which is replacement of human labour by machines (van der Zande et al., 2018). Van der Zande et al. also point out that automation is not the same as autonomously operating systems, which accomplish goals without predefined execution rules provided by humans. Instead, the concept of automation applies to systems that follow a fixed set of rules set by a human to complete their goals.

Artificial intelligence (AI) is such a broad field that it is a term that is extremely hard to define. Frankenfield (2021) defines AI as “simulation of human intelligence in machines that are programmed to think like humans and mimic their actions”. AI encompasses terms like machine learning, big data and robotics (van der Zande, 2018).

Robotics is a combination of various academic fields that include mechanical and electrical engineering. It is one of the primary technologies used in automation. Robotics is also a field that is very much related to AI (van der Zande et al., 2018).

In a lot of the literature written about automation, all the terms explained above are all used intertwined when talking about automation. In order to make this thesis more understandable, we define automation similar to McKinsey Company (2017). In this thesis automation is defined as the use of robotics (machines that perform physical activities) and AI (software algorithm that perform calculations and cognitive activities).

2.3 How Automation Will Affect the Future Work Market

A lot of the jobs that exist today seem to be in threat of being automated at least to some extent in the future. One of the reasons why automation will affect the labour markets in the future is because of the aging population. According to McKinsey Global Institute (2017), there will be at least 300 million more people that are aged 65 years and above than there were in 2014, and sixty percent of the people are living in countries with shrinking or static workforce (Prising, 2016). According to estimates, up to 47 percent of jobs in the United States in 2010 were regarded as highly likely to become computerized during the next 10-20 years (Prising, 2016). The OECD (2020) estimates that by 2025 humans and machines will account for equal amounts of time spent on work tasks.

Approximately 60 percentage of all occupations comprise activities of which at least 30 percent have potential to be technically automatable. This means that most of today’s occupations will change at least to some extent, with more people required to work with technology. This means that highly skilled workers who are already working with technology will benefit. For lower-skilled workers the prospects are mixed: some will be able to achieve more in terms of output and productivity, but they may experience wage

pressure, if there is a large supply of workers with similarly lower skill levels (Manyika, 2017).

Globally it is estimated that automation technologies could impact up to half of the world's economy, affecting 1.2 billion employees and $14.6 trillion in wages in total, for which China, India, Japan and the United States would account for just over half (Manyika, 2017). Nevertheless, big differences in automation potential exist between countries. These are mainly based on the structure of their economies, their relative wage levels and the quantity and skills of the labour force (Manyika, 2017; Vazquez et al., 2019).

Between 1999 and 2010, developments such as the computerisation of work seem to have produced net employment growth in the EU. The same appears to be true for the increasing deployment of industrial robots in manufacturing (Vazquez et al., 2019).

Automation will have differing effects on occupations. For example, occupations such as engineers, computer scientists and IT professionals can rise because of new technologies (McKinsey Global Institute, 2017). According to McKinsey Global Institute, the occupations that are most likely to suffer by automation are jobs that are caried out in a predictable setting, such as office assistants, finance, and accounting. This is agreed by a lot of the literature, but it is important to understand that automating routine work is not new. Tasks such as repetitive calculating, typing or sorting, along with production tasks that are focused on performing repetitive motions, have been automated since the early 1980s (OECD 2019).

A study made by Monika Kiss (2017) also estimates that there will be an impact for the future of work caused by automation, and the results follow those of found by McKinsey Global Institute. Jobs that are in the highest category for automation are jobs that are predictable, such as bookkeeping, and accounting. Service, sales and office jobs are also estimated to be on the high-risk category. The highest risk for automation is for jobs that require low-skilled workers and low-wage occupations. Employees in highly automatable jobs receive about 3,5% lower hourly earnings than workers working in jobs facing lower degrees of automation risk (Pouliakas, 2018). Jobs that are least likely to be affected by automation are those that require creativity and social intelligence.

Automation also has an effect on intermediate-level roles in financial intermediation. Online and mobile banking, combined with the increasing use of cashless payments through digital media, have all drastically altered banking and financial services. A lot of the tasks that involve processing payments, developing routine sources of information or maintaining records are more and more handled in a highly automated or algorithmic manner. Because of this, many employed in financial intermediation, from clerical work to technicians, have witnessed increasing computerization (Vazquez et al., 2019).

It seems that jobs identified as highly vulnerable to automation tend to be predominantly occupied by male employees. The reason for this is that men are more likely to sort into occupations and sectors that not only come with a higher risk of automation, but also previously required what will become 'automatable' skills. Men are more likely to be employed in roles that require greater levels of technical and numerical skills, which are positively correlated with automatability. Females on the other hand are more likely to be working in occupations which require more communication, team-working and planning/organisation skills, which have lower risk of automation (Pouliakas, 2018). An interesting observation is that middle-aged and older-aged workers seem to be less vulnerable to automation risk than younger workers. However, when taking age into account, those with longer tenure at their current employer face a higher chance of automation.

Kiss (2017) also points out that new technologies go hand in hand with this new division of labour, and workers will perform more tasks in the future that complement the machines in the workplace. This is why it is unlikely that machines will automate workplaces on a large scale, but rather transform the tasks the employees do.

2.4 Factors affecting pace and extent of automation

There are several factors that can affect the scope and extent of automation. Below five of these will be discussed: commercial availability, economic benefits, labour market dynamics and legal, social acceptance and aging population.

2.4.1 Commercial availability

Many of the technologies currently being developed today are still in their early stages with much to be done before they reach their full maturity (van der Zande et al., 2018). This is why many of the technologies still require more scientific research.

Van der Zande et al. (2018) also point out that it is important to distinguish between technological feasibility and commercial availability. Basic research concentrates on broad generalizable cases, whereas applied research focuses on more specific cases or applications, developing solutions for these. The technology first needs to be invented, then integrated and adapted into solutions that automate specific actions (McKinsey Global Institute, 2017).

2.4.2 Economic benefits

Another major factor affecting the speed and coverage of automation is the associated net economic benefit. Companies are usually more inclined to incorporate new technologies if the benefits will exceed the costs. Implementations of automation technologies will reduce labour costs due to the substitution of human labour (van der Zande et al., 2018; McKinsey Global Institute 2017).

It is important to point out though that it has been estimated that only five percent of current occupations can be fully automated (McKinsey Global Institute, 2017). What can be estimated though is that fewer employees are needed to generate the same levels of output due to the higher productivity driven by automation.

Economic benefits are not only shown in the saved labour costs. Other economic benefits include for example higher throughput and productivity, better quality, improved safety, and reduced waste. All of these will make additional economic benefits for the companies (McKinsey Global Institute, 2017; van Der Zande et al., 2018).

As mentioned earlier, the full automation of work is very unlikely. With the economic benefits the companies gain, they can re-invest the money in new areas and that way create new jobs.

2.4.3 Labour market dynamics

Supply and demand, quality and quantity, and the relative cost of human labour determine which activities will be automated and which not (McKinsey Global Institute, 2017). Supply and demand especially play a major role here. If there is a high supply of certain labour in combination with low demand, wages will decline. Low wages will then decrease the economic benefits of automation and make companies more inclined to automate (van der Zande et al., 2018).

According to Vazquez et al. (2019) structural differences in countries' or regions' industrial and occupational compositions are often regarded as the main reason for differences in job vulnerability to automation. The extent to which manufacturing is more exposed to automation than services will in turn likely affect countries with larger shares of employment in manufacturing. Most of the differences between countries are actually attributable to differences in occupational composition within economic sectors, in addition to the design of tasks within the same occupation. In consequence, a given job can be more likely to be automated in some countries or regions than in others, subject to how the work is organised locally. For example, 50% of non-managerial, professional and technical occupations in France's textile and leather industries could be potentially automated by 2030, whereas in Poland the figure is almost 78%. The organisation of work can vary a lot across territories, even within the same sector and occupation. This variation is a result of both the extent and quality of investments in past waves of technology, such as ICT and industrial robots (Vazquez et al., 2019).

2.4.4 Legal and social acceptance

If the work will be substituted from humans to machines in the future, application of all new technologies have to be socially and legally accepted. Legal and social acceptance are probably the main thing that will influence the pace of automation. Social and legal acceptance can also be connected to ethical acceptance (van der Zande et al., 2018). Legal change is typically much slower than technological change, and social attitudes can be equally slow to change and adapt. It can take years before new technology comes to the markets and workplaces, even when it is technologically and economically ready.

2.4.5 Aging population

Aging population can be seen also as contributing to the pace and extent of automation. In the European Union the population is turning increasingly older. It is projected that the total population in the EU will grow from 511 million in 2016 to 520 million in 2070, but the working-age population is estimated to decrease significantly from 333 million to 292 million during the same period (European Commission, 2018).

An aging workforce can lead to increased levels of automation. This is because employers need to react to the decreasing supply of middle-aged workers. New automation and robotic technologies can be deployed more rapidly in countries where young and middle-aged workers are comparatively scarce (Fitzgerald, 2018).

3 Methodology

Methodology

This thesis followed a research philosophy known as objectivism. Objectivism argues that the social reality being researched is external to the researcher and everyone else. The philosophy followed can also be identified as being that of realism. Realism sees social entities to be similar to physical entities of the natural world, as they exist independently of how we think of them, how we are aware of them, or how we label them. As the experiences and interpretations of different social actors do not influence in any way the existence of the social world, objectivists see that there is a sole real social reality experienced by all actors, and this social world is only made of solid and unchanging things, like critical social structures that individuals are born into (Saunders. et. al: 128).

This research philosophy was followed because the best way to answer the research question of this study and to understand the phenomenon of automation and its effects on the workforce is to study the social aspects that are connected to it. That being said, the research question was answered through theory and by studying and analysing real life cases.

The research approach of this thesis was that of deduction. Deduction approach involves a development of theory and following this the theory is then subjected to testing (Saunders. et. al: 146).

First, it was identified that there is a causal relationship between automation and the labor market. Then the theory was developed and understood in and through the literature review. Then appropriate data was collected and analyzed in chapter 4, and finally conclusions and findings were discussed.

This thesis followed the research strategy of secondary data analysis. Secondary data analysis means that the analyzed data has been previously collected and tabulated by other sources. Secondary data analysis is especially effective strategy for research when collecting primary data costs too much or is infeasible in other ways, and when the secondary data is on a high enough level of analysis that its suitable for answering the research questions (Bhattacherjee: 39). All these aspects were true considering this thesis, and therefore are the reason why secondary data analysis was chosen as the research strategy. For the data analysis both qualitative and quantitative methods were used but analyzed in a descriptive manner.

4 Data presentation and analysis

4.1 Has the COVID-19 pandemic affected the pace of automation?

The currently ongoing COVID-19 pandemic has speeded the pace of automation. During the pandemic, the United States it is estimated that 42 percent of the jobs that were lost during the pandemic are gone forever. As the pandemic continues, companies are forced to move to survival mode and figure out how to survive. It is estimated that by 2025, robots could replace approximately 2 million manufacturing sector workers in the United States alone (Semuels, 2020).

In Finland, it was estimated that automation of coronavirus testing could have increased daily testing capacity to 20,000. The public health authorities in Finland said that human labour was reducing the speed of analysis and diagnosis of coronavirus samples. The

public health authorities noted that automation would have significantly sped up the diagnostics (Yle, 2020).

Even though the pandemic has hastened the pace of automation, it does not only take jobs away. Companies that invested heavily in AI actually increased their workforce by 15 percent. This increase occurred not only within individual firms, but across entire industries (Gaskell, 2020).

4.2 Future skills need for the employees

While work and its content is being more and more modified by technology, so are the skills demanded by employers. Automation is transforming the very nature of a wide range of occupations. Digital technology is altering the division of labour between people and machines (Vazquez et al., 2019). Though not all or even a majority of tasks can be replaced by robots or other future technologies, it is estimated that the skills gap will continue to be high as the in-demand skills across different jobs evolve during the next five years (OECD, 2020).

As the capacity for data collection, processing and analytics paired with AI and machine learning grows, there is greater demand for digital skills. Although robots, machines and software powered by AI perform increasingly larger portions of the work compared to that currently done by humans, there is still a long way to go before computers can simulate human interaction (Vazquez et al., 2019).

The increasing digital technology is not able to substitute those tasks that demand the simultaneous use of a wide range of skills and require dealing with unforeseen circumstances. What that means is that the jobs that are available increasingly require unique sets of human skills. It is anticipated that technological change will facilitate a decline in physical work, with a corresponding increase in cognitive and social tasks, greater use of digital tools, and more teamwork (Vazquez et al. 2019).

Approximately 90% of occupations now need digital skills of whatever description. These can compensate for an absence of formal higher education, but the converse does not apply (Vazquez et al., 2019). A moderate degree of digital skills will be essential in the

future, but mismatches in more advanced digital skills can be expected in more than half of the EU Member States by the year 2030.

In this part, we will look at what are the sort of skills employees will need in the future in order to avoid being replaced by automation and other new technologies, such as AI and increasing computerisation, in the future. First, we distinguish cognitive and non-cognitive skills, social and emotional skills, and physical skills. Then we will take a look at what are the skills needed in the future workplace according to research (Velasquez, 2019).

Skills demands from employers are increasing at the same time as the rate of technology. Digital technology is increasingly affecting the distribution of work between man and machine. For example, machines are collecting more and more data and analysing it. However, even though machines are far more superior at collecting data, they still cannot compete with the human mind when it comes to making sense of the collected data and analysing it.

4.2.1 Cognitive skills

Cognitive skills can be defined as those skills that involve numeracy, logical reasoning and acquired knowledge. These include verbal, nonverbal and higher-order thinking skills as well as critical thinking, creative thinking and self-regulation (OECD, 2019).

Cognitive skills involve the capacity to consider the consequences of one's actions, evaluate risk and reward and the acceptance of accountability for the products of one's work. This is indicative of moral and intellectual maturity, enabling a person to reflect upon and evaluates their actions in light of experience, personal goals, societal objectives, what is right or wrong, and what he or she has been taught (OECD, 2019).

There seems to be a movement away from tasks that require only basic cognitive skills to those that demand higher cognitive skills. Demand for skills such as creativity and decision making is estimated to grow through 2030: in the United States by 19% and by 14% in Europe (McKinsey Global Institute, 2018).

Other higher cognitive skills, such as quantitative and statistical skills, literacy and writing, will not see the same kind of increase in demand in future. The decline in these skills does not mean that there will not mean that there are no more authors or editors in future. However these will see the same as many other occupation in the future, and some more basic aspects of the work will shift to machines (Mckinsey Global Institute, 2018).

4.2.2 Non-cognitive skills

Non-Cognitive skills can be defined as those attitudes, behaviours and strategies that are regarded as underpinning success in school and at work. They include motivation, perseverance and self-control. Usually they are contrasted with so called ‘hard skills’ of cognitive ability such as literacy and numeracy, which are assessed by academic tests (Gutman and Schoon, 2013; Kuatz et al., 2014).

4.2.3 Social and emotional skills

According to the OECD (2019) cognitive skills are those individual capacities that are revealed in consistent patterns of thought, feeling and behaviours that enable people to learn new skills, cultivate their relationships at home, work, school and in the community, and exercise their civic responsibilities.

McKinsey Global Institute anticipates growth in the demand for workers with finely tuned social and emotional skills. In the future workers will spend a lot more time deploying these skills than they do today. It is estimated that between 2016 and 2030, the demand for these social and emotional skills will grow across all industries by 22% in the United States and in Europe. While some of these social and emotional skills are inborn, such as empathy for example, they can be honed and taught more easily than technological skills (McKinsey Global Institute, 2018).

Some social and emotional skills are necessary for successful participation in academic environments. Achievement at school depends on various social and emotional skills. Some of these skills are for example self-control and perseverance. Poor social and emotional skills may obstruct the application of cognitive skills (OECD, 2019).

Heckman et al. (2014) find evidence of the relationship between personality and cognitive skills in results from the General Education Development (GEP) programme. The GED enables high school dropouts to earn a high school diploma by passing an academic performance test. The authors conclude that GED graduates who had left high school without qualifications and later earned a diploma by passing the GED test have levels of cognitive skills comparable to those of regular high school graduates, but poorer social and emotional skills.

4.2.4 Physical and manual skills

Physical skills comprise abilities to use physical tools, and to perform operations and functions. Physical skills include manual skills, such as competence in the use of information and communication technology devices and new machines, as well as ability to play musical instruments, craft artworks and play sports (OECD, 2019).

The demand for physical and manual skills is expected to decline in the future by an estimated 11 percent in the United States and by 16 percent in Europe between 2016 and 2030. The mix between physical and manual work will adjust according to the extent that tasks can be automated. For example, operating vehicles and packaging products are more likely to be automated than the provision of patient care in a hospital (McKinsey Global Institute, 2018).

4.2.5 Analysis of future skills

Almost all of the jobs in the future need digital skills to some extent. Even though one does not have to be a master in these skills, at least some level of knowledge will be required in the future. It is clear that automation will have a great impact on the jobs that have repetitive tasks.

From the research it is clear that jobs that only require basic cognitive skills are less in demand, and jobs that require more higher cognitive skills are increasingly more in demand. Based on the research, there will be growth in these skills through 2030 both in Europe as well as in the United States.

Social and emotional skills are likely to see an increasing demand in the future. As more and more work requires more interpersonal skills. Physical and manual skills on the other hand are likely to see an decrease in the future. This can be because machines are able to do more of the physical work that used to be done by humans.

4.3 Reskilling employees

In their Future of Jobs 2020 survey, the World Economic Forum (2020) estimates that approximately 40% of workers will require some form of retraining of six months or less. 94% of business leaders responded that they expect employees to pick up new skills on the job. This figure is even higher in the consumer and healthcare industries, where employers are likely to expect short-cycle reskilling. The data shows that the share of workers capable of reskilling within six months is lower in the financial services and energy sectors. In these sectors employers expect that workers will need more time-intensive reskilling (World Economic Forum, 2020).

The data also shows that employers expect to rely on in-house capacity to deliver training: 39% of training will be delivered internally. That training would then be supplemented by online training platforms (16% of training) and by external consultants (11% of training). Growing use of digital online reskilling has further accelerated during the restrictions on in-person learning since the beginning of the coronavirus pandemic (World Economic Forum, 2020).

In the future it is important for individuals to learn to anticipate change, becoming more flexible and adaptive towards it. It is expected that automation will make it harder for low-skilled workers to find employment without prior reskilling or upskilling. Because of the profound uncertainty regarding what competences will be required in the future, it is a must for citizens to acquire adaptive competences as well as knowledge. The workforce also needs to have the ability to anticipate and assess the possible unintended consequences of technological transformation (Vazquez et al., 2019).

Reskilling will almost certainly be a must in the near future. In the survey by World Economic Forum, almost all of the business leaders expected that their employees pick up new skills on the job. It is also evident that a lot of the employees today will require

reskilling. The way these new skills are expected to be delivered varies to some extent. While most workplaces are expecting the training to be delivered by an internal department, some would also like to supplement these training with online training platforms and by using an external consultant. During the ongoing COVID-19 pandemic, it is reasonable to assume that there has been a significant increase in different online training platforms due to the limitation of in person meetings.

4.4 New jobs caused by automation

Automation is not just taking work away from us. While routine and repetitive work is increasingly being automated, new jobs and tasks are being created. There is increasing demand for non-routine skills such as interpersonal and analytical skills. Because computer technologies have replaced human labour in routine tasks, they have also created new employment for workers with non-routine cognitive skills, including creativity, social and emotional skills (OECD, 2019).

Due to the aging population, the demand for professional cares can be expected to be one occupation that will need more professional workers in the future. This is because the profession requires a variety of non-cognitive skills. While digital technology has affected and changed the tasks of care managers, it has had a negligible impact on the normal daily work of professional carers themselves (Vazquez et al., 2019).

In its survey, the World Economic Forum (2020) reports that by 2025 employers expect that increasingly redundant roles will decline from 15.4 percent of the workforce to 9 percent, whereas emerging professions will grow from 7.8 percent to 13.5 percent. Based on those figures, the World Economic Forum estimates that approximately 85 million jobs may be displaced due to adjustments of the division of labour between humans and machines. At the same time, 97 million new roles might emerge that are more adapted to this new division of labour (World Economic Forum, 2020).

So what are these ‘jobs of tomorrow’? It is evident that these emerging professions will reflect the deployment of new technologies and increasing demand for new products and services. These are driving even greater demand for green economy jobs, jobs that have roles in the forefront of the digital economy (including AI and data), and new roles in

cloud computing, engineering and product development. These emerging professions highlight the continuing significance of human interaction in the new economy; it is vital to understand and be comfortable to work with people from different backgrounds (World Economic Forum, 2020).

Automation is mostly affecting work in routine and repetitive tasks. Even when automation is distributing more work from man to machine, it is also creating new job opportunities. For example, there in an increasing demand for jobs that are non-routine and require more interpersonal and analytical skills.

As we have already discovered, the population is getting more old and grey every year. This makes an increasing demand for care takers and professionals in the healthcare sector. Though some of the tasks in those jobs are probably possible to automate, it is impossible at least now to shift the work of a nurse to a robot for example. This is the sort of work that requires more problem solving and interpersonal skills, and at least now the current robots do not do well in those tasks.

4.5 Automation: Possible effects on the U.S. labour market

This section focuses on the U.S. market, but the features and trends discussed here can be generalized, especially regarding western industrial countries. This can be seen from the fact that the use of robots has expanded globally (Bharadwaj, Dvorkin 2019). This fact is further visualized in Figure 1.

A critical long-term change in the U.S. labour market is the decline of intermediate-skill occupations, such as production and manufacturing jobs. A second important change is the growth in high- and low-skill occupations, such as managerial jobs and other jobs that assist or care for others. This trend has been given a name: Job polarization (Bharadwaj, Dvorkin 2019).

Automation and offshoring can be identified to be the most biggest and most likely drivers, as these aspects lower the demand for mid-level skill occupation more than the rest of the levels. Grocery store checkout is a good example of an already largely automated process and it consequently requires less labour to perform routine tasks. In

a similar manner, some stages of production of a good or service can be performed abroad: in other words, they can be offshored. Those tasks that can be outsourced are generally routine tasks (Bharadwaj, Dvorkin 2019).

We now turn our attention to industrial robots. Industrial robots are defined, as stated by The International Federation of Robotics:

"automatically controlled, reprogrammable [and] multipurpose manipulator, programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications." (Bharadwaj, Dvorkin 2019).

Therefore industrial robots do not require any human help or intervention in doing their tasks, as they can be programmed to do many manual tasks. For a long time now economist have believed that automation will lead to a structural change in the labour market (Bharadwaj, Dvorkin 2019), as was already discussed in the literature review.

To properly make sense of the data in question, it is crucial to classify jobs and occupations according to routine content. It further makes sense to make distinctions between cognitive skills or manual skills, and which one the occupation in question uses mostly (Bharadwaj, Dvorkin 2019).

Figure 1 below demonstrates the evolution of U.S. employment in relation to different kinds of occupations.

These occupations are categorized as follows:

- Nonroutine cognitive: Managagement, professional and similar occupations.
- Nonroutine manual: Service occupation and other similar service occupations that include tasks like assisting or caring for others
- Routine Cognitive: Sales and office occupations

- Routine manual: Construction, transportation, production and repair related occupations (Bharadwaj, Dvorkin 2019).

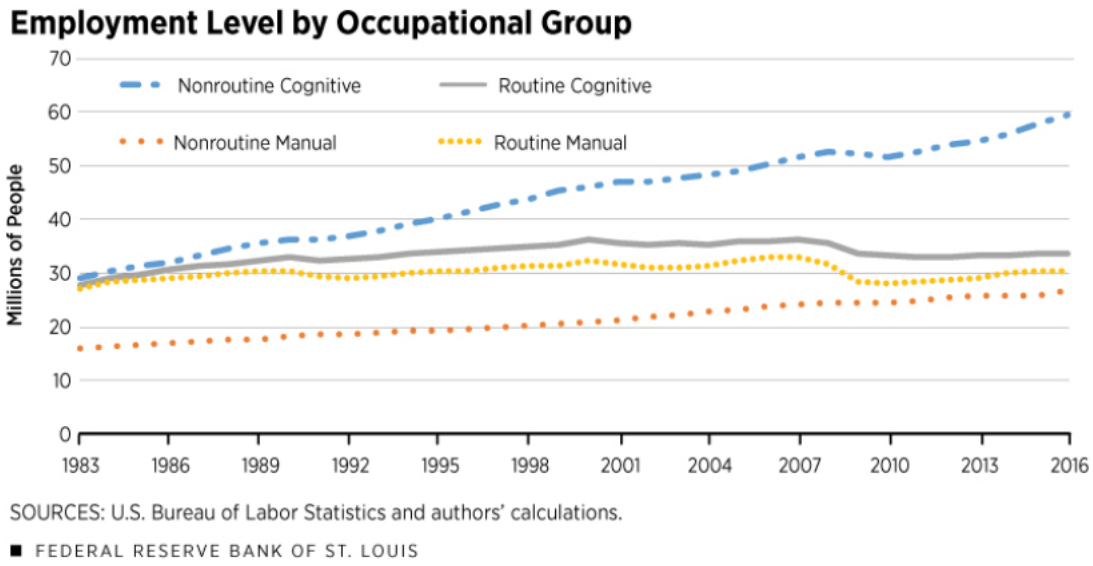


Figure 1 Employment Level by Occupational Group (Bharadwaj, Dvorkin 2019).

Figure 1 clearly indicates how employment in both cognitive and manual non-routine occupations has been steadily growing over decades, and how employment in routine occupations has been stagnant and declining (Bharadwaj, Dvorkin 2019). Figure 2 below on the other hand demonstrates the evolution of stock robots in advanced economies, which further demonstrates the global trend in increased use of robotics (Bharadwaj, Dvorkin 2019).

It is important not to over generalize the findings: Indeed, Figure 3 below demonstrates that the increase in the use of robots has not been similar across different industries, and therefore between different types of workers (Bharadwaj, Dvorkin 2019).

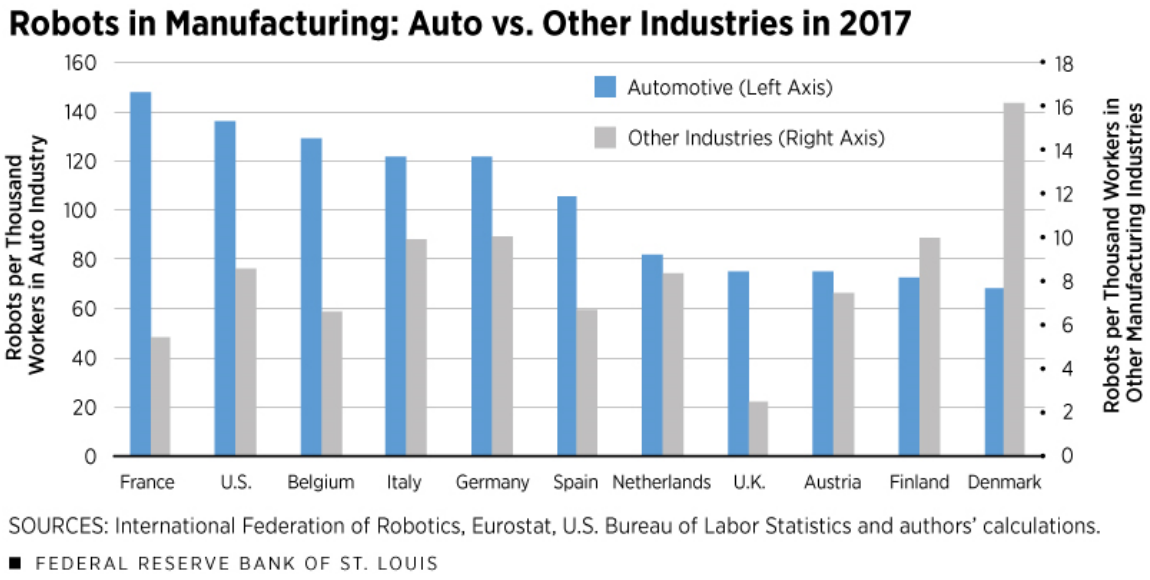
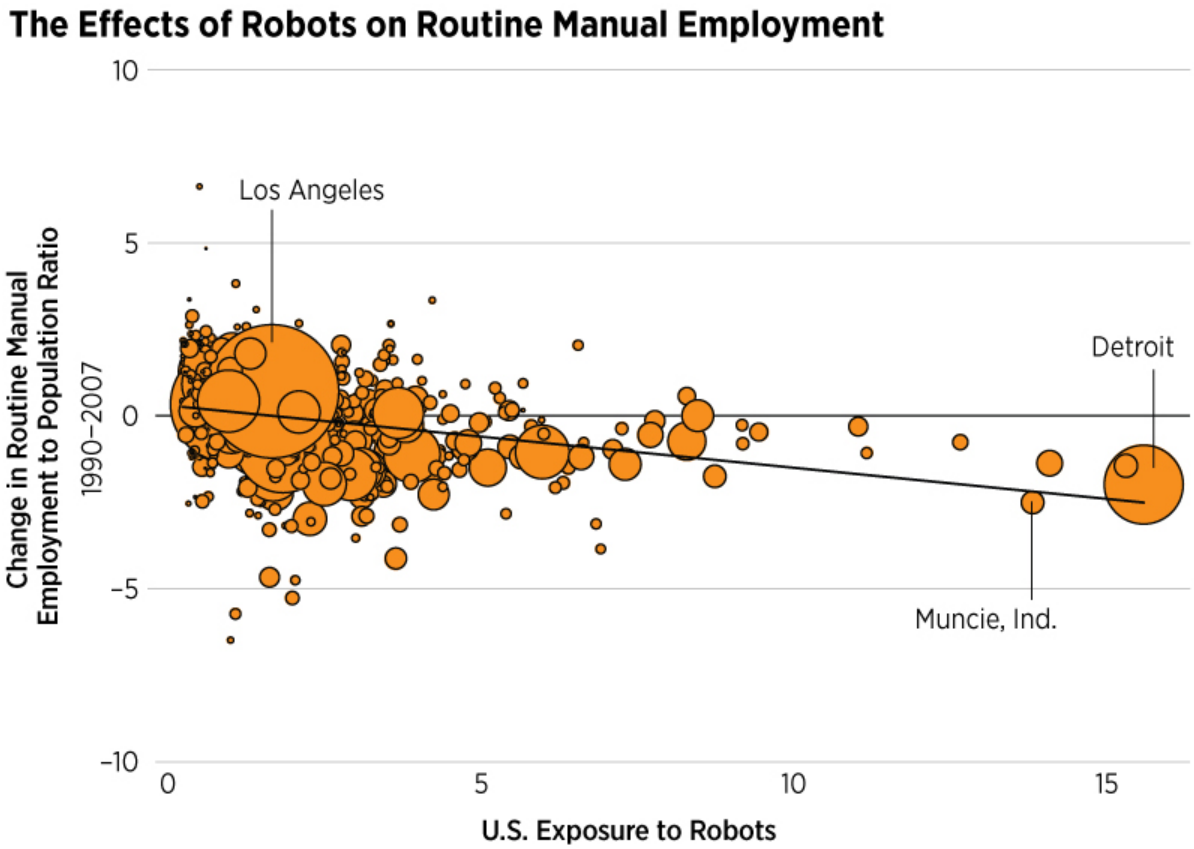


Figure 2 Robots In Manufacturing: Auto Vs. Other Industries in 2017 (Bharadwaj, Dvorkin 2019).

As Figure 2 demonstrates, the auto-industry is without a doubt the biggest user of robots. Another aspect that we can take from figure 2 is how in all the shown countries the ratio of robots to workers in the auto industry is significantly bigger compared to all other manufacturing industries combined (Bharadwaj, Dvorkin 2019).

When it comes to the asymmetrical effects across the labour markets, a range of outcomes can be regarded as possible: First of all, some of the workers in the automobile industry, especially those performing more manual and routine tasks, may lose their jobs as more and more tasks are being automated. It is also possible that robots end up raising the overall productivity and efficiency, which leads to increased demand for other skills, such as those of technicians. Another possibility altogether is that different industries benefit from the productivity spillovers and consequently increase their own labour demand (Bharadwaj, Dvorkin 2019).



SOURCES: International Federation of Robotics, the U.S. Bureau of Labor Statistics, IPUMS-ACS and authors' calculations.

NOTES: The figure represents the relationship between the changes in the number of robots per thousand workers (as given by our exposure measure) and in the ratio of routine manual employment to population from 1990 to 2007, after controlling for the effects of census divisions. Selected commuting zones are identified using the largest city in that commuting zone. The black line is the regression line. Each bubble in the graph is a single U.S. commuting zone.

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Figure 3 The Effects of Robots on Routine Manual Employment (Bharadwaj, Dvorkin 2019).

Figure 3 presents data (scatterplot) on industry employment and production (regression equation is represented by the black line). Each bubble represents a single U.S. commuting zone (Bharadwaj, Dvorkin 2019). A commuting zone is defined as:

"…a geographic unit that combines counties into an area that reflects the concept of a local labor market better than a metropolitan statistical area does." (Bharadwaj, Dvorkin 2019).

The analysis of this figure implies that a bigger addition in the use of robotics in certain commuting zones is having an effect on the decreasing proportion of people that are employed in routine manual occupations relative to the population that lives in those certain commuting zones. It may however be a possibility that automation leads to an overall increase in employment, but that increase is seen as being lower in commuting zones that have higher exposure to robots because of fewer routine manual jobs. It is therefore important to acknowledge that such figures alone cannot give us 100% insight on the aggregate effects of automation on employment. It is however worth entertaining the possibility that automation might be a critical driver of polarization in the labour market. With the forward push in computerization and artificial intelligence, many cognitive skills have already been automated, including handwriting recognition and pretrial research, and even skills like decision-making under high-pressure and challenging situations such as those in intensive care units may soon follow. Therefore it is clear that automation has far-reaching consequences, including the possibility of structural shifts in the labour market (Bharadwaj, Dvorkin 2019).

4.6 The Impact of artificial intelligence on employment and workforce

While it is true that artificial intelligence has a positive effect in various respects, there are still concerns over the impact of AI on the nature of employment and on the workers themselves. The coming of AI is not a questions of if, but when, and there are already predictions of millions of jobs lost in the coming decades as a result of the deployment of intelligent automation and AI. The whole socioeconomic system has been seen to enter a phase of accelerating transformation (Krasadakis 2018).

At risk are many tasks, roles and jobs. As has been stated in this thesis before, monotonous tasks can be automated with ease, which will make certain roles in the future obsolete. Customer care and call center operations, document classification, content moderation, discovery and retrieval are all tasks and activities that are in an accelerating manner subject to technology and automation. This also applies to roles related to the operation and support of production lines and factories, where humans are being replaced by smart self-navigating robots that can find and move objects, and perform complex assembling operations (Krasadakis 2018).

AI has indeed shown itself to be very effective in dealing with many complex tasks, even those that require processing multiple data streams, signals and accumulated knowledge in real time. A very good example of this is something called “autonomous vehicles” (like Teslas) that are able to understand the environment it operates in and comprehend its dynamics: They can indeed see, decide and act in real time (Krasadakis 2018).

There are further many sectors that will be transformed. For example, transportation is reaching the point where fully autonomous cars can soon be seen on the streets. Professional drivers will therefore see the demand of their skillset drop. Electronic commerce is also something that will go through a transformation, as fulfillment centers become fully automated and robots will navigate the facilities and complete tasks like collect products and execute orders by customers. These orders will then be sent or delivered to customers automatically with automated transportation (including drones and cars). This means that sales staff and physical stores will lose their significance to automation (Krasadakis 2018).

Even more “human” profession are in danger to losing their significance to automation, like legal professions for example. Many aspects of legal professions involve handling documents, classifications, discovery, comparison, summarization, management and knowledge extraction. All of these are already performed by AI in other jobs. Insurance, financial services and other sectors that need large amounts of data processing and content handling will also feel the positive effects of AI, and even in the future states, governance and social mechanisms (Krasadakis 2018).

The sequence of tasks involved in the handling of a customer request in the best possible way can be divided into separate jobs which are repeated over time and across different types of requests: for example, customer identification, request understanding and classification, problem identification, mapping to a solution (Krasadakis 2018).

Such sequences can be performed by AI algorithms that are more accurate and reliable, faster and cheaper than humans. A properly trained AI system can understand customer requests in everyday language, thereby identifying the mentioned or implied entities. It can estimate customer’s intent early; it can estimate the customer’s intent early enough, instantly process huge amounts of data and apply the correct policy in order to identify

the best action or decision for the case it is processing. This decision will then be communicated to the customer in everyday language.

The system knows early enough if it is capable of handling the request. If not, it will redirect the request to the correct operator, with the expectation that in such cases a human will take over their handling. This technological solution requires a fraction of the humans that traditional customer care departments would have employed. While this is a hybrid system in operation, the AI component learns from the expectations it forwards to the human team, leading to continuous improvements in its performance. This autonomous learning process will at some point minimize the need for human intervention, and thus making the AI system more independent (Krasadakis 2018).

Over time it becomes clear that certain jobs and roles are becoming less and less relevant, until finally they are obsolete. In a majority of cases artificial intelligence will perform a supportive role alongside humans. This will empower human employees to perform better in handling complex and critical problems that require critical thinking and judgement. Meanwhile, we can expect the development of numerous new roles and specialities focused on technology and science (Krasadakis 2018).

It is possible to envisage that the AI revolution will lead to a new age of prosperity, creativity and well-being. Humans would no longer need to perform routine, limited value and dull jobs. Employment patterns will move from traditional long-term and full-time employment agreements to flexible, selective premium service offerings (Krasadakis 2018).

This scenario would depend on a common, shared understanding of technology and its opportunities and risks. Societes must adapt to the new technology landscape, continue increasing their flexibility, and cultivate an attitude of lifelong learning, entrepreneurship, collaboration and innovation (Krasadakis 2018).

4.7 Effects of automation on a managerial level: Human Resource Management

It is important to analyze this subject also on a managerial level, especially through Human Resource Management, as they are the ones who actually hire the employees into organizations. Therefore, how automation effects HR also has an effect on the workers.

Indeed, employees require an efficient HR department in order to be optimally productive. When the HR department struggles, the whole organization feels the consequences (Sambandam 2019).

Organization called HR.com and Iron Mountain conducted a survey in 2018 called “The State Of HR Automation”. The study regarded the impact and extent of automation in different HR functions Across 397 enterprise organization. The HR operations automated by the respondents included for example payroll management (62%), benefits (58%) and time and attendance (56%) (Sambandam 2019).

Respondents also discussed the future, and stated that the likely functions to be automated in possibly even in the near future were onboarding (46%) followed closely by records management. The reported advantages to the respondent organizations included increased productivity (above average), more time for strategic planning, business initiatives and internal consulting, being able to provide HR services faster, and reduced cost in providing HR services. 96% of the respondents also wanted more automation, especially regarding outsourcing operation (41%), explaining that they believe it would boost efficiency (Sambandam 2019).

It is also important to distinguish how exactly typical HR functions benefit from automation:

Recruitment

Recruitment is obviously a major function of the HR department, as it can directly influence how a company performs. Finding the right person for the job requires mundane tasks, but also strategic decisions. For example, going through resumes is a

task that requires a lot of time and could be performed faster and more efficiently through automation. Indeed, organizations that have highly automated HR functions use AI to pick preferred and suitable resumes from online pools. This way the human effort is only needed for tasks that require judgement calls, and through automation time is saved for tasks like these (Sambandam 2019).

Onboarding and offboarding

Companied tend to deal with multiple onboardings and a couple of offboarding formalities every month, and many aspects of these processes tend to be predictable and repetitive. These aspects include collecting documents, training, and conducting exit interviews. Therefore it can be seen as a good business sense to automate these processes, as it provides deeper insights and feedback which can then be utilized to improve the future HR functions (Sambandam 2019).

Performance management

A large part of an employees development at the workplace has to be managed by HR (along with managers). Examples of these tasks include appraisals, timesheet tracking, leave management and event planning, all tasks that can be automated through effective HR software (Sambandam 2019).

Payroll management

The transformation of the workforce has resulted in increased appearance of remote employees, contractors and freelances, and timely payroll processing is therefore critical for companies that wish to retain and attract competent teams and vendors. Automating payroll can therefore help to keep these processes functioning properly and timely (Sambandam 2019).

HR analytics

Human resource teams have vast range of responsibilities, and therefore deal with large amount of data. Analyzing the HR functions can present critical insights into driving the company into the correct or desired direction (Sambandam 2019).

Compliance

Automation gives HR teams the possibility to record data about process performance. These records are really useful especially during audits when teams have to demonstrate compliance (Sambandam 2019).

The respondents to the questionnaire also reported the following advantages of automation:

- Greater insights
- Effective records management
- Streamlined efficient processes
- consistent operations across locations
- improved productivity
- improved resource allocation

5 Conclusions

This thesis was done with an aim to find out two key aspects regarding automation and its effects on the workforce: How will automation, robotics, artificial intelligence and digitalization effect the labour markets in the future and what are the skills employees will need in future labour markets to avoid being replaced by robots. By conducting

secondary data analysis, the main findings were identified to be that only 5 percent of occupations can be fully automated and would not need any humans. Estimations are that approximately 60 percent of all occupations have at least 30 percent of activities that have the potential to be automated technically. The biggest impact will be on monotonous and repetitive jobs. Most jobs today will change at least to some extent and more and more people will working with automation technologies in the future.

Globally automation technologies are estimated to affect up to 50 percent of world economy. When put into numbers, this means that 1.2 billion people could potentially be affected by automation technologies. In wages this would mean up to $14.6 trillion in wages. There are also differences I automation potential between countries.

Automation has a differing effects on occupations. Jobs such as scientist, IT professionals and engineers could potentially rise because of new technologies. Based on research, jobs that are most likely to be affected by automation are the kind of jobs that are done in a predictable setting. These jobs might include jobs such as bookkeeping, accounting, service, sales and office jobs.

Occupations with the highest risk of automation are jobs that require low-skilled workers. Another group that in a high risk of automation are people working in low-wage occupations. The group that is the least affected by automation are people working in high-skilled occupations. These jobs require creativity and social intelligence.

One interesting point is that jobs that are on high risk of automation seem to be mainly occupied by men. Based on research this is because men tend to work more in occupations and sectors that are more automatable and also with more automatable skills. This seems to be because men are more likely to work in jobs that require technical and numerical skills for example, which are highly linked to automatability.

The findings further demonstrate how the effects of automation on the job market have been asymmetric, effecting different occupations in a different manner: Due to rise in the use of automation, employment in routine occupations has been stagnant and declining, while employment in non-routine occupations has been increasing.

More and more interpersonal skills will be in demand in the future workplace. Social and emotional skills will see an increase in the future, end employees will spend a lot more time deploying these skills in the future than they do today.

In the future there will be a shift from basic cognitive to more higher level cognitive skills. These higher level cognitive skills require skills like creativity and decision making, which are the sort of skills machines are not performing well today.

The main limitations of this study were that the scope of automation in was quite large in scope. If the focus would have been smaller and the focus more country specific for example, the results could have been different. Second limitation of this research is that it is extremely difficult to say what are the skills that will be in demand in the future and how fast technology will take its next leap forward. As we have seen during the COVID-19 pandemic, it takes one event for technology to move forward in a speed that was not seen before.

The areas of further research around the themes of this thesis are many. The biggest one however must be how different actors like governments, managers of companies answer to the challenges and the job losses (and gains in different occupations) caused by automation. One other topic that has been brought up more frequently regarding automation and its effects on the labour market is how to compensate the workers for their lost jobs due to automation, with one possible solution being universal basic income. Researching the viability of this idea in connection to automation could be an interesting area of further research.

It is clear that automation will affect the job markets significantly in the future. Automation can be seen both as a great opportunity and a great threat. How everything will turn out depends on the skillsets and the willingness of workers to learn new skills as their existing ones might become obsolete, the companies they work at and even the willingness of governments to make plans for the future that relies more on the automation by the day. It is however clear that automation is not some futuristic aspect based in the future. It is already here, and it is a progress that cannot be stopped.

References

Bharadwaj A., Dvorkin M. 2019. *The Rise of Automation: How Robots May Impact the U.S. Labor Market.* [Online] Available at: https://www.stlouisfed.org/publications/regional-economist/second-quarter-2019/rise-automation-robots [Accessed 26.4.2021]

Bhattacherjee, A. 2012. Social Science Research: Principles, Methods, and Practices, *Textbooks Collection. 3*. [Online] Available at: http://scholarcommons.usf.edu/oa_textbooks/3 [Accessed 14.4.2021]

Bughin, J., Hazan, E., Lund, S., Dahlström, P., Wiesinger, A., Subramaniam, A., 2018. Skill Shift: Automation and the Future of the Workforce [Online] Available at: https://www.mckinsey.com/~/media/McKinsey/Industries/Public%20and%20Social%20Sector/Our%20Insights/Skill%20shift%20Automation%20and%20the%20future%20of%20the%20workforce/MGI-Skill-Shift-Automation-and-future-of-the-workforce-May-2018.pdf [Accessed 12.1.2021]

European Commission (2018). *The 2018 Ageing report: Economic and Budgetary Projections for the 28 EU Member States (2016-2070).* [Online]. Available at: https://ec.europa.eu/info/sites/info/files/economy-finance/ip079_en.pdf

Fitzgeralt, J. (2020). Automation Can Be A Response to an Aging Workforce. [Online] Available at: https://www.nber.org/digest/jul18/automation-can-be-response-aging-workforce [Accessed 14.2.2021]

Frankenfield, J. (2021) Artificial Intelligence. [Online] Available at: https://www.investopedia.com/terms/a/artificial-intelligence-ai.asp [Accessed 20.2.2021]

Gaskell, A. 2020. Automation, COVID, And The Future Of Work. [Online] Available at: https://www.forbes.com/sites/adigaskell/2020/10/16/automation-covid-and-the-future-of-work/?sh=2344e37c5e10

Gonçalves, A., 2019. Automation And Robots Are Coming – How Likely Is Your Job To Survive? [Online] Available at: https://youmatter.world/en/automation-and-robots-are-coming-how-likely-is-your-job-to-survive/ [Accessed 14.2.2021]

Gonzalez Vazquez, I., Milasi, S. Carratero Gomez, S., Napierala, J., Robledo Bottcher, N., Jonkers, K., Goenaga, X. (eds.), Arrenqui Pabolllet, E., Bacingalupo, M., Biagi, F., Cabrera Giraldez, M., Caena, F., Castano Munoz, J., Centeno Mediavilla, C., Edvards, J. Fernandez Maciaz, E., Gomez Gutierrez, E., Gomez Herrera, E., Inamorato Dos Santos, A., Kampylis, P., Klemert, D., López Cobo, M., Marschinski, R,. Pesole, A., Punie, Y., Tolan, S., TOrrejo Perez, S., Urzi Bracanti, C., Vuorikari, R. *The changing nature of work and skills in the digital age,* EUR 29823 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-09206-3, doi:10.2760/679150, JRC 117505.

Gutman, L., Schoon, I. (2018*) The impact of non-cognitive skills on outcomes for young people.* [Online] Available at: https://helmtraining.co.uk/wp-content/uploads/2017/03/Gutman-and-Schoon-Impact-of-non-cognitive-skills-on-outcomes-for-young-people-1.pdf [Accessed 14.2.2021]

Kautz, T., Heckman, J., Diris, R., ter Weel, B., Borghans, L. (2014) Fostering and Measuring Skills. Improving Cognitive and Non-Cognitive Skills to Promote Lifetime Success. [Online] Available at: https://www.nber.org/system/files/working_papers/w20749/w20749.pdf [Accessed 14.2.2021]

Kiss, M. 2017. *The future of work in the EU*. [Online]. [Accessed 25 May 2018]. Available at: http://www.europarl.europa.eu/RegData/etudes/BRIE/2017/599426/EPRS_BRI(2017)599426_EN.pdf [Accessed 18.2.2021]

Krasadakis, G. 2018. Artificial Intelligence: The Impact on Employment and the Workforce. [Online] Available at: https://medium.com/innovation-machine/artificial-intelligence-3c6d80072416 [Accessed 29.4.2021]

Manyika, J., 2017. Technology, jobs, and the future of work. [Online] Available at: http://fs2.american.edu/dfagel/www/Class%20Readings/Marx/Technology,%20jobs,%20and%20the%20future%20of%20work%20_%20McKinsey%20&%20Company.pdf [Accessed 14.2.2021]

Mckinsey global institute. 2017. *Jobs Lost, Jobs Gained: Workforce Transitions In a Time of Automation.* [Online]. [Accessed 25 May 2018]. Available at: https://www.mckinsey.com/~/media/McKinsey/Industries/Public%20and%20Social%20Sector/Our%20Insights/What%20the%20future%20of%20work%20will%20mean%20for%20jobs%20skills%20and%20wages/MGI-Jobs-Lost-Jobs-Gained-Report-December-6-2017.pdf [Accessed 23.3.2021]

Moueddene, K., Coppola, M., Wauters, P., Ivanova, M., Paquette, J., Ansaloni, V. 2019. Expected skills needs for the future of work. [Online] Available at: https://www2.deloitte.com/content/dam/insights/us/articles/22923_expected-skills-needs-for-the-future-of-work/DI_Expected-skills-needs-for-the-future-of-work.pdf

OECD (2020). Skills for 2020. [Online] Available at: https://www.oecd.org/education/2030-project/teaching-and-learning/learning/skills/Skills_for_2030_concept_note.pdf [Accessed 2.2.2021]

Prising, J. (2016) Four changes shaping the labour market. [Online] Available at: https://www.weforum.org/agenda/2016/01/four-changes-shaping-the-labour-market/

Sambandam, S., 2019. *How Automation Impacts Human Resource Management*. [Online] Available at: https://www.business2community.com/human-resources/how-automation-impacts-human-resource-management-02202741 [Accessed 26.4.2021]

Saunders, M., Lewis, P., Thornhill, A. 2009. *Research methods for business students.* 5th edition. Essex, England: Pearson Education Limited.

Semuels, A. 2020. Millions of Americans Have Lost Jobs in the Pandemic – And Robots and AI Are Replacing Them Faster Than Ever. [Online] Available at: https://time.com/5876604/machines-jobs-coronavirus/ [Accessed 14.2.2021]

Uzialko, A., 2019. Workplace Automation is Everywhere, and It's Not Just About Robots. [Online] Available at: https://www.businessnewsdaily.com/9835-automation-tech-workforce.html [Accessed 26.12.2020]

Whiting, K., 2020. These are the top 10 job skills of tomorrow – and how long it takes to learn them. [Online] Available at: https://www.weforum.org/agenda/2020/10/top-10-work-skills-of-tomorrow-how-long-it-takes-to-learn-them/ [Accessed 19.3.2021]

Yle. 2020. Experts: Automation could boost Finland's Covid testing capacity to 20,000 per day. [Online] Available at: https://yle.fi/uutiset/osasto/news/experts_automation_could_boost_finlands_covid_testing_capacity_to_20000_per_day/11497091 [Accessed 26.12.2020]

Title of the appendix

The contents of the appendix are placed here.