Work 4.0

AUTOMATION AND THE EUROPEAN LABOR MARKET

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Work 4.0: Automation and the European Labor market

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Executive Summary

Over the past five years a plethora of reports has been written on the repercussions of automation on the labor market. This report tries to synthesize key publications on the topic and focus on the impacts in the European context.

The ten key takeaways are split between the business and the public perspective. It is important that both perspectives inform each other and allow for an inclusive dialogue.

FROM THE BUSINESS PERSPECTIVE

1. Jobs vs. Task? It's Jobs AND Tasks!

Since the writing of Osborne and Frey's 2013 article on the impact of automation on jobs, a discussion started on how to best define the target of automation. Should it be jobs, or should it be tasks, as subsequent authors pointed out? This report argues that both methodologies illuminate part of the puzzle. Jobs are viewed as the sum of a set of tasks. With time, the nature and number of tasks change, facilitated by technology. Over time, the nature of jobs change as do tasks. This assumption seems reasonable across a wide array of jobs.

For example, a car mechanic's job has been changing with advances in technology and lead into a new, more software focused direction: the mechatronic. The job description of a mechatronic didn't exist years ago. Jobs will include more techy aspects. This will also require continuous training in technological products and know-how across the board.

2. Buckle Up Businesses!

Jobs are unlikely to stay within the confines of a 2017 job description. Impacts on hierarchies and day to day businesses is likely to change also. Companies' tech departments are probably also going to see increasing investments. This will in turn also come very costly in potential mergers. Employee trainings are likely to require continuously high investment, which will put a strong additional incentive onto outsourced jobs and working with external consultants. Enter the gig economy and employee leasing.

3. The Private Sector Will Revolutionize Public Goods.

Insurance systems will need to adapt to the changing nature of work. One of the possible frameworks that has been used is the Dutch and Danish Flexicurity Model, allowing for safety for employees and employers, improved lifelong learning opportunities and smoother job transitions. The initiative was put forth in the late 2000s and should now be reviewed to be implemented in policy in a broader context

4. Business Will Take It Slow!

Automation is still very expensive, nevertheless, costs are going down. Big players in the industry, such as Toyota or Mercedes are already heavily invested. The impact

for automation will probably relate to greater interconnectedness between products, complimentary products. Thus, automation initiatives are likely to come in small steps, with managers and CEOs having the possibility to review the implementation process. The process is likely to be gradual in most cases rather than a shock. This will also make it more possible for firms to be able to plan and hopefully invest in the respective phase.

FROM THE PUBLIC PERSPECTIVE

5. Where Do my Bots Pay Taxes?

The redistribution of services from offline to online may also bring about questions of taxation. We need to find out where providers pay taxes and where the respective services are being used. This may also bring new race to the bottom of national taxation policies as companies can easily provide services globally but be registered somewhere else. Tax evasion and avoidance may become increasingly difficult to monitor. The regulating bodies will have to adapt. Even businesses that want to pay taxes may find it harder to know which taxes to pay where.

7. Brace for the Gig Economy

As jobs change, the gig economy will see more and more people. This means that short term projects and initiatives will potentially take a more prominent role than previously thought. Regulators need to adapt. Some of the ways of addressing the adaptation of regulators have been to focus on a liberalized social security system.

8. Education Is Not a Matter of Front Loading Anymore

We have been frontloading our education systems, putting greater emphasis on the first 20 years than the next. This will not reflect the realities of the 21st century. Education will become an imperative across the entirety of professional lives. The rate of change within in an education system is likely going to increase. Review cycles may have to be adjusted to allow for greater changes in subjects taught.

9. Competitiveness Is On the Frontline

European countries and the European Union will need to find ways of remaining competitive, creating value for European citizens and enterprises. Most European Countries have been investing in broadband networks etc., and the role of 5G networks is already being harshly debated. Countries will have to examine viable ways of keeping competitive.

10. As Business Keeps Innovating, So Must Policy

As policymakers need to change perspective on evaluation cycles, so do regulators. This may mean short trial cycles, sandboxing experimenting in smaller groups etc., allowing for collaborations between breeding grounds for innovation, such as universities, start-ups and companies will be a way of creating and sustaining effectiveness and timeliness. This will also put a stronger focus on cyber security. The Tallinn Agenda helps to serve this purpose.

Glossary

Automation, Artificial Intelligence etc. are often used interchangeably to reflect similar trends. This report tries to put the different nuances and factors into perspectives and uses the definitions below.

Term	Definition
Arbeit 4.0	A comprehensive set of reforms to incorporate a growing sense of technological change in public and private life. The word "Arbeit 4.0" is often used synonymously with "Industria 4.0" or "Work 4.0" depending on the national context
Artificial Intelligence	1. A branch of computer science dealing with the simulation of intelligent behaviour in computers. 2. The capability of a machine to imitate intelligent human behaviour.
Automation	The use or introduction of automatic equipment in a manufacturing or other process or facility.
Computerize	To use a computer to do something that was done by people or other machines before.
Digitalization	The integration of digital technologies into everyday life by the digitization of everything that can be digitized.
Gig Economy	A way of working that is based on people having temporary jobs or doing separate pieces of work, each paid separately, rather than working for an employer.
Industrialisation	The development of industries in a country or region on a wide scale.6
Machine Learning	The capacity of a computer to learn from experience, i.e. to modify its processing on the basis of newly acquired information.
Microrobotics	The field of miniature robotics, in particular mobile robots with characteristic dimensions less than 1mm.

Contents

1. Introduction

"The next wave of economic dislocations won't come from overseas. It will come from the relentless pace of automation that makes a lot of good, middle-class jobs obsolete." (Obama, 2017).

As Barack Obama left the White House in January 2017, he left with a note of caution. The next wave of technological innovation in the US was going to be a substantial disruptor for employment. Some commentators state that 80% of the job losses in the US labor market alone are due to technological changes and putting millions more at risk globally (Tyson, 2017). Or do technological transformations create more than they destroy? After all, as one MIT author provocatively asks, why are there still so many Jobs? (Autor, Why Are There Still So Many Jobs? The History and Future of Workplace Automation, 2015) These possibilities have been debated vociferously over the past years on a political and business levels. The debates also have societal repercussions. How do we define work? How do we choose to work with robots? How do we measure quality? Technological progress will have grand societal impacts.

The pressures felt in the American labor market are comparable to the European Counterpart. Within the European context, there are countless options to liberalize the European labor market and to guarantee social security. These opportunities make the European example even more important to examine. Europe is facing a rapidly ageing population, an often-sclerotic labor market and high public spending. How will Europe adapt to cheaper, new members of the workforce, such as robots?
Whereas much of this review's focus lies on automation and artificial intelligence, the impacts of other factors, such as micro robotics, blockchain and other innovations that are yet to develop should not be understated. Disentangling only one factor within a mix of technological developments is virtually impossible as they often interrelate. The development of these technologies will not be singular but will come in conjunction with one another.

The hype around automation is not new though. The discussions on the definition began centuries ago, ranging from Automaton Chess player in the late 18th century, where people could compete against a falsely seeming autonomous chess robot, to the vision of robotics in the 1950s, where visions of autonomy were science fiction (Vagia, Transeth, & Fjerdingen, 2016). As time went on, the demands put on technology changed. Fast forward to today and the possibilities for automation coupled with artificial intelligence have a more complex and nuanced definitions, ranging from whether machines become agents or tools. With agents, the question arises whether they can make decisions based upon simple rules and surroundings (e.g. a Roomba vacuum cleaner). Tools on the other hand cannot make these decisions and work best in a constrained environment (Jebari & Lundborg, 2016). Largely, these discussions revolve around the levels of autonomy the respective robot accompanies and is destined for. Over time, the visions for automation changed and can now do so much more than previously conceivable.

As the vision of automation changed over the centuries, so did expectations. One of the most prolific examples of the impact of machine replacement are the Luddites, where employees saw a risk of being replaced by machines preceding and during the industrial revolution. Other examples have been very much task specific. Such as the elevator operator, or the bank teller. While the number of elevator operators dropped in the 20th century, many of the bank tellers were used in positions within a bank's organization, thus changing tasks and jobs to maximize productivity within an organization. Today, as in the 20th century,

"Robots can both reduce and increase the demand for human labour. Search algorithms reduced the need for travel agents, but Uber increased demand for drivers" (Mahtani & Miller, 2017).

Historically, technological innovations were made to increase productivity. With repetitive tasks offloaded onto machines, firms could come up with new products, and increase on competitiveness and productivity. However today, measured productivity has been dropping with one of the possible causes being technological innovations, such as automation (Moyo, 2016), (Avent, 2017). So why should we pursue it if productivity has been stalling and the impact on labor is not clear-cut? Although rapid technological change is creating new opportunities, fundamental questions still need answering. A comprehensive review of contemporary literature is needed to evaluate the possibilities posed by tech on a European level.

The following report tries to dissect the impacts of work 4.0 in different scenarios in the European context. The second chapter sets the stage by discussing various standpoints relating to business and society, including the state of the current debate, insurance, repercussions on other countries, etc. . Chapter 3 examines different types of jobs, focusing on the European service sector and on the manufacturing sector. Most papers on the issue state a range of jobs that are more and less likely to face automation. Often, the implied meaning is that these jobs will disappear as humans compete with ever cheaper robots and that some jobs are comparably "safe" meaning that the impact of tech would be comparably small. That is a fallacy. In the European context, the manufacturing sector adds one third of the cumulative GDP in Europe compared to services. Also, the services sector is often described as being left relatively safe in comparison to manufacturing jobs. The third chapter argues that all segments of society will be affected, both service and manufacturing. Chapter 4 focusses on country case studies and about their strategies with working with Work 4.0. These segments include industrial and infrastructural policy, education and labor market policies. After examining the industry specific and country case studies in a European context, the question arises: what now? Questions for policy are discussed in the fifth chapter in the policy implications. The last chapter, the Conclusion, serves as a more general roundup.

These chapters outline key debates that revolve around how we could live in an automated world. As much debate has flown into whether we actually want to live in an automated world. This chapter serves as a quick tour of these debates and addresses vulnerabilities that often remain under the radar of the debate.

2. Work 4.0, Business and Society

Around the world, a heated debate has been emerging questioning the fundamentals of automation. Is it stealing jobs in various sectors or creating them? Others argue that it's impossible to predict whether jobs will be lost or gained due to automation. "Search algorithms reduced the need for travel agents, but Uber increased demand for drivers" (Mahtani & Miller, 2017). The developments with technology will depend on the ways that businesses implement these changes and how they will reflect on society.

This chapter will focus on the repercussions that the debate will have on business and society. The first part will introduce concepts and debates. These debates often reach staggering conclusions, translated as social risks, such as mass unemployment. Arguing that robots will be able to replace most of the working population soon. These results have to be taken with a grain of salt. Section 2.2 serves this purpose. Section 2.3 will address how the fundamentals of existing businesses will be addressed and the challenges they will bring. Section 2.4 examines the repercussions the trend has on insurance and public health. The last part, Section 2.5, will focus on the repercussions of automation in terms of global competitiveness around the world.

2.1 The Automation and Labor Debate in late 2017

The question of how to deal with potential consequences of technological progress has a long history of interpretations. Queen Elisabeth I was said to refuse a patent for a precedent to a knotting machine, called the stocking frame, asking what would happen to the knitters as their jobs became jeopardized (Kolbert, 2016). As the Industrial Revolution loomed and Adam Smith's example of the division of labor became applicable, luddites came storming companies and factories as they saw their respective jobs at risk of technology. Fast forward to the beginning of the 20th century, Keynes warned of "technological unemployment" but equally argued that 15 hour workweeks would become the norm in 2030 (Mahdawi & Chalabi, 2017) and that technological and intellectual progress will have solved humanity's "economic problem". Amongst most economists, the question of unemployment caused by technology has largely been deemed as a fallacy (Autor, Why Are There Still So Many Jobs? The History and Future of Workplace Automation, 2015), (Krugman, 2013), as human ingenuity increased productivity and jobs and large-scale policy interventions, such as in education (Autor, TED.com, 2016), created a responsive and better educated workforce with new tools to handle a growing number of complex tasks.

One of the studies that furthered the discussions was recently published in Technological Forecasting and Social Change by Osbourne and Frey (2017). Although, the paper had been widely cited since 2013. The research quantifies the potential impacts of automation on the American workforce and the susceptibility of over 700 occupations. The results amount to 47% of the American workforce by the time of writing. Although the results and the methodology have been harshly criticized, the paper by Michael Osborne and Carl-Benedict Frey has been widely cited and built the foundation for the current debate and the methodology as equally been used in other studies, amongst others the World Development Report 2016 (World Bank Group, 2016). Taking this paper, a step further, similar methodologies were used to create predictive models elsewhere, such as in Germany (Bonin, Gregory, & Zierahn, 2015). Having examined the trends in Germany, one of the impacts has been the possibility to widen the research for the rest of the OECD countries (Arntz, Gregory, & Zierahn, 2016). Another team of researchers tweaked this methodology, arguing on behalf of tasks rather than jobs (Dengler & Matthes, 2015). One of their key findings has been that approximately 15% of the employees working in job with mandatory social insurance strong competition through automation. By taking tasks into account, rather than jobs, the authors argue a more realistic picture of automatable jobs will be generated. Others put the change of definitions of jobs in the focus of their argument, arguing that a large segment of American jobs will be exposed to automation (Mahdawi & Chalabi, 2017). Thus arguing for redefinition rather than replacement. The Royal Society's report entitled "The Age of Automation: Artificial Intelligence, Robotics And The Future Of Low-Skilled Work" complements these ideas and argues that jobs will be "altered" (Dellot & Wallace-Stephens, The Age Of Automation: Artificial Intelligence, Robotics And The Future Of Low-Skilled Work, 2017). On the other hand, Susskind and Susskind also stress that the impact of computers on the workplace should not be underestimated and thus it is increasingly hard to pass judgement on how the impact of automation will play out soon (Susskind & Susskind, HBR.org, 2016). The debate has developed significantly since the writing of Osborne and Frey's arguments allowing for more granular debates (such as whether to go for analyze jobs or tasks) but equally how the essence of jobs may change in the wake of automation.

In this report, jobs are viewed as the sum of a set of tasks. With time, the nature and number of tasks change, facilitated by technology. For example, a car mechanic's job has been changing with advances in technology and ultimately lead into a new, more technologically focused direction: the mechatronic. The job description of

a mechatronic didn't exist years ago. Jobs will include more techy aspects than previously. This will also require continuous training in technological products and knowledge across a wide range of jobs, as many countries in Europe have already attempted doing (see chapter 3). As new tools and technologies become available jobs adapt. This adaptation can also take place within an organization as Autor points out (2015).

Furthermore, new technologies also present more jobs, offsetting a potential reduction of jobs. For example, in the UK alone, the number of programmers increased by 40% in the UK since 2011 as the number of IT directors doubled concurrently (Dellot & Wallace-Stephens, The Age Of Automation: Artificial Intelligence, Robotics And The Future Of Low-Skilled Work, 2017). A McKinsey report equally points out that one third of the jobs created in the past 25 years were in jobs that 25 years ago did not or barely exist yet (Manyika, et al., 2017). Technology fosters jobs.

Although the debate on automation and the impacts on labor have a long history, the results have often been harshly debated and widely debunked. As new methodologies emerged, new results questioned the outcomes of the previous results. Technological progress has been on the frontline of political debates for a long time, with new results shedding a new light onto the debate and jobs created through technology.

2.2 How Should These Studies Be Interpreted?

The studies cited above have been widely cited. Although the results of these interpretations have often been questioned, the methodologies are still being used. Understanding the mechanics of these studies allows to improve the use of the results. One of the assumptions, though often implicit, studies published on the impact of work has been the monocausal nature of the process. The argumentation follows that in the often vaguely defined future, work can be replaced by robots. Competition between firms drives down the costs of production of robots. If the costs of programming, implementing and maintaining automated production lines are below aggregate labor costs, firms have a strong incentive to invest in automation in the production line. Hire and fire laws stand between rapidly reducing the labor force. Thus, excluding a series of other factors in the equation, the argument assumes that only one factor will influence the change of employment in the future. This is not necessarily the case, as questions about legality, costs, ethics, political and technological advancements abound. Equally, a multitude of factors have consequences on technological progress. These factors are not solely based upon ICT but can easily also be political, social, environmental, infrastructural, economic etc. in nature. Numerous studies have been crystal balling the impacts of automation without defining a scope in terms of time often neglecting endogenous and exogenous variation. The studies are non-deterministic and thus their interpretation should not be numeric but contextual. Exogenous variation and endogenous changes can impact the numbers of people affected by automation.

Secondly, the increasing speed of developments in the realm of automation will have varying effects on developments within an industry. The Google ImageNet competition has been ranking image recognition based upon a multitude of factors (lighting, content, speed) allowing different teams to compete and compare the most precise image recognizing algorithms. In 2015, the average mistake made by a computer become systematically lower than those made by humans (Russakovsky, et al., 2015). As margins of error in image recognition decreased, greater trust was put into the developments of algorithms to champion in image recognition and other facts usually assumed to be done by human. Very few studies include the changing nature of quality in automation, as exemplified by ImageNet. Computer can now do many of the tasks that years ago, were completely unimaginable, computers in 5 years will be able to do things that we are currently not imagining. In the extrapolation of projections, assuming “safety” of other job categories, as technology will change and create jobs. Thirdly, costs. Measuring costs in IT has been difficult, in software especially. Computers for example can now do much more than they could previously, with increasing storage capacitates and improved design. One example where the costs of storage is measurable (including increased speed) is the price per Gigabyte that has been decreasing dramatically in recent years and the storage opportunities have risen constantly. This makes digitization and greater computing power more accessible to groups of people that 10 years ago, would have not been able to afford devices, such as smartphones. Today, smartphones create the backbone of payments in rural Africa, such as MPESA. The increasing possibility of the sharing economy, bitcoin and blockchain enabled systems are a recent phenomenon, facilitated by technological advances that have previously been unimaginable. Decreasing prices in IT will have a multitude of effects across a broad segment of society.

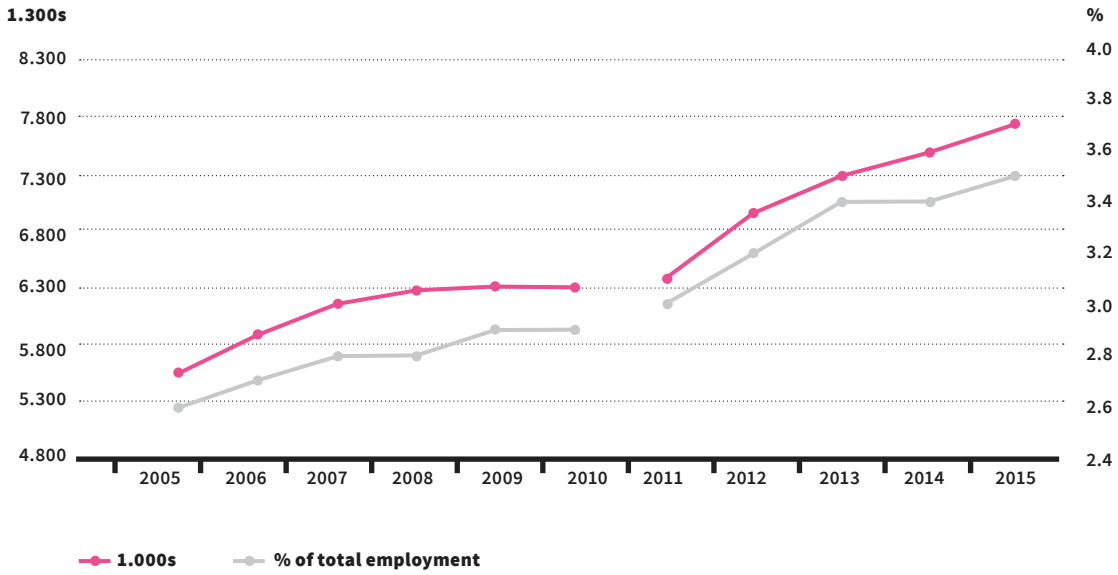
Fourthly, the studies cited above fail to put the number of jobs created into account and to compare them respectively. Firstly, increased technological productivity has been increasing output. As MIT affiliated economist David Autor points out, the number of people employed in US agriculture in the early 1900s decreased 95% until today, yet the US is nowhere near a food shortage (Autor, TED.com, 2016), the same

author demonstrates the rise of people employed as tellers in US banks in conjunction with the automatic teller machine, as this personnel could be reemployed in other activities and tasks (Autor, Why Are There Still So Many Jobs? The History and Future of Workplace Automation, 2015) . Productivity gains have decreased the number of personnel needed. Concurrently, more people could improve their livelihoods through higher levels of education and moving into more profitable sectors. Secondly, improved livelihoods and spending power increase demand for services. Secondly, as a report by Deloitte points out, as livelihoods improved, so did jobs in hairdressing, bar staff etc. The report evaluated 150 years of the interaction between technology and jobs to find that jobs have been destroyed, more have been created though. Even in sectors paying lower wages, which are often the first targets of automation (Stewart, De, & Cole, 2015). Thirdly, almost ironically, one commentator pointed out

"In order for bots to get better and to "steal" all those customer service jobs, we actually need to create an awful lot of new jobs" (Mariansky, 2017).

as these bots are being created, they need to be created with the respective experts if they are meant to be able to eventually contribute to their roles, which has led to an increase in linguistics related jobs to control and improve bots (ibidem). This has helped graduates in disciplines that have previously found it hard to find jobs after their tertiary education (ibidem). Fourthly, with new tools come new professions. A recent study by Eurostat shows that "the employment growth rate for ICT specialists has remained on an upwards path averaging 3 % growth per annum since 2006, i.e. it was more than eight times higher than the average growth rate of total employment over the same period" (Eurostat, 2016). A recent report by McKinsey and company has equally pointed out that approximately one third of the jobs created in the last 25 years did not or barely existed 25 years ago (Manyika, et al., 2017). In London, approximately 10% of current jobs did not exist in 1990 (O'Connor & Bounds, 2015). Although technology has in the past eliminated the need for some professions, others have clearly been created, these jobs include both low and higher levels of education as the demand for services increased over time with improved livelihoods. In order be able to handle these impacts, education and lifelong learning will be key in order for a workforce to adapt.

ICT specialists in the EU-28, 2005-2015 (in 1 000s and as a % of total employment)



Source: (Eurostat, 2016)

Fifthly key assumption of studies is that conclusions about job categories cannot necessarily be aggregated. As a stark example, a report by McKinsey shows that 25% time spent in various tasks by CEOs could be done by machines (Manyika, McKinsey & Co. , 2017). And thus, have the possibility to be automated, however of course this does not mean that 25% of all CEOs can be automated. By induction, the percentage of jobs that can be automated doesn't necessarily mean that the entirety of a job group become irrelevant or replaceable with improving technology. Rather, it showcases the opportunity costs of not working efficiently and are leaving productivity and output on the table. This statistic shows that if a CEO is using 75% of the time on things that could not be automated, she could increase her output by 33%, if she employed the necessary technology without working a minute more. On average used the technological possibilities available they could gain more than an entire week per month (assuming 22 work days) without working a minute more or the fear of being automated. Job categories are not necessarily aggregates of individuals. Additionally, keeping an eye out for impactful tech can increase productivity substantially.

It should also be noted that the reported ratio of 25% is likely to rise with new technological products and research and may eventually flatten. This means that over time, CEOs will leave increasing productivity on the table if they do not adapt to new tools available. Jobs will change as the sum of tasks changes.

A series of factors that will have very real, unintentional and often unforeseeable impacts on the proliferation of automation will shape how we choose to live with and potentially regulate automation. In the past these endogenous factors included, amongst others, the speed of development, lowering costs of data storage and improved data processing. Exogenous factors will include political stability, international trade, environmental challenges and many more. These will all have effects on automation and potentially vice versa and firms will have to adapt structurally and responsibly. Equally, the job creating aspect of better technology cannot be underestimated Reacting to the cited studies is not only vital for policy but equally for business. The following section attempts shine a light on the legal mechanics of job creation.

2.3 Legal Hurdles With New Technologies

The international Bar Association recently published a 120-page report on the impacts of automation and the labor market to, amongst others also review the way we currently define work and how that may change in the future, whereby the legal perspectives on automation are on the frontline of the argument. The implementation of large scale automation will also be subjected to legal challenges, which will dampen the promulgation. These challenges are manifold and so are the repercussions. One industrial example, with a strong focus on legality and liability impacting the development of products has been the automotive industry. One of the key questions in the legal realm hindering fully automated vehicles is the question of liability in a self-driving car. The authors go as far as to state that

"The liability issues may become an insurmountable obstacle to the introduction of fully automated driving" (Wisskirchen, et al., 2017).

Although currently being tested in the United States, potential implementation and legalization is much further in the USA than in the EU. One way to regulate the impacts of automation has been by creating a roadmap for automation in the driving industry on a European level. Again, the focus on the European approach has been on the tasks that are required both from the driver as well as from the car (European Parliamentary Research Service, 2016). The splitting of requirements into granular tasks permeates not only the business realm, but also the legal and policy realm. Different legal systems assign different responsibilities in the same industry to different agents, impacting research and potential production.

Additionally, with increasing promulgation of the internet, companies need to increase their respective awareness of cyber security to reduce their vulnerabilities. However, an important debate within the sphere of cyber security has been on the table, specifically about the automation of cyber security protocols, which are mainly routine. Thus, many have started arguing for more automation in cyber security (Davenport & Amjad, 2016). As automation as well as other components of Work 4.0 develop further, so will the need for enhanced security protocols. A recently held conference on the impact of digitization in Europe put a strong emphasis on cybersecurity, urging European states to implement a common strategy to improve and upkeep security online both for individuals as well as for companies.

Accountability and automation is going to be multifaceted. The liability issue in the self-driving car debate currently spearheads the discussion. The importance and value of data and its respective legal protection. Labor standards and fair employment relations will have to be guaranteed.

2.4 Insurance With More Tech

As our definition of work changes, so does the ecosystem surrounding labour relations. One key aspect of employment relations is insurance. Social insurance, health insurance, pension insurance etc. Europe has some of the most elaborate insurance systems in the world. As the nature of work changes, so must they.

Denmark and the Netherlands have been purveying a model of insurance known as flexicurity, which has been used as a blueprint by the Council of the European Union to strengthen the flexibility as well as the security in employer/employee relations in EU member countries. The policy on European level aimed at ensuring more lifelong learning possibilities for employees and was meant to facilitate the transition to new jobs, lifelong learning and income support (Spidla & Larcher, 2008). The strategy was derived from a series of talks with European social partners in an inclusive and democratic discourse. Although the policy was published in 2008, it serves as a very fitting example to tackles issues applicable today.

Over the past 10 years, the missions to further flexicurity on a European level started off well, but seems to have stalled. In 2008, after the publication of the common labor market policies the mission to flexicurity targeted a selected group of European countries. By 2012, as the flexicurity final report concluded individual countries showed varying approaches to the respective structural changes to the European labor market, some cherry-picking and other barely responding to the suggestions. What started off well, seems to have seeped through the sand on a national level. Now, with greater economic changes, there is an increasing imperative to follow up on the initiatives on flexicurity on a European level and to implement them on a national level (ICF GHK, 2012).

However, there is light at the end of the tunnel. The recently published Conclusions of the Tallinn conference picks up part of the agenda again. One of the conclusions states the importance of fostering an attractive ecosystem for startups and for tech companies (Ratas, 2017). More and more startups in Europe, as witnessed in Austria are already working with flexible working relationships, allowing people to work from home and as well as other structural changes with new business models (Arthur D. Little, 2017), flexible relationships are becoming a norm. The Tallinn agenda goes on to address issues linked to lifelong learning, which were equally in the 2007 agenda on flexicurity to smoothen employment paths. Although the 2007 flexicurity agenda seems to have stalled, more flexible working relationships as well as lifelong learning were picked up again 10 years later.

Again, this is not to say that the repercussions of technological advancements on policy are not being discussed on the European level. One initiative on the table on a European level has been the possibility of viewing robots as “electronic persons”. The owners of the robots would have to pay insurance and foresees the implementation of a registrar of smart autonomous robots (European Parliament, 2016). Additionally, the guideline foresees that businesses must declare their respective savings to adjust taxes. This move was immediately criticized by robot producing firms stating that it would distort incentives in research and would stunt the development of robots (Prodhan, 2016).

As the tasks we constitute as work change, So do the mechanics that drive work; insurance, social security etc. EU efforts to adjust to a new work culture already started in the late 2000s. One such country is France, where debates about flexicurity already started in 2008 (Taylor P. , 2008). With increasing technological rates of change, a new need to reinterpret insurance becomes more pressing. Member states need to speed up the process to allow for such changes. France has recently followed up

on these policy options again (Goodman, 2017), where relations with labor unions are different from the Nordic counterpart. On an academic level, flexicurity is being discussed again as well (Bekker, 2017). The French example may reinvigorate the debates about flexicurity in Europe as a whole.

2.5 Trade and Competitiveness with Robotic Labor around the Globe

Automation is often said to decrease costs, having the possibility to render sectors, such as manufacturing, in developed economies more profitable. Until now, cheaper production possibilities have been creating comparative advantages for developing countries and have been a driver for industrialization. Imagine the thousands of call centers in the Indian subcontinent, hi-tech production facilities in China competing with robots in industrialized countries. Again, these jobs are very repetitive and task specific, which face the greatest threats. these developments are likely going to alter the long run mechanisms of international trade.

One of the impacts of automation will lie in the increased competition that manufacturing can play in already developed countries. With increasing demand from the side of consumers, lowering costs of automated capitalas well as closer Research and Development facilities and headquarters, manufacturing may have the possibility to increase in comparative advantage in developed countries these repercussions are likely to increase capital and infrastructural investments in developed countries, as is already the case in Germany and its automotive industry (see German example in Chapter 4). The possibility that developing countries will be drained of investments, exacerbated by increasing interest rates in developed countries is a point of concern. A recently published article by the World Bank's Trade and Competitiveness Unit analyzed the risks of basing development policy on manufacturing considering automation. This has potentially highly detrimental impacts on the workforce in industries that have been basing their development trajectories upon the offshoring policies by industrialized countries. Industrializing countries, with often loose employment relations, low levels of education in the manufacturing sectors, are surely going to feel an impact in the long term (Hallward-Driemeier & Nayyar, 2017). The repercussions of automation in the developed world will equally impact developing countries. As one commentator put it,

"the comparative advantage of poorer, emerging economies will soon be eroded" (Bowcott, 2017).

The impacts of automation in the developed world are likely to have global consequences. These consequences will reflect in international competitiveness, industrialization and potential unemployment. On the other hand, digitalization also became a tool to argue for a more inclusive and democratic changes.
The long-term changes are yet to be seen.

3. Jobs Cases

Computers have been changing the way we live and work. Across a wide range of jobs, the impacts of technological change have been received differently. In a Eurobarometer study conducted in 2015, different countries showed different attitudes towards robots at home and at work. On average, Europeans showed that 61% of respondents believed that a robot could not do their respective job in the future (European Commission, 2015). Manual workers were amongst the top segment of persons responding that a robot would be very likely to do their job in the future with over 40%. Nearly half of all respondents claim that they would be interested in having a robot assist them at work (48%) (ibidem). The way we feel towards robots at home and at work will change.

Until 2015, the promulgation of automation was still concentrated on four industrial groupings; computers and electronic products, electrical equipment and components, transportation machinery (Sirkin, Zinser, & Rose, 2015). In 2017, the picture has already changed. As automation develops and so do the products that grow out of startups and large companies, the increasing rate of implementation, coupled with decreasing development costs, will allow for a widespread implementation of automation. As the role of tech increases, so do the possibilities that come with it, already lurking into professions that would have been unforeseeable only five years ago.

Most publications, such as Autor 2015, Osborne and Frey 2017 and Susskind and Susskind (2016) concur that occupations where creativity and human communication are key, are relatively safe from automation. Thus, this literature review specifically targets services and jobs that are particularly based upon thinking outside the box, human interaction and tacit understanding. Services account for over 73,4% of European GDP in 2016, whereas industry accounted for 25% of GDP in 2016 (European Central Bank, 2016). This section argues that although services might be “safer” than other jobs, it does not mean that the way we interpret work in these services won’t change. Digital literacy and increased knowledge of technological tools and opportunities will become even more important. The first group (3.1-3.4) focuses on services (also accounting for approximately three fourths of European GDP, see above). where human interaction, creativity, compassion, analytical skills and people skills have been vital. The last section focusses on a classical example in automation and focusses on German car manufacturing (manufacturing accounts for one fourth of European GDP, see above). Where the impacts of automation can be felt at full speed.

3.1 Journalism

Human interest in history blooms begins with recorded history. People recording occurrences on papyrus, paper or clay for posterity has been an existential trait of human development. The recording of occurrences creates an understanding of who we are, what we experienced and how we fee. Journalism thereby is an industry existential to human history, culture and self-identification. What happens when robots start writing news?

One industry with a predictably low probability of replacements of robots is Journalism, as mentioned in one of the most quoted studies on the impacts of automation, it is an industry with a relatively low probability of showing considerable effects on automation (Frey & Osborne, 2017). However, once we add exogenous variation to the predictive indicators, such as market power, we see how industries change with automation.

Journalism has been riddled with the transition to automation. the reason for this transition is likely to be cash. in the US, smaller media outlets are struggling to remain competitive and profitable, larger newspapers, such as the Washington Post, have been dipping into smaller niches to increase readership and revenue. As the author one article writes

"instead of targeting a big audience with a small number of labor-intensive human-written stories, Heliograf, one such software, can target many audiences with a huge number of automated stories about niche or local topics" (Keohane, 2017).

Robots literally write history. With these new business models also come new challenges, such as the potential for articles to be rewritten and be constantly updated, as the author shows. As the profitability of different news outlets dwindles, they are forced to consider different directions to keep their numbers in the black, allowing highly targeted articles, which human journalists couldn't. In Sweden, this trend has already been well documented as well (Löfgren, 2016). As the Associated Press' Automation Editor Justin Myers suggests "You can take a step back and tell me instead what you noticed, what was interesting, something personal" (Holmes, 2016). Automation has lead large media corporations to focus on personalizing stories. Globally, more and more new outlets see automatically written news as a way of increasing revenue through improved targeting in niche markets.
Equally, sheer volume that is now being produced allow for more content, but also more quality. As more reports and articles are being automatically generated, the quality of the respective software improves as the algorithm learns. The editor makes changes and the software has the possibility to learn and to adjust its punditry. As Reg Chua, Executive Editor, Editorial Operations, Data and Innovation at Thomson Reuters suggests

"in a blind taste test, the machines actually came out as more readable than the humans" (Holmes, 2016).

Better access to data, accompanied by machine learning, allow for more targeted articles and a greater volume of output through automation. These factors are changing the nature and definition of journalism. New types of jobs are created simultaneously.

3.2 Medical Professions and Pharmaceutical Industry

The impact of automation has been argued to be positive for the end consumers and target groups in the previous example. Personalized targeting, more quality, more niche markets at lower operational costs is argument that favors the reader, or the account holder. However, how does automation change a profession in industries where the recipient and target of the product is not as clearly defined, such as the medical industry? Where end targets can be patients, insurance firms, doctors or hospital managers. According to Osbourne and Frey's 2017 paper, the medical profession has is ranked predominantly in the lowest decile in terms of probability of being replaced by automation. Nevertheless, the medical profession and the pharmaceutical industry have seen tech change the respective occupations.

How do we deal with dying patients, how compassionately should we infer about life and death in an oncological ward? The medical profession, as well as the countless of industries attached to it, such as the insurance industry (see section 2.4) and the pharmaceutical industry have already seen the impacts of automation in key cases with the possibility to further extrapolate these findings to other jobs and sectors. A survey conducted by the European Commission in 2012 and in 2014 showed varying changes in the acceptance of robots in healthcare. The results showed that 55% of respondents would be uncomfortable with a robot performing medical operations on them. Like 2012, where that number was slightly higher (57%). In 2014, 51% of respondents claimed that they would be totally uncomfortable with robots providing companionship to the elderly and 29% saying that they would be totally comfortable with robots doing so (European Commission, 2015). The survey suggests a fear of intimate contact with robots amongst the questioned sample. Reluctance to intimate contact with robots is improving.

Others argue that due to the advent of automation, in the USA, the bargaining power of doctors is shifting, towards insurance companies as technological progress drives down administrative costs and service costs (Mourdoukoutas, 2017). Yet others argue that the advent of digitalization will have unpredictable effects on the pharmaceutical industry, depending on the administrative national system in place (Spinks, Jackson, Kirkpatrick, & Wheeler, 2017). Key factors are still up in the air.

Two authors have shown with over 100 interviews in a variety of highly educated professions which ones are likely to undergo profound change (Susskind & Susskind, HBR.org, 2016). The two researchers showed that most of these industries demonstrate two kinds of problems, the first being the empirical, the second being the conceptual. The empirical part argues that often professionals in the field of law, medicine etc. argue that their respective profession falls under the creative, empathic, group, where automation will set in later. However, mundane, day to day tasks can easily be broken down into process oriented, routine tasks, making them more probable to automate. The second problem, as the two authors argue is that the outcomes are only possible through sentient beings, being compassionate and empathetic, they called this the "AI fallacy" (Susskind & Susskind, HBR.org, 2016) and showed how these tasks could equally be done by an algorithm or robots. Again, as technological advancements change tasks, the limits of artificial intelligence change and so do the opportunities for AI enabled programs.

For example, Radiology saves lives through the cognizant observation of x rays, MRI scans etc. The recognition of anomalies in these scans can be learnt and is a task. Artificial intelligence and machine learning has been improving the precision of image recognition (Russakovsky, et al., 2015), making the impact on radiology imminent. Enter IBM's response enabled by Watson (Vespi, Caroline, 2016). IBM's Medical Sieve was presented at the Radiological Society of North America in 2016 to assist doctors

and to allow for higher precision in the field of radiology. Other sectors in medicine are no exception. The diagnosis of schizophrenia, psychosis and liver disease have seen improvements through new technologies (Marr, 2017). With these new developments come potential savings. It's no surprise that a million-dollar prize has been announced on algorithms that can spot cancer (Knight, 2017). Artificial Intelligence has the possibility to drastically reduce the costs of healthcare through improved image recognition and more precise diagnostics.

With new diagnostic possibilities, medical research will be defined anew. In conjunction with improvements in CT scans, different initiatives have been trying to decrease the number of false positive in the diagnostics. Microsoft has been working on personalised possibilities for cancer treatment that take the patient's specific preconditions into account (Bass, 2016) and potentially make cancer history by reprogramming cells (Knapton, 2016). Other companies, such as IBM have also l ong been playing the field. IBM's Watson has been working on improving diagnostics, but equally has the possibility to improve the trainings of surgeons (Cohn, 2013). New micro robotics improvements have restored vision through surgeries that previously needed meticulous precision, with a robot these invasive surgeries are vastly facilitated (Stark, 2017). New possibilities in AI and micro robotics could lead to new treatments to cope with cancer, the reprogramming of cells and better trained and more precise surgeons.

On the side of the patient, there is also another benefit, additional to decreased costs. As Cohn notes, for most patients, interactions with the respective healthcare system are episodic. However, with increased possibilities form mobile devices as well as new technological developments in machine learning and artificial intelligence interactions have the possibility to be long terms and predictive and could potentially resolve health issues before they arise.

According to a McKinsey report in 2013, better informed decision making through, new technological products, such as big data strategies could result in $100 billion gains in the USA (Cattell, Chilukuri, & Levy, 2013). New technological products fuelled by big data strategies, artificial intelligence and micro robotics have the possibility to revolutionize the sector in Europe as well and provide better healthcare for millions of people.

3.3 Recruiting

Hiring the right personnel is the cornerstone of successful business and institutions, requiring interviews, tacit understanding of composure and interpersonal skills. Thus, recruiting has long been a field that has been at the pinnacle of human interaction, analytical decision making. How does a person relate to the counterpart in an interview, how confidently applicants respond to questions, how would that specific person fit in a team? Already according to studies, such as Osbourne and Frey in 2013, it should be these jobs where automation should not be a dramatic counterpart to human interaction. That assumption cannot stand the test of empirics.

The recruitment process is based upon different intervals, like tasks. The first step being requisition, a firm needs someone to fill a void. The next step is the sourcing, where recruiters search within a pool of potentially interested applicants. That follows a screening process. This process can have several steps, such as numerical tests, personality tests, etc. Thereafter, interviews begin. The successful candidate(s) are found and hired. The recruiter is paid, i.e. Based upon the salary of the successful candidate. This is especially valuable in hiring executives. This process ideally takes days, often it takes weeks. Also, given the respective constancy of procedures, it is also repetitive. The fact that these individual steps, like tasks are repetitive makes the procedure automatable.

Enter AI. Numerous firms are already in the market to make AI applicable to the recruiting sphere. They interpret every step along the ladder as an individual task that can be automated. For example. One firm sees the possibilities of recruiting in saving time, reducing bias, and increasing efficiency in recruiting. The company states that recruiters spend up between 40 and 60% sourcing applicants (Arya, 2017). This time could be put to other use with the usage of AI, according to Arya. Mya, is another example of a recruiting firm, which has been focusing on revolutionizing recruiting through artificial intelligence (Efron, 2016). One of the key pain points the company has been trying to address has been lacking responses from recruiters. The AI enabled product enables questions from applicants to be answered in virtually no-time, thus applicants to stay engaged (Efron, 2016). The program goes further to schedule interviews and assessments and evaluate resumes for recruiters. Additionally, where Mya sees that applicants are not fit, the program suggests other jobs the applicant might be more successful in. Based upon recent evaluations, the company states that 72% of all applicants thought they were chatting with a human (Prior, 2017). Recently, the company managed to raise $11.4 mio. to improve this communication and recruiting tool (Mannes, 2017). Mya focused on retail, warehouse and call-center jobs, where repetition is high and the diversity of tasks to expect is low. Improved interactions with potential employers, reduced friction and time spent searching are some of the pros for using AI enabled systems to streamline recruiting operations. In an industry that has been associated with personal interactions have been the norm, AI again has been changing the definition of jobs in recruiting.

3.4 Finance

The story of the ATM is a parade example of automation. Again, an industry, which often demonstrates significant roles in people to people interaction, where personal interactions have been important. Autor (2015) demonstrates that the number of tellers in banks grew although automated telling machines (ATMs) replaced most of the work of bank tellers. In the USA, the number of tellers quadrupled from ca. 100,000 to 400,000 between 1995 and 2010. Concurrently, the number of tellers increased by 10%, rather than being wiped out. The number of tellers rose from 500,000 to 550,00 in the same timeframe in the USA. How come?

Bessen argues this is due to the gains in efficiency. He argues that greater efficiency allowed for more bank branches to be opened, thus increasing the number of tellers needed (Bessen, 2015). Additionally, skillsets demonstrated by tellers changed, focusing more on interpersonal relations as well as marketing became more important (ibidem). He goes on to argue that these gains can offset the number of jobs lost due to automation and thus redefined the jobs rather than destroying jobs. Although Autor notes that this example should not be taken as paradigmatic, the study shows the job creation effects of automation. As the sum of tasks change, so do jobs.

Fast forward into the next decade and the issues facing the industry are similar in nature. In the UK, PWC argues that 350,000 jobs in finance and insurance in the UK may be at risk due to automation without a clear timeframe of when this change is meant to be expected or in what intervals (PWC, 2017). This number is still low in comparison to other sectors, such as wholesale and retail trade, where approximately where approximately 2,25 million jobs are at risk, accounting for over 14% of the UK's total employment share (ibidem). A recent report by EY also showed that robotic process automation (RPA) can create 50-70% in cost reductions in high frequency tasks and can contribute to increasing effectiveness and efficiency within the workforce (EY, 2016). The same report argues that making sure these automated tasks will lead to a refocused workforce is a priority. Additionally, robotic processes will necessarily be managed by humans, increasing personnel. Like the examples of the telling machine (Autor, Why Are There Still So Many Jobs? The History and Future of Workplace Automation, 2015), these reports demonstrate possible effects on employment ; one report arguing greater risk of jobs, the other report showcases gains in efficiency and the need for potential refocusing the respective workforce, as done in the case of bank tellers.

Taking the finance industry into perspective showcases a well-documented examples of the effects of automation. It should also be noted that financial institutions have a comparatively high stake in their respective operative efficiency and profitability, and have relatively homogenous demands on their workforce. This homogeneity increases incentives for third parties, like service providers, startups etc., and banking institutions themselves to develop resources for these firms that improve efficiency and profitability. The past has shown that within this sector, retraining has been possible and that the human interaction is vital as many jobs are at risk in the sector.

3.5 Manufacturing

Manufacturing serves as an example of typical cases that have been greatly influenced by increasing automation, with numerous studies either describing or predicting the rise of the robots in manufacturing, displacing jobs and hurting blue collar workers. In Osborne and Frey's study, manufacturing was an industry with a high potential to feel the changes of automation.

Over 2 million enterprises in the EU were in the business of manufacturing in 2014 (Eurostat, 2017). The sector itself employs between 12.5% in the Netherlands to 34.9% in the Czech Republic of its respective labor force (European Commission, 2017). Central Europe has generally been a focal point for manufacturing in Europe (Stehrer & Stöllinger, 2015). Germany has become the country with the highest density of industrial robots in Europe, with a staggering number of 301 per 10,000 employees, the country also ranks fourth in the world by that same metric (Germany Trade and Invest, 2017). Europe is a manufacturing powerhouse, where automation has been on the frontline of the news, with Germany as an example.

Car Manufacturing is a parade example for jobs that are often being replaced by robots. Consistent quality is needed, hazardous gases in paint shops make work there dangerous, jobs are based upon repetition (Scemama & Harbour, 2017). Due to the extensive costs of labor, one car manufacturer invested in wind-shield installing robots in the assembly line. However, due to the high costs of maintenance of the machine, the machine turned out to be far less efficient than the usage of human labor, in fact they ended up having to employ twice as many workers as previously (Scemama & Harbour, 2017). As automation advances, the costs of development and installation are assumed to drop, improving the effectiveness and efficiency of the products. The seemingly simple task of gluing windshields has proven to be a major bump in the road in the production process.

The car manufacturing industry is prone to customize. Every customer has a slightly different version of the car in mind she buys and businesses need to adapt. For robots, changed production lines has proved to be expensive and hard to handle and can require weeks to align and reprogram (for humans, this task takes a weekend) (Gibbs, 2016), additionally, customization has been a key bottleneck in the automation process, requiring more workers (Scemama & Harbour, 2017). Given that German car manufacturers are classically more expensive cars, the need for consistent, reliable and top of the line customization is a key selling point. In 2015 alone, the number of employees in the automotive industry has risen by 2% to 792,500 employed by German car manufacturers in 2015 (Germany Trade and Investment, 2015). The example shows that the costs of automation may not be as low as previously assumed with seemingly simple tasks becoming a significant hurdle. As one executive put it,

"We're moving away from trying to maximise automation with people taking a bigger part in industrial processes again. We need to be flexible. The variety is too much to take on for the machines. They can't work with all the different options and keep pace with changes." Markus Schaefer, Mercedes-Benz' head of production[1]

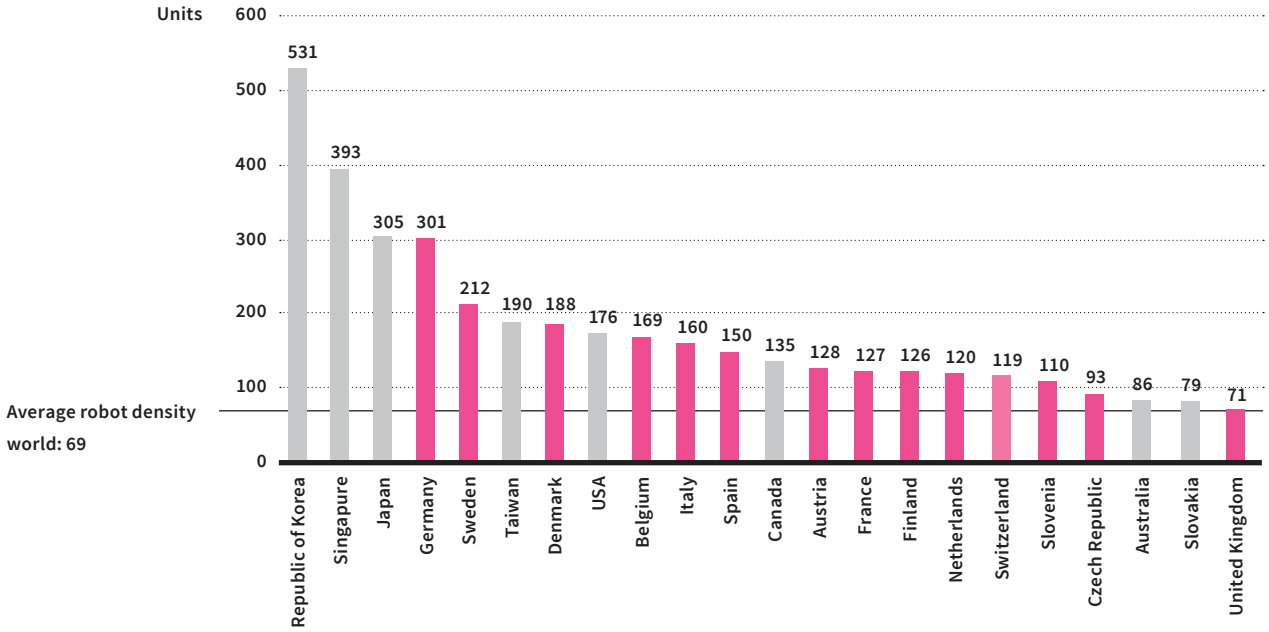
As more investments will pour into automation and streamlined workflows, a greater proportion will have to be attributed to maintenance and programming. As one example in German luxury car manufacturing shows, the impact of increased automation also requires more investment in trained personnel to repair, maintain and customize products. The costs of such maintenance can be higher than the costs of employing lower skilled workers (Gibbs, 2016).

1 taken from (Gibbs, 2016)

Although the German Auto industry has been keen to invest in automation technologies, hundreds of thousands of people are still employed in the manufacturing in these industries with current estimates of employment leaving room for optimism. Robots find it hard to change their workflow, costs of maintenance and reprogramming are high and customized products cause severe are speedbumps for robots in the auto industry. This serves an industrial example of Moravec's Paradox, the fact that tasks that are seemingly easy are in fact much harder to automate than more complex tasks. The more complex tasks take up less computing power than the ones that are more elementary.

High robot density in EU countries

Number of multipurpose robots (all types) per 10.000 employees in the manufacturing industry (ISIC rev.4: C) 2015



Source (International Federation of Robotics, 2016)

4. Country Case Studies and Work 4.0

Europe is not only a set of shared values, goods and services but also a common market, allowing for the free flow of goods and services under the Schengen Agreement. Various legal systems, countries, policies and customs heterogeneity are likely to impact the proliferation of automation and to develop in different countries and industries in different speeds.

The selected examples are united in their respective diversity. They include Germany, Italy, Austria, and Estonia. These examples are meant to reflect the political, economic, demographic and industrial heterogeneity within Europe. Germany has been one of the first purveyors of an inclusive decision making process in the wake of increased automation in the workforce, resulting in their famous White Paper. Estonia is a comparably small country within the selected sample with a small population (1,35 mio.). In 2017 it is one of the countries that has been investing heavily in the use of computerized public services. Italy is a southern European powerhouse with strong regional connectivity chasms. Austria is a sample for a medium sized economy comparable in size with central European countries as well as Benelux countries. These examples reflect the variety of countries tackled by a comparatively similar input: rising tech.

A recent report by the World Economic Forum points out that most European countries are often badly prepared for the advent of large scale automation and need to prepare for the impacts it will have on competitiveness (Schwab, 2017). A recent report by McKinsey points Europe towards increased investment and competitiveness to be able to adjust to automation (Manyika, McKinsey & Co. , 2017). On a political level, the 2017 Digital Summit held in Tallinn, Estonia shoved Europe in the direction of increased automation with follow up meetings scheduled to take place in mid-October 2017 in Brussels (Ratas, 2017). The three cited reports were published within the span of only a couple of months. As tech develops, the need for Europe to react becomes more urgent. Most countries have taken on a policy mix to address increasing automation in the workplace. These policies often range from education to infrastructural and industry related investments to labor market regulations and deregulations. Thus, the following chapter examines

1. **Education and Lifelong Learning**

2. **Infrastructural, Industrial and Research Policy**

3. **Regulating/ Deregulating Labor**

on a country by country basis wherever possible. The chapter underlines the need for investments in education across the case studies. Additionally, the value of infrastructure is shown by offering new possibilities even in remote places. Lastly, reevaluating social security mechanisms under new trends, such as the gig economy, will provide massive opportunities for Europe as a whole and European states specifically.

4.1 Germany

One of Europe largest economies, contributing one sixth to the total European GDP is Germany. Germany has been on the frontline of innovation policies to accommodate its Industrie 4.0 package. An inclusive decision making process, comparable political system across Europe and its demonstrably high integration in the European common market make it an imperative example. The focus of Industrie 4.0 was predominantly looking at the business possibilities that the future entailed artificial intelligence as well as other technologically sparked trends. The proliferation of these trends lead to concern for work, both for the government as well as other stakeholders. The resulting questions were discussed at length and the results were published in late 2016, resulting in the term Work 4.0, or Arbeit 4.0. This paper was meant to be an addition and complement to the previous publication to be able to align the business and industrial factors with the social factors.

This White Paper focused on the flexibility argument whilst securing a safe and healthy workplace and work life balance. It is using the technological transformation to leeway into a transformation of the way people work in Germany. Family, work times, education and fair and remuneration were key instances of the findings that were meant as a blueprint for the future.

Education and Lifelong Learning

As the nature of work changes, so does the need for education, as previous chapters already showed. As education's half-life deteriorates in the advent of automation knowledge that was relevant in the past may not be as relevant in the future. Thus, the need for lifelong learning and the legal right for vocational training, especially as the workforce gets older and as job descriptions will change in the future. Additionally, the paper paved the way to the Working Time Choice Act, which is meant to adapt working conditions at the workplace. The German "Digital Pact" also increased funding for schools in ICT. This policy is meant to improve tech resources in primary schools, advanced general schools and vocational schools (Brady, 2016). Germany's policy mix has been targeting the multifaceted repercussions of technological development, improving educational resources and schooling across the age spectrum.

Infrastructural, Industrial and Research Policy

In terms of Germany's industrial policy is the centerpiece of its success. Germany has been investing heavily in streamlining its manufacturing and its competitive edge. Despite digitization, high levels of investment and a well-educated labor force, productivity has been low since the 2000s. This is known as the productivity puzzle. Additionally, clusters of relevant companies working on similar topics dispersed in Germany allowing for targeted spillovers of knowledge (Germany Trade and Invest, 2017). This makes use of the fact that Germany is currently Europe's biggest research spender (ibidem) and the tendency seems to be growing. According to Germany Trade and Invest, over Euro 2.2 billion are expected to flow into Germany's Industrie 4.0. These investments are assumed to translate both into increased physical as well as human capital.

Regulating/ Deregulating Labor

In terms of employment, the Ministry of labor has set a goal to move away from unemployment insurance to potential employment insurance. Thereby aspiring to guarantee work rather than guaranteeing unemployment benefits. One of the ways in which the German ministry has been trying to accomplish this goal is through a personal work account, which every person would start at the beginning of the working life. This account allows for 'credits', which workers can attain through work and individual contributions for education and skill enhancement. This allows the policy to render work more flexible and self-determined amongst employees whilst creating an incentive to reduce presentism amongst employers. Additionally, workers face increasing pressures from their employers to be reachable outside of working hours. These policies are meant to create incentives for businesses whilst adapting to a changing workplace and insure a healthy working environment. Regulatory frameworks need to adapt to a changing nature and definition of work.

Germany's policy has been inclusive, taking various stakeholders into account. As multifaceted as the inputs were to the discussions regarding the policies for Arbeit 4.0, so are the outputs.

4.2 Italy

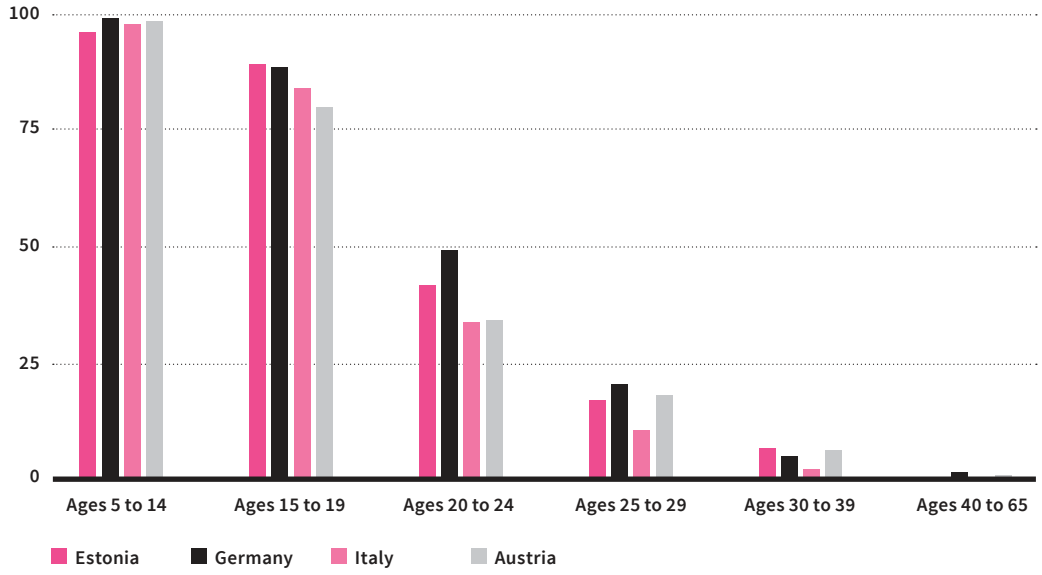
Italy has been on the tail end of Europe's research and investment success stories. According to the Ministry of Labor (2016), the Italian strategy will be focused on attracting startups in Industria 4.0. Italy has been lagging on research spending as well as the possibility to generate growth through startups to address regional inequalities and to become more competitive in the European market (Frankenberger & Schmid, 2016). In 2016, the Italian Ministry for Economic Development (MISE) revealed its plan to enhance start-ups and to create plans to facilitate investments in such and allow more companies to spur growth through investments in newly founded Italian firms (MISE, 2017).

Education and Lifelong Learning

As a recent report by the OECD points out, Italy still has a long road ahead to fill the gaps in the education system (OECD, 2017) to make it more resilient and adaptive to new trends in technology. One of the ways one researcher argues is by making private sector research equal to academic research (Tiraboschi, 2017). The researcher argues that the on-demand economy will have correlating effects with Industry 4.0 in accordance to the European Charter for Research. Private sector research has been one of the key components of success stories of for example the German case.
In terms of education, Italy has been focusing its policy around industry 4.0, based upon two educational target groups. These are young high school graduates as well workers, showcasing the need for lifelong learning. Only 1,4% of all of all Italian graduates graduate in STEM subjects and vocational training has been on the brink. Thus, one of the policies has been to focus on "industrial PhDs" and to focus on digital schools (Firpo, 2017), connecting industry with academia. Further initiatives have been to tie academia and industry closer together and to create Competence Centers and Innovation hubs. These factors were unified in the National Skill Approach (ibidem).

One of the findings has been that Italy still demonstrates enormous potential for growth in matters regarding education as a whole, both front and back loaded, as reinforced in the conclusions of the Tallinn Digital Summit 2017 (Ratas, 2017). Italy still has wide ranging potential in terms of education policy and lifelong learning.

Students as a percentage of the population of a specific age group



Source: (OECD, 2017)

Infrastructural, Industrial And Research Policy

The Italian Industrial policy has been focused on providing necessary infrastructure to businesses. One such resource has been optic fiber to guarantee an 30Mbps connection to all businesses by 2020, with 50% of all businesses to receive 100Mbps connections by 2020 (Firpo, 2017). Better internet connections help firms and can thereby also increase employment (Falck, 2017). Additionally, a key aspect of Italian Industrial policy has been to form consortia around matters dealing with the Internet of Things. Another way of creating incentives on behalf of industry 4.0 has been through tax incentives. These policies were presented in accordance with a new business law, which is meant to spur growth amongst firms investing in tech. driven and big data approaches 2017 (PWC, 2017).

Regulating/ Deregulating Labor

Although Italy has been launching numerous initiatives to tackle industry 4.0 and the impacts of increased technological possibilities, the possibilities for reform in post crisis Italy are still abound. Yes, the technological possibilities for the employers improved following the 2014 job act and new types of contracts were created (Fana & Guarascio, 2016). However, is still room for improvement. With increased structural investment, such as in broadband internet, firms may find additional incentives to hire (Falck, 2017).

4.3 Estonia

The Estonian example shows differing characteristics compared to the previous examples. Estonia is the only Baltic state in the selection, it has a very high density of startup founders is a former Soviet state, and has the lowest population in the selected samples . Given Estonia's size, large infrastructural investments are comparatively cheap on a national level. The common history with the country's neighbors have lead the country to develop strong regional ties and connecting pathways for goods and services.

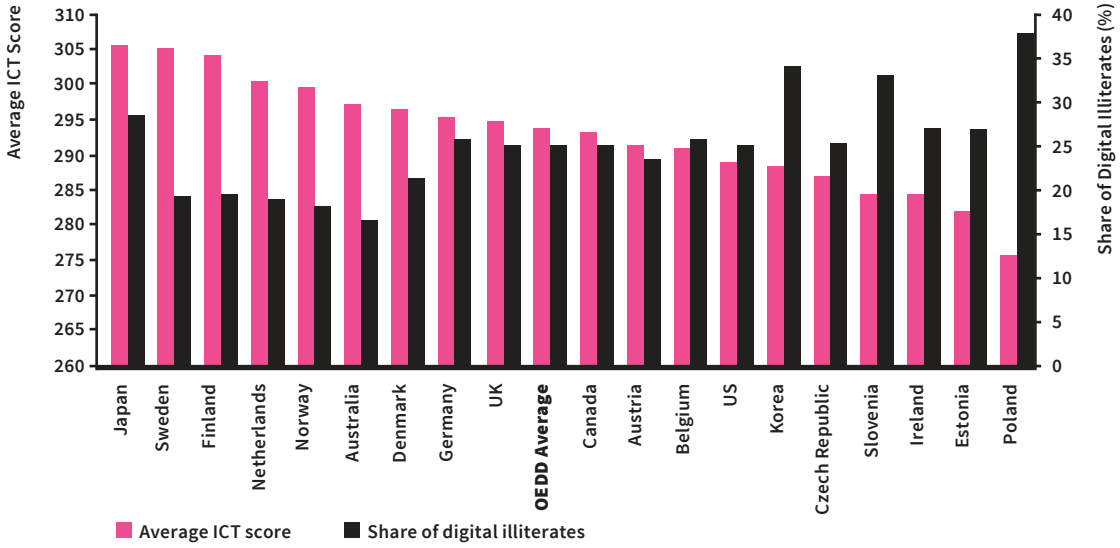
Education and Lifelong Learning

With Estonia's tech policy focusing on industry 4.0, one of the key questions has been around the retraining of its workforce, to create a smarter and better educated workforce. This must be accomplished in tandem with companies and the state (Tubalkain, 2016). Additionally, as early as primary school, children are being actively confronted with tech and programming. With the nation-wide program entitled "Bit by Bit", pupils between the ages 7 and 11 learn programming. A similar policy is also used in vocational training for entrepreneurs (Buhr, Frankenberger, & Ludewig, 2017). Estonia is not only investing heavily in childhood tech education; the state is also able to reduce expenditure through similar programs for adults and children.

School infrastructure is equally being revolutionized. E-schools are used to provide a collaboration platform for parents, teachers and students (e-estonia.com, 2017). The Interactive platform is used for messaging, sharing grades, tracking homework and keeping parents and administrators up to date (ibidem).

"Estonia's success in the digital revolution can be seen in the educational landscape since twice as many students pursue IT careers than in Estonia than the average in other OECD countries" (e-estonia.com, 2017)

Information and communication technologies (ICT) skills across OECD countries



Notes: Average ICt skills of employees aged 20–49 (no first-generation migrants); share of digital illiterates among PIAAC participants. Digital illiterates either scored below 175 point (out of 500), reported no computer experience, or failed ICT core test. (Source: Author's own calculation based on PIAAC 2012)

Source: IZA – Does the broadband infrastructure boost employment? [2]

2 https://wol.iza.org/articles/does-broadband-infrastructure-boost-employment

Infrastructural, Industrial and Research Policy

In terms of industrial policy, Estonia has been focusing on making factories smarter. This policy has been called the Real-Time Factory, allowing managers to track progress within their factories with virtually no time lag (Tubalkain, 2016). Part of Estonia's strategy was for businesses to quickly gobble up government contracts for them to have the possibility to have a competitive advantage vis a vis international competitors despite the relatively small home market (ibidem). To share best practices in the development in industry and digitalization, Germany and Estonia have been hosting industrial digitalization initiatives to business leaders.

Regulating/ Deregulating

Labor Attracting talent from the vicinity has been one of Estonia's key priorities. In 2015, one of Estonia's target countries for new residents was Ukraine, where 60% of new residents came from Ukraine (Tubalkain, 2016). Other examples of target countries include EU member states, such as Finland. Estonia takes an active role in finding human capital to boost its policy of proactively promoting digitalization.

The Estonian labor market has been undergoing deregulation to accommodate a "flexicurity model" (Buhr, Frankenberger, & Ludewig, 2017), following the Dutch and Danish example (see Section 2.4). Some of the key partners in the endeavor have been the Ministry of Social Affairs and the Estonian Unemployment Fund. Unemployment benefits are currently very low and are state funded (Buhr, Frankenberger, & Ludewig, 2017).

As part of Estonia's presidency in the council of Europe, the country consciously made automation and the future of work a priority both for itself as well as for the European counterparts. (Tubalkain, 2016). It is therefore no surprise that Tallinn served as a primary example of how digitization can be used to transform the public sector and to spur innovation on a national level. The summit paved the way for a common agenda to improve the impact modern technology can have on European livelihoods. The political results are yet to be seen.

4.4 Austria

Austria is an average sized country in comparison with the other examples. It has a has a relatively high proportion of industry in comparison to the rest of the EU, with the aim to increase this proportion until 2020. One of the key components of the Austrian policy is to enhance the possibilities of funding for startups and companies willing to invest in industry 4.0 related initiatives. Additionally, the policies advocated in 2015 also show the importance of diversified education, mixing theory with practice (BMWFW, 2015). Although significant public spending has also been put invested in taking the public apparatus online. Initiatives, such as digital Austria (digital.austria.gv.at), are only the beginning. There is still a long way to go to make bureaucracy smarter and adaptable for the future, especially considering the Tallinn Summit 2017. One initiative to address the digital shortcoming within the sphere of the Austrian apparatus is the Chancenplan fuer Digitalisierung, presented by NEOS. It covers a range of topics from privacy and political participation and thereby integrate a digital narrative into key social imperatives. One of the insistences the paper makes is greater digital literacy for students as well as basic coding skills (NEOS, 2017). Others include a focus on infrastructure, as well as improved e-governance to increase participation and improve transparency.

Education and Lifelong Learning

In terms of education, the Austrian Computer Society (Oesterreichische Computer Gesellschaft) put forth a position paper in early 2017 arguing for more digital literacy in schools (OCG, 2017) considering the new labor markets that Austrian pupils will experience. These positions argue for education policy focusing on creating policy that goes hand in hand with industry 4.0, this includes digital literacy, educational robots, computational thinking, coding and gamification, maker activities, media literacy for schoolchildren nationwide across varying age groups. Although educational policies have not been set in stone, initiatives to further digitalization have seen initiatives from civil society. After OCG publication, NEOS published their stance on digitization. Taking from a different vantage point, the publication outlines the need for students to increase their digital literacy, learn basic coding and improve online access to teaching material. There seems to be consensus amongst the parties that structural issues in terms of education need to change.

Infrastructural, Industrial And Research Policy

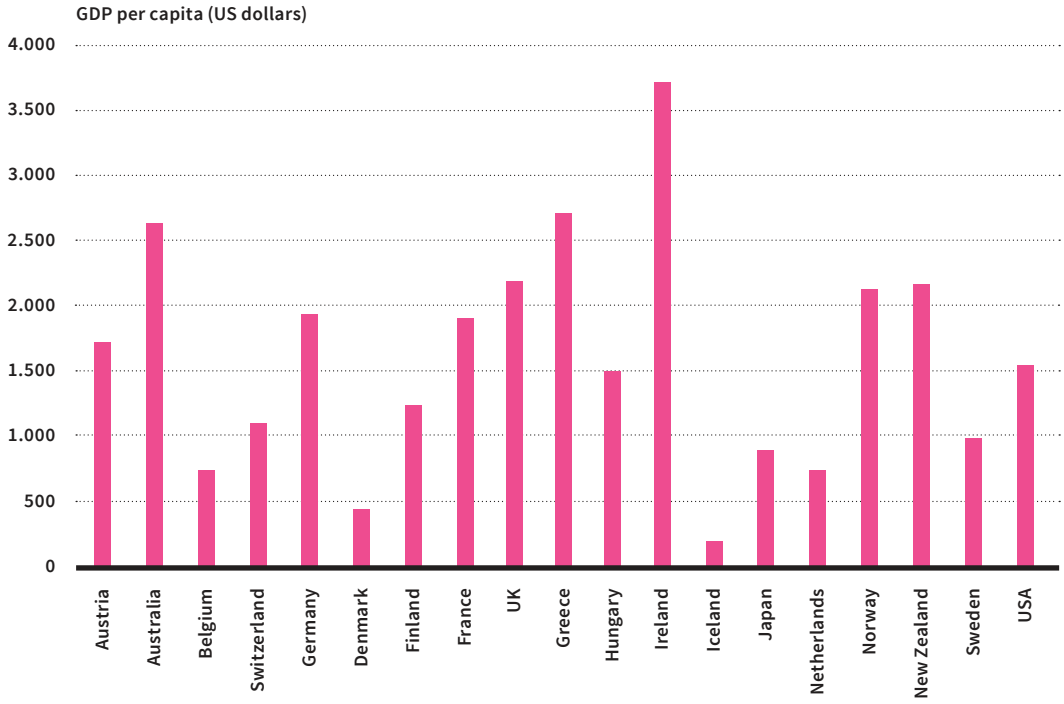
Austria ranks above average on the European spectrum in terms of digital integration (Peneder, Bock-Schappelwein, Firgo, Fritz, & Streicher, 2016). this is partially because Austria has been investing heavily in the physical infrastructure in ICT, such as the nationwide broadband strategy (Neumann, Plückebaum, Böheim, & Bärenthaler-Sieber, 2017). This initiative is meant to connect all communities in Austria with 100 Mbit broadband connection by 2020. To stay competitive strong and far reaching infrastructural investments are needed as well as the strengthening of institutions protecting critical infrastructure (NEOS, 2017) Putting a strong internet connection at the heart of a digitization policy has proven to be effective, there is more work to be done. Some first steps in this process are discussed in Österreich: Digitale Agenda 2025 (Ziegner & Moosburger, 2016).

Austria also recently invested over Euros 250 mio. to a knowledge hub on microelectronics, which is meant to create 500 jobs in 5 years and will be called Silicon Austria (Die Presse, 2017). These initiatives are conscious projects to propel the ICT sector into the 21st century.

Regulating/ Deregulating Labor

One of the key conclusions of the report by amongst others the ministry for transport Innovation and Technology is the necessity to catch up in terms of realizing the potentials of automation from a business perspective (Lassnig, et al., 2016). Although the report demonstrates that businesses see the advent of Industrie 4.0 as a logical next step, the impacts on the labor market seem polarizing. Higher earners seem to profit in terms of their respective scope of work whereas those that earn less face higher risks. A similar conclusion was reached by a report by the consulting firm Arthur D. Little focusing on SMEs in September 2017 (Arthur D. Little, 2017). Firms with lower digital penetration, such as the transport and manual labor jobs see higher risks. Furthermore, over half of the over 1700 questioned SMEs showed that working from home is a viable alternative, loosening common employment practices. Additionally, the report shows that firms with higher digital penetration see lower risks for employment. Reports both from policy and the private sector underline the potential that businesses can face in Austria with the advent of technology. Smart policies are needed to safely integrate these findings on a political level. Winners are those that can take their work home with them, whereas manual workers see increasing competition through technological advancement. Possibilities to deregulate labor abound, with Austria's over 850 collective agreements, the country offers broad array of options for reform to increase resilience in the labor market. These reforms should be in line with broader digital policies, such as Österreich: Digitale Agenda 2025 (Ziegner & Moosburger, 2016).

Additional GDP in 2007 if country had same broadband diffusion rate as the leading county in 2003



Note: 2003 lead country = Canada, with a broadband diffusion rate of 15.1%.
(Source: Author's own calculation based on [1])

Source: IZA – Does the broadband infrastructure boost employment? [3]

3 https://wol.iza.org/articles/does-broadband-infrastructure-boost-employment

5. Policy Implications and Discussions

Creating a framework for addressing the possibilities of automation needs thorough policy crafting and a clear vision. There are still numerous unknown in various facets of policymaking. These 5 takeaways are aimed at structuring debate to facilitate policymaking.

On a societal level, the advent of automation has also created a reason for skepticism. Previous technological developments increased the levels of productivity with a society. Now, productivity has largely stalled in developed economies. In 1987, the Nobel prize winning Economist Robert Solow noted that

"Computers are everywhere but in the productivity statistics" Robert Solow, cited in (Turner, 2017).

The author goes on to argue that measured GDP will inevitably tell us less about human welfare than often assumed. The quest for human welfare should not be decoupled from technological advancement. One of the most prolific evaluations of the phenomenon came from two authors in 2015 (Brynjolfsson & McAfee, 2015), arguing that although the trajectories of future technological deployment is a reason for optimism, there are still key challenges ahead.

5.1 Will There Be Safe Jobs?

Most studies show demonstrate a list of occupations that will face a lower risk of technological developments, such as automation. Whether in Osborne and Frey's (2017) creative jobs or the medical profession in Dengler and Matthes (2015) or the creative and human centric jobs such as in Susskind and Susskind (2016). The selected case studies showed that even in those industries, the possibilities of automation are manifold. With increasing speed of developments in automation it seems likely that most jobs will be confronted, potentially altered with technological progress (Dellot & Wallace-Stephens, The Age Of Automation: Artificial Intelligence, Robotics And The Future Of Low-Skilled Work, 2017). They span the creative sector, as well as manufacturing, blue as well as white collar workers.

With increasing rates of change, tasks will change that will constitute jobs. Over time, jobs will change across a wide spectrum. Those jobs most receptive towards a potential risk of automation are those that are hard to develop further, such as manual labor jobs. Those that can adapt are likely to continue being successful with a new set of tasks, changing over time.

Education will play an important role in having resilient jobs and incomes in the future. This resilience will base upon individual activism as well as structural changes. Broader options for education arise constantly , such as MOOCS (Massive Open Online Courses), tutorials, apps etc. Education on a public level will equally also have to incorporate new technologies, such as already shown in Estonia or in Germany. 5.2 Will More Technological Progress Accommodate More Or Less Regulation? Probably Both. The BAR Association's report suggestions stated the importance of clearly delineating what areas become "no-go" areas for the impact of automation. These no-go areas include for example weapons to avoid "killer-robots", (Wisskirchen, et al., 2017). Others view the risks of robotics in work 4.0 and the impacts on the labor force as having to undergo four ethical dilemmas for regulators. They include 1. Discrimination, as it relates to great precision in forecasting. 2. Privacy, as computers will rely on multitudes of data 3. Agency, where the computer has the possibility to become an agent of change rather than the instrument (see (Jebari & Lundborg, 2016)) 4. Authenticity, how do we deal with human relationships under increased automation (Dellot & Wallace-Stephens, The Age Of Automation: Artificial Intelligence, Robotics And The Future Of Low-Skilled Work, 2017). So yes, we are likely see regulation in the sector. In terms of cybersecurity we are also going to be likely to see more regulation to safeguard citizens' and other entities' information. This could also become a product of the Tallinn Agenda (Ratas, 2017). These new trends will create new jobs, options and ideas and risks. As two authors note in London 10% of people work in jobs that did not exist in 1990 (O'Connor & Bounds, 2015), similar results were also published by McKinsey in a recent report (Manyika, McKinsey & Co. , 2017). The nature of jobs will change and smart policy options are needed to accommodate these changes.

Some sectors are probably going to see deregulation as employment relations become diluted. The advent of the smartphone has already paved way for increased disposability between working in an office and working at home, as small and medium sized enterprises already often do (Arthur D. Little, 2017).

5.3 Healthcare and Insurance

Issues relating to insurance now have the possibility to be put back on the table with the Tallinn Agenda. After losing a lot of ground with EU member states, the possibilities of flexicurity are still abound in Europe as the 2012 final report on flexicurity shows (ICF GHK, 2012).

On the supply side of healthcare, doctors, the pharmaceutical industry etc., technological improvements have the possibility to do a lot of good for millions of patients. This includes personalized cancer treatments, better diagnostics, improved training for surgeons and micro robotics aiding in surgeries that were previously almost unfathomable.

5.4 Broader Social Repercussions

The report by the RSA points out, the impacts of automation have the possibility to be a force for great positive change or the opposite. The question lies in the policies framework that will accommodate these changes.

"New machines could be used to de-skill jobs, strip workers of their bargaining power, put downward pressure on wages, amplify monitoring and standardization of work, and bake biases into recruitment. Yet the same technology could equally raise productivity, open the door to higher wages, phase out mundane work in favor of more intellectually stimulating vocations, and create a level playing field in terms of recruitment" (Dellot, thersa.org, 2017).

Similar candor in terms of the variety of factors that can determine the outcome of policy implementation is also reflected in Susskind and Susskind's interpretation of what may lie in the future. Will it result in mass unemployment or will it create more possibilities for the future, for social problems to be addressed more widely (Susskind, The Guardian, 2015)? One stated that the additional human resources could be put to beneficial use for society and for example contribute to greater volunteerism (West, 2015). The impact on society is likely to be multifaceted we need resilient and adaptive institutions for the potentially upcoming stress test.

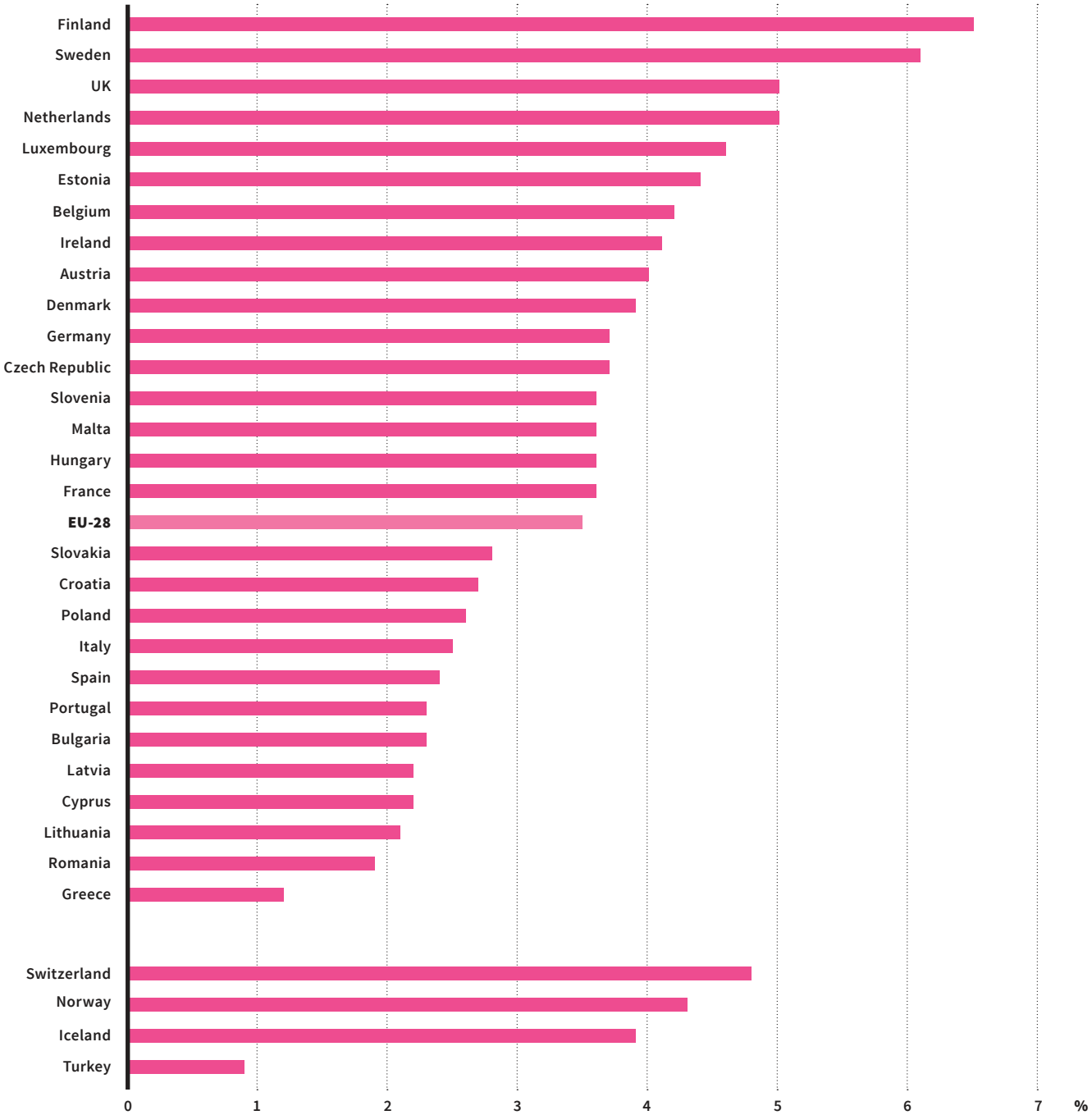
5.5 Education on Centre Stage

Today, automation is "blind to the color of your collar." It doesn't matter whether you're a factory worker, a financial advisor or a professional flute-player: automation is coming for you" J. Kaplan, Author of Humans Need Not Apply: A Guide to Wealth and Work in the Age of Artificial Intelligence taken from (Mahtani & Miller, 2017).

As Kaplan put it, the impact of automation will not discriminate between jobs. Attaining a higher education has been a way of mitigating such occupational threats in the past (Krugman, 2013). Lifelong learning opportunities have the possibility to

serve that goal as the half-life of education decreases and risks increase. Many of the discussed European examples have looked at education as an investment for the future for the entirety of their population. Viewing education as frontloaded, focusing on the first half of a person's work life will probably become antiquated. Following Estonia's and Germany's example, investing in technology in the schooling system has to be a priority. These investments should be distributed across a person's work life. Lifelong learning enforces resilience against shocks.

ICT specialists in Europe, 2015 (as a % of total employment)



Source: (Eurostat, 2016)

5.6 Getting Infrastructure Right

In terms of Industrial Investments, most countries have been investing heavily in internet access. The fact of the matter is that countries such as Italy or Austria have been investing heavily in making broadband accessible to even remote areas. The assumption that connectivity will be force for good in the interconnected European market and allow for the sprouting of businesses is demonstrated by Falck (Falck, 2017) . These focusses on the impact of the internet as a source of good will also have to accommodate the possibilities for the clear definitions of what can be done with the data gathered by the providers of automated products (Wisskirchen, et al., 2017) and will reinforce the need for increased cybersecurity for both individuals and businesses. (Ratas, 2017).

5.7 Structural Change in The Making

Allowing more flexibility at work will be a repercussion of the automation debate. These issues already include working from home, flexible work times as well as gig work, but also the increased promulgation of the smartphone. As the manner of work changes, so will the possibilities that will the legal contexts to accommodate and gain growth potential. Additional possibilities may include evaluating policy options, such as the mentioned “flexicurity” models that allow for an adaptive framework on insurance. Equally, where and how companies pay taxes will be a key concern to policymakers.

6. Conclusion

The definition and interpretation of jobs is likely to change. Two authors have been showcasing difficult conceptual hurdles on designating “safe jobs”. In their work, the authors argue that making such predictions is both empirically as well as conceptually flawed (Susskind & Susskind, HBR.org, 2016) and allows for the fallacy of job that will not change over a given period. This report comes to a similar conclusion after revisiting a range of different studies on the topic. Rather, jobs are likely to change. This report has been viewing the debate between tasks and jobs as complimentary. We have been arguing that tasks and jobs are both part of the story. This report argues that jobs are the sum of a set of tasks. These tasks change over time, altering the scope of a job. This allows for the creation of new jobs and changes in the definitions of most jobs. Also, automation is not necessarily going to come stampeding into factories, but rather gradually change the way we work. This could mean that new internal communications tool might be used, or that a new segment of a production line may be automated, whilst others may not (as the German automotive example shows). Thus, mid-level and senior management will have to evaluate the respective profitability of the respective automation initiatives.

Another probable outcome of further automation is the promulgation of the gig-economy. Policymakers need to be aware of these trends to be able to deal with them in a smart and effective way. This also implies that the move to the gig economy does not necessarily mean that the individuals are voluntarily in the gig economy, but rather that they were moved in that direction. Thus, across Europe, we will need answers on how to deal with gig-work, how to tax it and how to monitor it. These changes will also have to translate into resilient insurance systems, which cater to changed employment relations.

Education will equally have to be rethought and will require investment. Until now, a considerable focus is put on the first quarter of a person’s life, with minor course corrections or complementarities taking place thereafter. Vocational trainings, including webinars will gain in importance, as will MOOCs and will also gain in relevance. Education and Lifelong learning create resilience.

Countries in Europe and around the world will face growing pressures and will need to respond with foresight. These policies will probably be focused on reforming the labor market, investing in infrastructure and the respective education system and robust competitiveness. Additionally, taxation and where companies pay taxes is going to be an issue to monitor closely. Recent debates around the taxation of internet giants, such as Google will probably only be the beginning (Boffey, US retaliation feared as Brussels prepares to close Google’s tax loopholes , 2017). Developing countries will have to adapt to the potentially detrimental effects of moving manufacturing back to developed countries.

New tools available have created major changes in the interpretation of society. The increasing potential of automation and work 4.0 is likely going to show similar results on playing fields that may not be fathomable for now.

Appendix

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INSTITUTIONS

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ELF is made up of a number of European think tanks, political foundations and institutes. The diversity of the membership provides ELF with a wealth of knowledge and is a constant source of innovation. In turn, the member get the opportunity to cooperate on European projects under the ELF umbrella.

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