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ANALYSING JOB CHANGE IN THE AUTOMATION OF PROCESSES IN THE LOGISTICS INDUSTRY – THE CASE OF FINLAND

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ABSTRACT OF
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Objectives

The main objectives of this study are (1) to identify to what extent the logistics industry is being automated, (2) to identify what effects the automation of the logistics industry has on the number and nature of jobs in the industry, (3) to identify what effects the automation of the logistics industry has on workers, and (4) to identify the specific factors in the logistics industry that affect the amount of change in the number and nature of jobs.

Summary

The logistics industry has become crucial for conducting business in the modern world and is being increasingly automated, leading to concerns over the effects of automation on a multitude of stakeholders. To study how automation is affecting the number and nature of jobs, as well as workers, Finnish logistics managers and union and association representatives were interviewed.

Conclusions

Automation is used mainly in office work and a bit in physical tasks. It was found to have several different effects on the number and nature of jobs, as well as workers. The four factors affecting the extent of automation's effects were high skill requirements, difficult and slow implementation of automation, a low level of automation and infrastructure, and the low commercial viability of automation. Because of these factors, the effects of automation in the industry were found to be relatively low, with potential of significantly increasing in the near future.

Key words: automation, digitalization, logistics, supply chain, work, employment, employee participation, employee attitudes, retraining
Language: English

Grade:

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1. INTRODUCTION

1.1 Background

With globalization and the need to produce ever more goods for the growing number of people in the world, the logistics industry has become a very important player in supporting global trade and the global economy. With modern economic theory, especially logistics has become the backbone of the global economy as countries have become economically interdependent of one another, specializing in certain industries, and relying on their respective competitive advantages, be it natural or human resource based. With the number of people in the world increasing, so has increased the number of products needed to fulfil the needs of those people, creating the need for higher-capacity logistics processes. Akin to industries like manufacturing, the logistics industry has a high amount of potential for automation, being in the top three most automatable sectors according to experts (Manyika et al., 2019). Coupled with the findings of other researchers that automation in the logistics industry can deliver significant increases in productivity, as well as lower the rate of human errors in the logistics process (Nitsche, 2021), many logistics companies, especially big multinational corporations, have significantly invested in the automation of their logistics processes.

With the increasing amount of automation in the logistics industry, there are not only positives, but also rising concerns regarding factors such as large job losses and mass unemployment, employees' worsening mental health due to job insecurity and lowering job satisfaction, as well as the need for large-scale retraining of workers to fit into the new logistics landscape. Furthermore, the fact that the effects of automation are highly different depending on the specific country- and industry-specific factors (Gentili et al., 2020; Nedelkoska & Quintini, 2018; Arntz et al., 2016; Manyika et al., 2017; Parschau & Hauge, 2020) means that there is no good way to be able to predict how automation will change specific industries or countries without conducting research about that exact case, as basing the prediction on a similar country or industry could easily overlook some of the many factors that are not apparent until doing further research.

In this thesis, the main factors in the automation of the Finnish logistics industry that are affecting the change in the number and nature of jobs are evaluated, alongside with gaining an overview of the Finnish logistics landscape by assessing in what ways the Finnish logistics industry is being automated. Current literature on the topic is reviewed in order to connect the numerous factors driving the adoption of automation in the logistics industry, the effects automation continues to have in the industry and in the wider world, and how stakeholders such as employees are specifically affected in the reorganizing of the logistics landscape. Based on the literature, a conceptual framework is developed, guiding the process of developing interview questions, as well as the overall structure of the thesis. Through interviews with managers at Finnish logistics companies, as well as trade unions and associations, empirical evidence is gathered and then analysed in contrast to existing and relevant literature in the field.

1.2 Outline of the Thesis

Automation, meaning “the partial or full replacement or support of a human-performed physical or informational process by a machine”, as defined by Nitsche (2021), is increasingly being adopted in companies across the globe and companies are increasingly forced to do so in order to remain competitive in a globalized world. Because of the significant amount of disruption that automation creates in various industries, experts have widely researched the effects that automation is likely to bring. There remains, however, relatively little research on how logistics companies will be affected by the changes automation is likely to bring, especially so regarding the Finnish logistics industry. In Section 2 of the thesis, research about the current landscape of automation is reviewed alongside the driving forces currently behind automation adoption. After briefly covering the current situation, studies regarding the effects of automation on the number and nature of jobs in the near and far future are evaluated, highlighting topics such as the current identified weaknesses in overall research on automation, as well as how the effects of automation apply specifically to workers.

While there are several studies about the effects of automation on the global workplace, as well as individual countries, some experts have criticised the rather

opaque methods used, with concerns about many country- and industry-specific conditions being ignored in the research (Parschau & Hauge, 2020). In order to avoid these issues, a particular case will be evaluated, that being the Finnish logistics industry. The case of the Finnish logistics industry is the focus of sections 3, 4, and 5. The Finnish logistics industry was chosen to be the focus of empirical research due to logistics being an industry with a high amount of pressure towards increased automation due to factors such as rising demands for faster service and higher capacity, as well as labour shortages. Furthermore, logistics is a crucial industry for the whole global economy, as we have been able to see from supply chain troubles during the COVID-19 pandemic. Additionally, the transportation-and-warehousing industry has been found to have the third-highest potential for automation out of any sector (Dekhne et al., 2019). With the logistics industry being pivotal to conducting business and being relevant to any business conducted that is related to exchanging goods, there are also significant benefits for not the only businesses but society in general through the successful adoption of efficient logistics solutions, leading to a significantly lower carbon footprint for conducting international business and possibilities of tackling current problems related to climate change. Furthermore, there also exists a very limited amount of research into the logistics industries of the Nordic countries in this context, which made looking into the Finnish logistics industry very appealing. Finally, in Section 6, final conclusions are drawn from the analysis and the main findings of the research are stated. Additionally, implications for international business, as well as limitations and suggestions for further research are given.

1.3 Research Questions

The research conducted aims to answer the following questions:

- In what ways is the logistics industry being automated?

- What are the industry-specific factors in the automation of the logistics industry that are affecting the amount of change in the number of jobs?

- What are the industry-specific factors in the automation of the logistics industry that are affecting the amount of change in the nature of jobs?

1.4 Research Objectives

The objectives of the research conducted are the following:

- To identify to what extent the logistics industry is currently being automated
- To identify what effects the automation of the logistics industry has on the number and nature of jobs in the industry
- To identify what effects the automation of the logistics industry has on workers
- To identify the specific factors in the logistic industry that affect the amount of change in the number and nature of jobs

2. LITERATURE REVIEW

This literature review's purpose is to create a foundation on which to build the research, as well as build a conceptual framework containing variables and relationships through which the topic will be studied. This literature review addresses the automation of the logistics industry and its effects on the nature and number of jobs, including worker effects, by reviewing the literature surrounding automation and its effects on a multitude of industries, the application of automation in logistics, and its effects on workers.

Automation as a topic has seen a remarkable amount of research over the last decade, with researchers diving into researching its impact on a multitude of topics such as job substitution, employment related risks, the global economy, and employee wellbeing to name a few. With this amount of research have come many different theories regarding automation, as well as how it will affect different areas of our everyday lives. The most well-known research conducted on automation are

studies regarding the effects of automation on employment and jobs. There are multiple widely cited papers by authors such as Frey and Osborne (2017), who gained widespread media attention with their findings of 47% of total US employment being at high risk of being automated over the next decade or so. There are, however, other experts who have disagreed with this estimation, giving more modest estimations on the effects of automation on the level of employment (Arntz et al., 2016; Arntz et al., 2017; Nedelkoska & Quintini, 2018; Gentili et al., 2020). Although in the short term the overall number of jobs may be lower due to automation, in the long term more jobs are expected to be created. These results are in line with that was been observed from previous times of technological change. Automation as a field of study is full of similar debates regarding its effects on employment level, workers' wellbeing, as well as the ways in which its effects can be affected by different factors. In this literature review, many of these debates will be covered as part the critical evaluation of the existing literature and state of knowledge on automation.

In research about automation, there is a significant gap regarding the effects of automation on specific industries in specific countries. Experts in the field widely agree that the effects of automation are heavily influenced by several country- and industry-specific factors (Gentili et al., 2020; Nedelkoska & Quintini, 2018; Arntz et al., 2016; Manyika et al., 2017; Parschau & Hauge, 2020), essentially meaning that it is highly problematic to generalize from one automation-related study and its results to another industry in the same country, or the same industry in another country due to factors such as the social acceptance of automation, current state of automation within an industry, or specific country-, or industry-related regulations.

In comparing, contrasting, and analysing the literature, several criteria will be used. These criteria include, first and foremost, the date of publication of the source, as well as the methodology and sources of the research. Other criteria include any weaknesses or limitation in the methodology, or more current research undertaken in the topic, possibly contradicting the results. Other things to be considered are the authors' personal qualifications and existing critique against a study from other relevant publications.

This literature review will first briefly cover the current state of automation in logistics, as well as what is likely to come for logistics automation in the near future, effectively covering the research question of “in what ways is the logistics industry being automated?”. Afterwards, studies that cover the effects of automation on the number and nature of jobs across industries are assessed, providing important information helpful in supporting the research questions of “what are the main factors in the automation of the logistics industry that are affecting the amount of change in the number, and nature of jobs?”. Towards the end of the literature review, studies that deal with the effects of automation more specifically on employees, as well as how that might be seen in logistics, are evaluated.

2.1 The Current Landscape of Logistics Automation

Automation technologies are in use around the world, in numerous different industries. One such industry is logistics, where automated solutions are in relatively widespread use. In modern logistics companies, or the logistics branches of large e-commerce companies such as Amazon, automation is everywhere. For years now, automation, as part of digital transformation, has likely been one of the logistics industry’s most significant developments, offering cost reductions and productivity increases with also the possibility for increased independence from personnel in logistics networks, allowing for processes to become less error prone due to less interference from individual workers (Nitsche, 2021). Foster and Rhoden (2020) agree, finding that companies that were early adopters to AI and automation have been able to gain a competitive edge due to the technologies’ abilities to streamline the entire supply chain and logistics function. Similarly, Dekhne et al. (2019) emphasise that some companies have been able to reduce time spent in shipment-processing by up to 50 percent through the adoption of automated systems. Different automated systems are being used in different parts of the logistics function, with technologies such as automated guided vehicles, swarm robots, advanced storage and retrieval systems, robotic shuttles, handling devices, advanced conveyor systems, drones, and exoskeletons being used by logistics companies (Dekhne et al, 2019), allowing for greater efficiency, among other benefits. Some of the latest automation developments are also looking promising for the logistics industry, with technologies like the industrial internet of things, digital twins, and autonomous

vehicles likely changing processes in the industry quite significantly (Ponis & Efthymiou, 2020; Moshood et al., 2021; Nowak, 2016, respectively).

2.1.1 The Driving Forces Behind Automation Adoption

The automation of the logistics industry is not, however, driven only by the potential increases in productivity or efficiency. Dekhne et al. (2019) rightly state that automation is also answering to other problems faced by companies. According to them, automation is offering a solution to two problems faced by logistics companies: the lack of an infrastructure capable of sustaining growing e-commerce needs and a worker shortage (Ponis & Efthymiou, 2020). Dekhne et al. found that as the volume of goods ordered through e-commerce rises, more logistics companies are experiencing significant strain on their business processes. With this pressure put on by the growth of e-commerce, automation is found to be a promising option for logistics companies trying to size up their operations in order to perform in the ever more competitive logistics market. In their findings about a labour shortage, Dekhne et al. (2019) assert that some e-commerce facilities require from 2,000 to 3,000 full-time equivalents, hinting that the growth of e-commerce has created a sharp increase in the number of workers needed, leading to problems in recruiting enough staff. Ponis and Efthymiou (2020) also comment that especially in developed countries, there is a lack of a blue-collar workforce, leading to some need for automation. These findings could be questioned, however, as the “shortage” of labour could be solved with pay-raises to attract more workers, or by the imminent large-scale migration of people form developing countries due to factors such as political instability or worsening environmental conditions. It should be noted, however, that there exists significant anti-immigration sentiment in many countries, which could make the shortage of employees a long-lasting issue. Regardless of the likelihood of the labour shortages’ longevity, automation seems like an effective long-term solution for companies looking to expand their business.

2.1.2 Automation and Problems of Traditional Work Organization

Aside from these major forces driving for more automation in the logistics industry, automation has also mitigated some other problems related to traditional work

organisation in logistics. Historically, the logistics industry has had to deal with persistent problems like employee shortages in warehousing (Min, 2007), cargo theft (Ekwall, 2009), as well as negative employee health effects due to the manual labour involved in some logistics work (Loske et al., 2021). Loske et al. especially found that logistics employees' health risks leading to both lost logistics efficiency and less profit. With employee shortages being caused by a combination of different factors, part of it is due to relatively high turnover in some warehouses (Min, 2007). Min found that especially having a high number of employees, as well as a large warehouse, were both factors that were strongly associated with high turnover. Among other findings were that referral bonuses and a family-friendly atmosphere could lower turnover, but only to a certain extent. The main way to lower turnover was found to be recognizing the importance of job security and employee retention.
With the logistics industry increasingly implementing automation, some of these problems appear to be becoming less impactful for companies. With multiple experts over the years agreeing that automation offers a possibility to substitute for human labour (Manyika et al., 2017; Autor, 2015), especially so in low-skill jobs or so-called routine tasks (Frey & Osborne, 2017; OECD, 2018) where the number of workers is likely to become lower, with some jobs being transformed from primarily executive roles to supervisory ones (Gruchmann et al., 2020). This effect seems likely to lower turnover, at least in warehousing, as the shortage in supervisory roles was also found to be significantly lower than in floor-level jobs (Min, 2007). According to Loske et al. (2021), automation is also capable of mitigating adverse health effect from physical labour activities. Automation, as such, seems capable of mitigating a significant number of problems related to traditional work organization in logistics, offering tangible positive effects such as improved efficiency, lower turnover, and higher profits.

2.2 The Effects of Automation on the Number of Jobs

In the last decade, multiple experts have noted a growing fear that automation could begin displacing jobs at a rate too quickly for job creation to keep up, harming the level of human employment (Brynjolfsson & McAfee, 2014; Frey & Osborne, 2017). According to Frey and Osborne's study, originally published in 2013, around 47% of total US employment would be at high risk of being automated in the next decade or

two. However, in 2016, Arntz et al. disagreed with the estimate due to its occupation-based approach, arguing that it could lead to an overestimation of job automatability due to the occupations labelled as high-risk still containing a significant number of tasks that are hard to automate (Willcocks, 2020). This sentiment was later agreed upon by Willcocks (2020), as well as Nedelkoska and Quintini (2018). Arntz et al. (2016) proceeded to do their own estimation based on Frey and Osborne's calculation, with their own task-based approach, getting a significantly lower and more realistic sounding figure of 9%, instead of Frey and Osborne's 47%. Additionally, they found that Frey and Osborne's approach neglects the possibility of automation technologies creating new jobs (Borland & Coelli, 2017; Willcocks, 2020), offsetting the number of jobs lost to automation. Moreover, they rightly argue that there is a possibility for new technologies to bring positive effects on labour demand, through raising product demand because of improved competitiveness and positive effects on workers' incomes. Arntz et al. (2016) thus reasonably concluded that workplaces are likely to be less at risk than was first suspected.

Other experts also disagreed with Frey and Osborne's estimations. Nedelkoska and Quintini (2018), in their study built on the work done by Arntz et al., found that around 14% of jobs in OECD countries are highly automatable, meaning over 70% probability of automation. While their figures are lower than Frey and Osborne's they are still somewhat higher than what Arntz et al. estimated, highlighting that there are multiple different factors that affect the level of automatability across countries and industries (Arntz et al., 2016; Nedelkoska & Quintini, 2018).

2.2.1 Timeframe of Automation

Another task-based study akin to the one by Arntz et al. (2016) was carried out in 2017, where Manyika et al. found that 60% of all occupations in the world contain at least 30% technically automated activities. This would mean that between 400 to 800 million people could be displaced by automation and need to find new jobs by 2030. Additionally, they found that 75 to 375 million (equivalent to 3-14% of workers globally) could need to switch occupational categories or learn new skills to gain employment. However, they also found that only 5 percent of occupation had over 90 percent of automatable work. The estimations by Manyika et al. are in line with the

findings of Arntz et al., with most differences being highly likely from the different countries or industries in their sample. Furthermore, Manyika et al. also intelligently consider technical feasibility, financial feasibility, country-specific regulations, and social effects in their analysis on the implementation of automation, building on the many criticisms aimed at the previous research by Frey and Osborne (2017). In taking the factors into account, Manyika et al. create both early and late estimations for 50% of work being automated. The early estimation is found to be 2035, with the late estimate being 2065. The validity of such estimates is hard to quantify as Willcocks (2020) notes that several factors affect the speed of implementation of new technologies, possibly stretching the timeframe of implementation over several years. With countless country- and industry specific factors such as regulations, the current state of automation, commercial viability, and social factors like the acceptance of automation to take into consideration, there is plenty of variance to consider when predicting the overall speed of automation adoption globally. Furthermore, given the lack of certainty regarding the effects of automation on the global workplace, both positive and negative consequences for automation implementation can materialize during the adoption process, with a chance to significantly affect the speed of adoption even further. Given the possibility for things like government intervention on the adoption of automation, or the possibility for unions and workers to exert pressure on automation initiatives, predicting the speed of automation implementation globally remains as such considerably difficult, even when trying to predict the pace for only specific countries or industries.

2.2.2 Weaknesses in Current Research

It seems that predicting automation's effects on the number of jobs is tricky, with several factors creating the possibility of net job creation or loss, depending on the country, industry, and employee demographic in question. Considering the variance in the levels of education, age, experience, and skills between countries, industries, and workers within those countries and industries, it remains challenging to be able to accurately measure the effects of automation based on these factors. Furthermore, there are significant differences between different researchers' results, based on their specific sample. Parschau and Hauge (2020) bring up this point in their study into the effects of automation on the South African apparel industry. They

criticise the current literature in the field, pointing out that many recent forecast studies are global in outlook, applying opaque methodologies which are bound to ignore many country- and industry-specific conditions as well as barriers to implementing automation technologies. In their study, they additionally stress the lack of research into how certain occupations can become obsolete through automation technologies and the fact that studies in the field tend to assume that many technologies are already further developed than they really are, causing an overestimation of automation capability in certain industries, such as the apparel industry.

Frey and Osborne's controversial results were not only criticized by those adopting the task-based approach but also other experts in the field, pointing out that the job creation effects of new technologies were not taken properly into account (Borland & Coelli, 2017; Willcocks, 2020). Other criticisms both Borland and Coelli (2017), and Willcocks (2020) had of Frey and Osborne's study was the lack of consideration for the pace of change in the labour market, as well as the lack of analysis concerning the feasibility of adopting automated technologies. This weakness of Frey and Osborne's analysis was also rightly pointed out by Arntz et al. earlier in 2016.
Both Willcocks (2020) and Borland and Coelli (2017) had several further criticisms regarding the methodology of Frey and Osborne's study. Willcocks questions the binary distinction used in the labelling of jobs as either automatable or not in the training of the machine learning programme used in the research, citing a study done by Walsh in 2017, finding that 7% of the 70 jobs in the training set used by Frey and Osborne (2017) were classified wrongly. Walsh further finds it unlikely that bicycle repair and watch repair automation are accurately assessed, being at 94% and 97% respectively. Borland and Coelli further agree with Walsh, arguing that some of Frey and Osborne's estimations contradict each other, such as identifying finger dexterity as an impediment to automation but finding the likelihood of automation for watch repairers to be 98 percent. Based on these findings, it seems highly likely that there is a reasonable amount of variance in the data used as the basis of Frey and Osborne's study. This further explains the large differences between the results of Frey and Osborne, and other researchers in the field.

2.3 The Effects of Automation on the Nature of Jobs

As the effects of automation on the number of jobs have been subject to thorough research, studies have been increasingly conducted with the objective of finding out how the nature of jobs will change in response to automation, how the transformation of jobs will change dynamics in the workplace, and how these affect the global workforce. Already in their research Frey and Osborne (2017) found that salary and education had a strong negative relationship with the probability of computerization, thus leading to low-skill workers having to move to tasks that require creativity or social intelligence, two factors which were found by Frey and Osborne to be less or completely non-susceptible to computerisation. These findings were supported by other experts, finding that due to creativity and social intelligence being highly challenging to automate, they are likely to remain non-susceptible to automation even in the long run. (Arntz et al., 2016; Manyika et al., 2017; Nedelkoska & Quintini, 2018). Frey and Osborne (2017) further found that in addition to creativity and social intelligence, perception, and manipulation skills such as finger dexterity and manual dexterity, as well as conditions such as cramped workspace prove difficult to automate or to account for in automation in the short term, remaining significant bottlenecks in the automation of processes. The jobs that have these characteristics are generally medium- or high-skill jobs, further supporting their findings that low-skilled jobs are more likely to be automated in the near future.

Characteristics of work	
Likely to be automated quickly	Unlikely to be automated quickly
Repetitiveness	Creativity (questioned by Coupe, 2019)
Low skill requirement	Social intelligence / Interpersonal skills
High labour cost	Fine motor skills
	Tight working spaces

Table 1: Characteristics for the nature of work that is likely and unlikely to be automated in the near future (Frey and Osborne, 2017; Coupe, 2019; Arntz et al., 2016; Manyika et al., 2017; Nedelkoska and Quintini, 2018; Brynjolfsson & McAfee, 2014; Bhargava et al., 2021)

However, not all experts agree with these findings. Coupe (2019) suggested that while social intelligence (or “interpersonal skills”) is important, creativity was not. Coupe argued that there were no findings to conclude that having a creative job was related in any way to concerns about one’s job or the long-run existence of said job. On the other hand, having a repetitive job was found to be significantly associated with a higher concern of being replaced by automation, but not the long-run existence of the job. Coupe thus concludes that his findings create questions regarding the effectiveness of automation-proofing strategies suggested by prior studies. It should be noted, however, that Coupe’s study is based on the respondents’ self-identified job characteristics, meaning that there can be differences between what the respondents consider, for example, a creative job, as well as how accurately they can evaluate the likelihood of their job being replaced by automation.
Willcocks (2020), on the other hand, challenges Frey and Osborne’s identification of the three engineering barriers to computerization, “complex perception and manipulation tasks”, “creative intelligence”, and “social intelligence”. According to Willcocks, the three concepts used by Frey and Osborne do not adequately describe the multiple human qualities that remain applicable in the workplace. She does not, however, argue for or against the findings of creativity, social intelligence, or fine motor skills requiring jobs being less susceptible to automation, simply pointing out the perceived flaws in the concepts created by Frey and Osborne in their study. Based on the little amount of research countering Frey and Osborne’s finding related to these characteristics, however, it remains difficult to say whether they are entirely reliable until further research is conducted on the topic.

Morgan (2019) offers a very different perspective compared to the other experts, voicing the possibility for social change as a result of automation, making it possible that instead of all displaced workers retraining and returning to work, some could be “liberated from work”. This view has been discussed in the media extensively, with initiatives such as universal basic income and reduced working hours perhaps being a not-so-distant possibility, depending on how automation ends up shaping the global workplace (Manyika et al., 2017).

2.3.1 Upskilling and Social Policy

While the job-saving effects of creativity are not agreed upon (see Coupe, 2019), most experts do believe that social intelligence or interpersonal skills cannot be replaced by automation in the near future (Frey & Osborne, 2017; Manyika et al., 2017; Willcocks, 2020; Coupe, 2019; Nedelkoska & Quintini, 2018; Brynjolfsson & McAfee, 2014; Bhargava et al., 2021). As such, experts have generally suggested that primarily low-skilled workers should attempt to acquire creative and social skills so they can improve their chances of attaining employment (Frey & Osborne, 2017; Manyika et al., 2017; Brynjolfsson & McAfee, 2014).

Another regularly mentioned topic related to workers' re-training is the need for policies supporting workers gaining new skills due to the negative effects of automation on employment and wealth polarisation in the short run (Gentili et al., 2020; Nedelkoska & Quintini, 2018). However, as Coupe (2019) notes, it is important to do further research into what skills should be acquired by the workers, due to the debate around creativity's importance for retaining employment. The importance of policies for supporting adult learning is further amplified by experts' findings that the odds of participating in any kind of training is lower for workers whose jobs are at risk of being automated (Nedelkoska & Quintini, 2018). Manyika et al. (2017) also suggest other policy decisions to help with retraining, such as unemployment insurance, public assistance in finding work, as well as portable benefits that transfer with workers regardless of job. In general, most experts emphasise the need for public policy decisions to help with retraining efforts (see Borland & Coelli, 2017; Nedelkoska & Quintini, 2018; Manyika et al., 2018; Bughin et al., 2017). With the large impact automation is likely to have on the global workplace, economic stability is important to consider, creating the need to policy aimed at tackling automation's adverse effects and protecting the demographics at highest risk to be negatively affected by the implementation of automation. Nedelkoska and Quintini (2018) take the policy-importance narrative of Manyika et al. (2017) further, strongly stressing the importance of understanding that the effects of automation, just like other technological change, affect employment and wages depending on how effectively educational and training institutions anticipate and respond to them, making the negative effects of technological change highly possible to mitigate through well thought-out institutional responses. Furthermore, they highlight that due to the overall automatability being highly variable between countries, the importance of

policy decisions also depends significantly on the region. Particularly countries with low geographic mobility are most likely to be significantly affected if they face high likelihood of automation to begin with. The high amount of variance between different regions and countries and their automatability further creates the need for policymakers to be informed about the effects of automation and act accordingly through initiatives such as the re-training of workers displaced by automation, as the lack of a sufficient policy response to the upcoming changes is likely to have a severe impact on specific demographics, creating possibilities for severe socioeconomic problems.

2.3.2 Demographics at Risk of Displacement

Frey and Osborne's (2017) findings that automation affects low-skilled and low-wage occupations are not agreed upon by all experts, just like most of their other findings. Manyika et al. (2017) allege that middle-income jobs will decline the most, with some low-wage occupations alongside high-wages occupation growing. This contradicts Frey and Osborne's findings as they state that income polarisation is likely to slow down. Many experts do, however, agree with Frey and Osborne's findings that automation will affect low-skill jobs more so than middle- or high-skilled jobs (Nedelkoska & Quintini, 2018; OECD 2018), at least for the next 12 years or so (Willcocks, 2020). Nedelkoska and Quintini (2018) further find that teenage jobs have the highest risk of automation. The risk of automation based on age is U-shaped, with it being the highest among the youth and the elderly. However, they find that the automatability among teenage jobs is significantly higher than that of the jobs done by the elderly. Nedelkoska and Quintini further reason that automation is likely to lead to youth employment, or at least more so than early retirements. They do also believe, however, that the higher risk may be countered by the fact that young people tend to be higher skilled than the elderly, having an easier time adapting to new occupations and as such lowering the rate of youth unemployment. Another possibility they suggest, is the possibility of internships increasingly replacing summer jobs as a way for the youth to gain new job-specific skills. This seems like a reasonable possibility, given the likelihood of automation replacing the most accessible jobs for young people.

2.4 The Effects of Automation on Workers

While a large amount of research has been conducted on how automation will likely affect the number and nature of jobs in the near future, there has been significantly less research about how automation will affect individual employees. Researchers have found that, in general, automation can affect employees' productivity, wages, and job satisfaction (Schwabe & Castellacci, 2020; Bhargava et al., 2020), as well as their mental health and overall wellbeing (Abeliansky & Beulmann, 2019; Nazareno and Schiff, 2021; Loretto et al., 2010). The significance of these effects, as well as whether they are positive or negative, depends significantly on factors such as gender, age, and job description (Abeliansky & Beulmann, 2019). Abeliansky and Beulmann found in their research that younger people, as well as employees with less interactive jobs, see automation as more of a threat than the average worker. Older people on the other hand, were found to be less concerned about automation. It cannot be said, however, whether this is due to older people having less knowledge about automation, and thus not being worried, or perhaps simply not caring due to being relatively close to the end of their careers. Abeliansky and Beulmann additionally find that men are more likely to have their mental health be negatively affected, due to having more automatable tasks than women. These findings suggest that the effects of automation on the mental health of workers are directly proportional to how much they or their occupation is affected by automation. This, however, seems not to be the case as Bhargava et al. (2020) found that most employees lack the information needed to properly evaluate how automation will affect them or their jobs. This seems to tie in with Abeliansky and Beulmann's (2019) findings that exposure to robots is making employees worried about their job security and economic situation, negatively affecting their mental health. As such, it seems highly likely that despite workers being unable to assess their own job's risk of being automated, they are increasingly worried about such outcomes once their workplace sees more automation. Another concern over automation's effects on workers is the increased use of sensors that collect employee data at work, posing risks for worker privacy (Nissim & Simon, 2021). With companies quickly implementing automation in hopes for first-mover advantages, entities such as unions need to act swiftly and decisively in ensuring that the position of employees is secure in a time of rapid change.

2.4.1 Automation and Job Insecurity

While automation is found by experts to have negative mental health effects, most of it seems to stem from job insecurity. Because of this, some experts stress the importance of managers informing employees adequately about changes in the workplace, making sure that employees perceive the technological changes as an opportunity instead of a threat (Bhargava et al., 2020). Loretto et al. (2010) found that managers' effectiveness in informing employees was significantly associated with mental health and that workers wanted to be informed of changes that are relevant to them, along with the consequences of said changes. It could be argued that the increasing amount of job insecurity because of automation will likely make workers more interested in being able to influence the automation of their workplace, ensuring the protection of their position in the company. With the promises of higher productivity being touted by companies implementing automation, workers are likely to want a share of the benefits. With the large-scale changes in workplaces implementation automation, trade unions should already have plans to support workers and ensure that their rights are taken into account. Experts such as Nissim and Simon (2021) believe that with the increased skill requirements brought by automation, unions need to increasingly focus on facilitating worker re-training and upskilling as not all companies are going to be focusing on educating their workers.

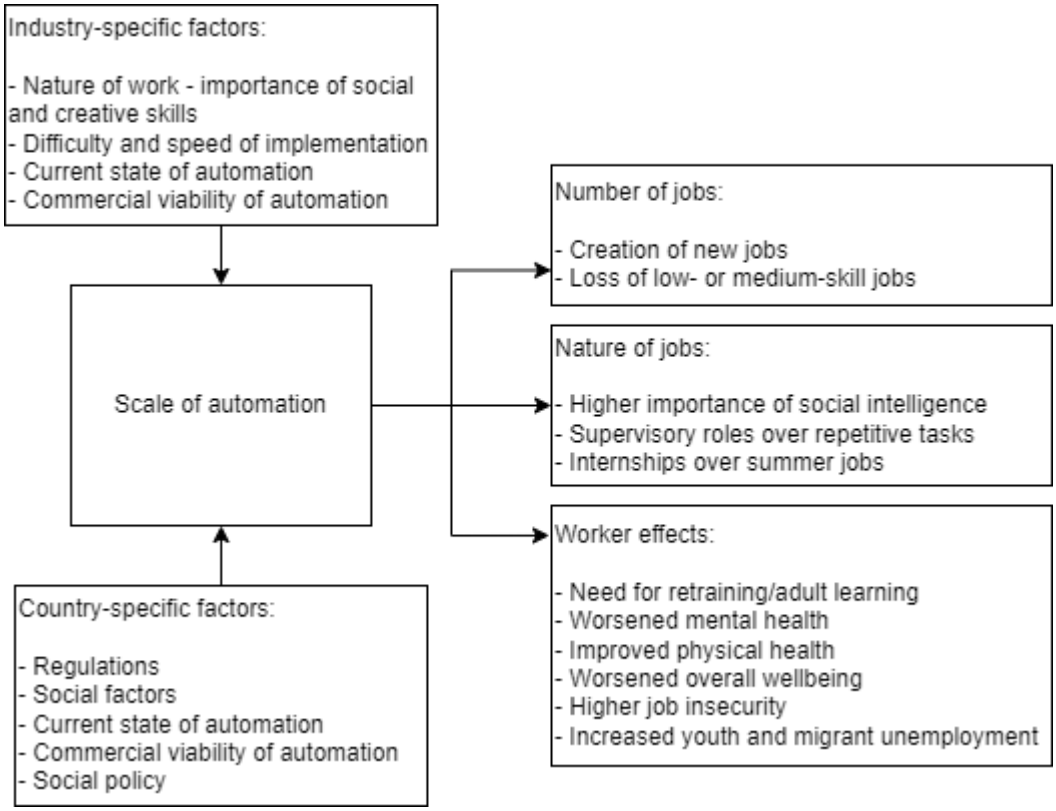
While some experts believe that automation is related to job insecurity and is thus potentially causing negative mental health effects (Abeliansky & Beulmann, 2019; Loretto et al., 2010), Nazareno and Schiff (2021) did not find any evidence of job insecurity's effect on well-being. They stress that workers might be unaware of the risk of automation or simply believe that their colleagues' jobs are more at risk than theirs. This seems to be at least partly in accordance with the findings of Bhargava et al. (2020) regarding the awareness of workers on the likelihood of automation. Considering the lack of agreement between researchers on the issue of job insecurity's effect on wellbeing, no conclusion can be reached yet, stressing the importance of further studies on the matter.

2.4.2 Automation and Health Effects

Looking at the effects of automation on workers' health, experts seem to agree that, on average, automation does have both positive and negative health effects, depending on the type of automation. Nazareno and Schiff (2020) find that automation's negative effects on mental health affect workers' overall health negatively, both in the short and long term. The finding is surprising, as automation is expected to deliver positive health effects due to being able to mitigate negative effects from tasks such as heavy physical labour (Loske et al., 2021). The extent to which negative health effects arise likely depends on whether automation is expected to complement or substitute for human labour in the specific job. The findings could be explained by the fact that some employees expect to completely lose their jobs to automation even if they are not at risk, thus leading to a significant negative impact on their mental health. As such, better communication on behalf of management or an emphasis on automation transforming jobs instead of taking them away could significantly reduce the mental health effects on some workers. Based on these findings, it is reasonable to expect automation's effects on overall worker health to vary depending on the industry, with the overall health effects being more negative in industries with little to no heavy physical labour to be complemented by automation as the overall negative effects to mental health outweigh the possible benefits to physical health.

2.5 Conceptual Framework

The conceptual framework has been constructed from the different variables identified from the literature surrounding automation. Automation will affect the number of jobs, the nature of jobs, and workers depending on how widely present it is, as well as depending on the specific industry and country in question. Several industry- and country-specific factors have been identified by experts, affecting the strength and direction of the effects of automation significantly. Industry- and country-specific factors have been identified as moderating variables in the diagram. Several aspects of each variable in the conceptual framework have further been identified to showcase the concrete effects of automation, as well as the specific factors affecting it.



Graph 1: Conceptual framework

3. METHODOLOGY

3.1 Research Methodology and Design

A qualitative research method was chosen for the research due to it allowing the analyzation of non-numeric data in an exploratory manner which is necessary due to the relative lack of studies regarding the automation of the logistics industry, specifically so in Finland and the Nordics. As the automation of the Finnish logistics industry has not been sufficiently studied in the past, an interview method was chosen in order to generate relevant data from managers and union representatives working in the Finnish logistics field. The interviews conducted were semi-structured, having a number of predetermined questions that were asked of participants. Then during the interviews, based on the interviewees' answers, some non-planned questions were posed in order to gain further insights on the topic.

3.2 Interview Sample

In order to have a sufficient overview of the Finnish logistics industry, managers from relatively large Finnish logistics companies were chosen in addition to some union representatives and a representative from a logistics association. The summary of the roles of the participants is presented in Table 2 with the level of experience of the research participants being presented in Table 3.

Roles of research participants	Number of interviewees
Directors of Finnish logistics companies	2
Managers of Finnish logistics companies	3
Labour union representatives	1
Labour union managing director	1
Logistics association managing director	1

Table 2: Roles of research participants.

Experience of research participants	Number of interviewees
20-30 years in the Finnish logistics industry	1
15-20 years in the Finnish logistics industry	3
10-15 years in the Finnish logistics industry	2
2-5 years in the Finnish logistics industry	2

Table 3: Experience of research participants.

The two sampling methods used in recruiting research participants were purposive sampling and snowball sampling. The research participants were selected from some of the largest logistics companies in Finland, as well as unions that represent employees or companies in the industry. Furthermore, the participants have been in contact with automated technologies in their work and are thus able to reasonably accurately assess the topic of automation in the Finnish logistics industry. The participants were approached on social media platforms such as LinkedIn or through email, with some participants being suggested by other participants.

Six of the eight research participants have more than 10 years of experience in the Finnish logistics industry, making them more likely to be aware of the change to automation. One of the three logistics companies interviewed is large, having over 600 employees in 2019. Another company interviewed has over 250 employees as of 2020, being a medium-sized company. The third company interviewed has slightly over 80 employees, being a small-sized company, having presence both in and outside of Finland. While this sample is not representative, only having participants from three companies, two unions, and an association in the Finnish logistics space, the companies chosen are among some of the largest or most successful in the space and are thus expected to have more experience with automated processes and to be able to give insights into the topic, as well as have wider relevance. Furthermore, the inclusion of directors, managers, labour union representatives, and representatives from logistics associations allows the exploration of different viewpoints between the participants and the minimization of subjectivity, the main downside of qualitative research.

3.3 Interview Process and Structure

The interviews conducted included questions from six different themes, based on the debates identified in the literature in the field. The number of questions related to each theme, and in general, varies based on the group of research participants. For managers from Finnish logistics companies fifteen different predetermined questions were developed, while union representatives, one manager, and one association representative were posed nine predetermined questions that are primarily focused on the Finnish logistics industry. The one manager was included in this group due to their company's position in the market, servicing other logistics companies and therefor having a particularly comprehensive perspective on the Finnish logistics landscape. The overall number of questions asked varied slightly depending on the answers of the research participants due to the semi-structured nature of the interviews. The interviews were conducted in Finnish through online meetings in March 2022, with the interviews lasting between 30 to 60 minutes depending on how in-depth the research participants' answers were. All of the interviews were recorded, transcribed in Finnish, and coded as part of the research process. Any

direct quotations of the participants were translated into English. The six themes of questions in the interviews are as follows:

1. Demographics questions and questions fitting multiple themes, possibly tying into other questions.

2. Criticisms against current research, such as opaqueness and ignorance of country- and industry-specific factors, as posed by Parschau and Hauge (2020).

3. Debate around the importance of creativity and social skills in the workplace by Coupe (2019), Arntz et al. (2016), Manyika et al. (2017), Nedelkoska and Quintini (2018).

4. Debate about the change in the overall number of jobs, change in the number of jobs depending on skill, and change in the number of jobs depending on age by Frey and Osborne (2017), Arntz et al. (2016), Willcocks (2020), Nedelkoska and Quintini (2018), Manyika et al. (2017).

5. Debate about the change in the nature of jobs, from executory to supervisory roles, and upskilling and retraining by Gruchmann et al. (2020), Frey and Osborne (2017), Manyika et al. (2017), Brynjolfsson and McAfee (2014).

6. Debate about automation's effects on employee health, motivation, and productivity; employee views on automation; and employee inclusion and consultation by Abeliansky and Beulmann (2019), Schwabe and Castellacci (2020), Bhargava et al. (2020), Loretto et al. (2010).

4. FINDINGS

4.1 The Current State of Automation in Finnish Logistics

4.1.1 Company Perspectives on Their Level of Automation

Company	Use case of automation
Company 1	Software automation and RPA used in office work, to fix data and change the structure of some shipping orders. Route planning is being automated.
Company 2	Automation used in sorting through automated sorting equipment in specific terminals. Route planning in early stages of being automated. Accounting processes and marketing being automated.

Table 4: Use cases of automation for the participants' companies.

According to participants A, B, and C, all from company 1, their company had relatively little automation. The most of their company's automation is software automation that is most visible in office work. According to participant C, their company has implemented software automation as well as RPA, robotic process automation, in different parts of their processes: "*I wouldn't yet say that much overall but significantly nonetheless.*" Software automation in the company is used mainly to fix data as well as change the structure of some shipping orders. Software automation in the company has been used for some years already and more is being implemented. Participant B reports that software automation is currently being implemented into route planning: "*We might have 40 percent of it moved now and the goal is for 80 percent to be moved for automation to do.*" It should be noted that the estimates of participants B and C for current automation of route planning differ, with participant C reporting that "*We are now, at large, at a few percent but are set to increase to 80-90 [percent]*". This potentially signals that there are differences regarding the level of automation in different branches of the company. Neither of the participants mention the timeframe for the planned automation. All three of the participants highlight that there is little to no physical automation in their company.

Participant D from company 2 evaluates the level of automation in their company as three out of ten, with slightly more physical automation than company 1. The majority of physical automation is in automated sorting in specific terminals, with there remaining many terminals where the only automated solution is a conveyor belt. Akin to company 1, company 2 also has software automation, although addressed as "*not differing in the level of automation from that of our production automation*" by participant D. More specifically, automation of certain accounting, marketing, and supporting processes has been pursued in the company, with route planning currently being automated but still relatively manual in nature. Furthermore, the marketing department does not have any automated systems yet. Overall, participant D considers their company to be in its infancy when it comes to automation, having identified many areas where automation could be utilized significantly more but only being in the planning and investigating stage.

4.1.2 Company and Union Perspectives on the Level of Automation in Finland

When asked about the level of automation in Finland, participants had widely varying perspectives. The answers varied mostly based on whether participants considered the extent of software automation in their answers. Participants C, E, F, and G emphasised that Finland is at least level with, if not ahead of Central European countries when it comes to things like software automation and overall digitalization of order registration, with some of the participants highlighting factors such as systems development. The participants agreed, however, that in Finland there is significantly less physical automation than in Central Europe, for example. Other participants largely neglected comparing the level of software automation, sticking to comparing only the level of physical automation and ultimately arriving to similar conclusions.

When having to evaluate the level of automation in Finland, participant A believed Finland to be keeping up with automation when compared to other European countries but not in a leading position. Similar sentiment was echoed by participant D who emphasised the relative lack of automated warehouses that they consider the beginning of automating logistics. Participant H explained that Finnish logistics historically didn't get up to speed with Central European logistics automation but is

apparently catching up to some extent, with there being many projects currently being implemented or investigated by Finnish logistics companies. Participant B also found Finnish logistics to be lagging behind some of Europe, finding that Finnish companies are at a relative disadvantage when it comes to trying to automate their processes, and that Finnish logistics companies mostly base their automation projects on what has already been done elsewhere. Overall, there were no significant differences between the answers of managers and union or association representatives.

	Finland ahead or among the leaders	Finland relatively up to speed	Finland relatively behind
Mentioned software automation	4	0	0
Did not mention software automation	0	2	2

Table 5: Participants' evaluations of the level of automation in the Finnish logistics industry compared to Europe (note that the table is about overall automation, all participants found physical automation to be behind in Finland)

4.1.3 Automation in Finland Versus Europe

As previously mentioned, the level of physical automation in Finland was found to be lower than in Europe by all of the participants. However, participants C, E, F, and G found Finland to be ahead or level with other European countries when taking into account software automation. According to participant A, most physical automation in Finland happens through the use of parcel machines which are adopted by some of Finland's largest logistics companies such as Posti, for example.

Reasons for Finland being less automated	Number of participants reported by
Low volumes	5
Small sized companies	2

Wide range of different products	2
Large and thinly populated country	1
Customers do not require fast delivery	1
Non-standardized delivery sizes	1
Companies' concerns over automation technology expiring quickly	1
Split focus between automation and climate-friendly equipment	1
Depression and financial crisis slowed progress	1

Table 6: Reasons given by participants for Finland being behind, at least in physical automation, to other European countries

The participants' most widely given reason for Finland being behind in physical automation was the low volumes in the Finnish logistics industry. Participants, A, B, D, E, and F mentioned low volumes in Finland as one of the main reasons why automation has not been worth doing for companies. Participant H, however, asserts that: "*Finland has low volumes and those cannot be automated. Yes, it is sort of true but, on the other hand, we do also have expensive labour.*", emphasising that the effects of low volumes are offset by other factors.

Outside of the low volumes, participants tended to mention reasons related to the small sizes of Finnish logistics companies. Small-sized companies have relatively little resources and face higher risks in implementing automation. An overarching theme was that of relatively little drivers for automation, and several reasons why current automated solutions are incompatible with the Finnish logistics industry, such as a wide range of different products and non-standardized delivery sizes, both of which require automation to have more flexibility. Interestingly, participant H finds that low volumes are not the direct reason for why Finnish companies have not invested in automation but rather that automation has not been historically compatible with the Finnish logistics market in general, predicting that modern and more flexible automated solutions and partial automation are a more suitable alternative for smaller companies such as those in Finland, to older, less flexible and more resource-intensive automated technologies. Interestingly, participants F and G find that there is a significant amount of potential for automation in the Finnish logistics industry. Furthermore, participants H and E imply that there will be a large

amount of growth specifically through partial automation in the near future. In a similar vein, participant D finds that due to the lower volumes, automation is focused on giving different benefits in Finland, such as being able to deliver more cost-effectively to remote places.

Potential for automation	Number of participants reported by
Significant potential	2
Strong potential for partial automation specifically	2

Table 7: Union and association participants' evaluation of potential of the Finnish logistics industry for further automation

4.2 The Positives and Negatives of Automation

4.2.1 Advantages and Drivers for Automation

When asked about the main advantages of automation, participants had somewhat different first answers but additionally named advantages were similar. Overall, it appears that there is a set of multiple advantages provided by automation, with participants having recognized which ones are more and less important for their company strategy.

Advantage	Number of participants reported by
Increased efficiency/profitability/cost effectiveness	7
Precision of processes	4
Employees freed from routine work	3
Flexibility	3
Higher quality	3
Ecological benefits	2
Safety benefits	2
Facilitation of growth in the industry	2
New ways of marketing	1

Higher capacity	2
Need for less personnel	1

Table 8: Advantages of automation mentioned by participants. (Note that some of these are mentioned in more interviews but not necessarily as advantages but as simply properties of automation).

Participant A found the main advantage of automation to be higher efficiency. Efficiency was the most commonly mentioned advantage by the participants. Besides efficiency, participant A highlighted a by-product of higher efficiency, that being increased profitability. Additionally, they found that automation allows employees to focus on more difficult, problematic, or time-consuming activities as automation does more routine work. Participant B, on the other hand, emphasised precision in the processes, with automation always doing the process in the same way and to the same extent. Additionally, both efficiency, profitability, and personnel being able to do more challenging tasks were named as advantages of automation, akin to participant A. Participant C thought the main advantage of automation was that it could handle higher transaction volumes that employees had trouble dealing with. This in turn lowers the number of human errors and allows for improvement of customer experience and perceived quality. Participant C also mentions that the higher efficiency of automation frees employees to focus on creating value elsewhere.

Advantage	Recognized by company 1	Recognized by company 2
Increased efficiency/profitability/cost effectiveness	X	X
Precision of processes	X	X
Employees freed from routine work	X	
Higher capacity	X	
Higher quality		X
Flexibility		X
New ways of marketing		X

Need for less personnel		X

Table 9: Advantages of automation recognized by managers from different companies

Cost effectiveness was the main advantage recognized by participant D, as a similar amount of work could be done by automation while requiring significantly less personnel. This would in practice lead to significantly faster deliveries in the company, creating efficiency. Other advantages mentioned were the lower rate of human errors in processes. Overall, participant D emphasised that automation can bring cost efficiency, speed, and quality simultaneously. Differing from answers of company 1 participants, participant D mentioned that automation allows for completely new ways of marketing, facilitating on-time marketing with very precisely targeted marketing messaging based on accurate information. Furthermore, participant D also noted that automation had allowed for more flexible 24/7 service through parcel machines. Participant D's company 2 is focused more on parcel deliveries than company 1, which does not have parcel delivery, but rather deals in larger deliveries. As such, participant D's answers are more in line with companies focused on B2C, instead of company 1, that is mainly B2B. That likely explains the differences in the answers of participants from the two companies.

Participant H highlighted that automation has many different advantages, depending on how it is implemented by companies and for what purpose: "*If the think about a company's operation strategy on a general level, it usually aims for cost effectiveness, flexibility, speed, precision, responsibility and it does not mean that all of these are weighed equally at the same time*." This is very much in line with the answers of managers who are looking at the advantages of automation through their companies, and how they have chosen to approach automation.

4.2.2 The Main Difficulties Faced in Automation

When discussing difficulties that company participants had faced, most participants found that they were at such early steps in automation that they had not faced difficulties related to automating specific tasks. Participant D highlights: "*We have not perhaps gotten to the point where we would have thought of all the stages that we*

want to automate and then noticed that it is difficult." Company 2 had already found difficulties in implementing very basic automation and as such has not moved forward with automation. Concerning physical automation, company 1 is in a similar situation, having mostly found theoretical problems in planning but not had many problems in practice.

Most common difficulties recognized by respondents were the high cost of automation, both in terms of monetary investment, as well as having to rebuild systems and other existing infrastructure, and being limited by automation in terms of flexibility in the future. Participants gave over 31 example of different difficulties that had come or are currently in the way of automation adoption. Most of them were examples of how certain aspects of automation such as inflexibility, high cost, or higher skill requirements for staff make automation difficult to implement of maintain.

When asked about economic and non-economic barriers to adopting automation, all four managers asked talked about how much automation needs to be integrated into existing infrastructure, or that infrastructure might need to be entirely rebuilt to allow for automation to work. Other points mentioned were how high the cost of investing into automation is, as well as the lack of availability for working automation, and that available automation is not advanced enough. All of the answers are intertwined in that there is, to a high extent, basically no automation available that would fit the needs of the companies. Additionally, what few automated technologies would work need heavy investment due to high price, as well as needing infrastructural changes. The high cost is to a large extent because of the infrastructural incompatibilities.

Barriers to automation	Number of participants reported by
Automation not compatible with existing infrastructure	4
High investment cost	2
Lack of availability	2
Automation not advanced enough	2

Table 10: Barriers to automation identified by managers

4.3 Effects of Automation on Level of Employment

When asked about how automation affects the level of employment in companies, participants A, B, C, and D all found that there exists movement from tasks that are substituted by automation to others. However, there were varying views on whether or not automation would lower the number of jobs in the company in the short run. Participant B, specifically, found that the number of people working in the company had lowered, mainly through people retiring: "*Yes there has actually been a decrease [in personnel]. I don't know exact numbers but mainly through retirements and such, or role changes*." They do reiterate later than automation rarely allows for the substitution of an employee but rather individual tasks, seemingly not finding automation to overall lower the level of employment. Surprisingly, Participant D, however, found that in the short run the number of employees had risen as a result of automation: "*Momentarily it looks like the number of workers has increased as we have not been able to entirely get rid of old ways of working*". In company 2, automation has been sort of paired with some of the old processes without entirely substituting them, leading to higher employment, at least for now. Participants A, C, and D believed that in the short run automation would not lower the number of jobs, with all of them stating that in the long run there isn't necessarily a lower number of jobs due to the change in employee tasks and roles, as well as job creation by automation. The main consensus of the managers is that the level of employment in certain roles will decrease, and similarly rise in other roles.

Effects of automation on employment	Number of manager participants agreeing	Number of union and association participants agreeing
Automation does not lower the level of employment	3	4
Automation does lower the level of employment	0	0

Table 11: Managers, as well as union and association participants' views on automation's effects on employment

None of participants E, F, G or H, the participants answering the union-focused questions, believed that automation would lead to an overall loss in the number of jobs in the industry. Participants F and G specifically mention that automation will remove and create new tasks akin to participants A, C, and D. Participants E and H, on the other hand, mainly emphasise that automation allows for growth and supports it in the logistics industry, which in turn creates jobs. According to participant E, "*For example, the fact that ecommerce is growing rapidly. It employs the most in the logistics industry. Even though simultaneously automation can lower [the amount of personnel], I can say that it has employed even more*". Participant H asserts that "*In a way this increase in selections, just-in-time, the speed of ecommerce, customisations made, it increases the workload of the task in a way that automation and digitalisation is needed to maintain efficiency and precision, but it does not mean that manpower isn't needed. Likely a lot of manpower is needed in the future as well*." They both also state that when looking at a specific process or at automation as a separate phenomenon, job loss will be seen. One example of such happening given by participant H was that of a warehouse being replaced by an automate warehouse in which case the number of employees went from 2000 to a few hundred. They both reiterate, however, that in the wider context of the market, automation will not lower the number of existing jobs, which will likely increase.

4.4 Effects of Automation on Tasks

4.4.1 Nature of Change in Jobs and Tasks

Effects on nature of jobs	Number of participants reported by
Less routine work	7
Increased need for retraining	7
Movement from routine to supervisory roles	4

Employees need to participate more in improving automation	4
Work becomes more interesting	3
Need for more IT knowledge	2
Need for deeper understanding of data and similar	2
Certain work might become less interesting	2
Jobs become more customer-oriented	1
Need for more social skills	1

Table 12: Automation's effects on the nature of jobs identified by participants

When asked about how automation is likely to change the nature of jobs, the overarching theme was that of less routine work, more challenging and interesting work, and the need for employees to gain new skills. Regarding how automation affects the nature of jobs, all participants except participant E directly mentioned that automation is taking away routine jobs and, as such, employees will be doing less routine work. The second most often mentioned effect was that of increased need for retraining. All participants except participant D mentioned or agreed that there is more pressure or need for retraining. Additionally, participant D highlighted that there is a need for more know-how regarding new automated systems and systems in general. So, while participant D did not mention retraining, the need for more skilled labour was identified and one way of reaching that is through retraining. Interestingly participant D also mentioned that automation could potentially make jobs either more or less interesting, depending on the job in question, as well as either lower the amount of routine or non-routine jobs, depending on the situation. Participant D mentioned an example of route planning, where "*a driver [might] only have to load the goods in the car and drive in the order given by the system. It massively removes the need for knowledge and a person who has done a job their whole life … might feel that this system is replacing them*." Interestingly, participant D also states that similar effects of automation in sorting could make work more boring, and ultimately raise turnover in that particular job: *"Similarly, at the sorting line the work becomes perhaps more monotonous*." "*Then turnover rises, [as] it is conveyor belt work, so [people] might not necessarily stand it year in, year out*." Overall, the participants tended to believe that automation will most of the time make jobs more interesting instead of less interesting.

4.4.2 Changing Needs for Employee Qualities

As previously mentioned, the need for higher skilled employees was one of the clearest effects that participants saw automation as having. When asked more specifically about which qualities for employees could be more or less important as a result of increasing automation, most participants only saw more important skills, with most not mentioning a skill that might become less important. Only participants D and E identified less important skills, with participant D mentioning the lower amount of knowledge needed in route planning, and less skill required in sorting. Participant E found that driving jobs are likely to become easier with the implementation of supportive automation, and that voice picking in warehousing has lowered language requirements, as the devices can be programmed in many different languages.

Skills to become more important	Number of participants reported by
Technical skills	5
IT/ICT skills and systems knowledge	5
Social interaction skills	2
Creativity	2
Perceptive skills (e.g., being able to operate machinery in tight spaces)	1
Problem solving skills	1

Table 13: Employee skills that have become more important as a result of more automation mentioned by participants

The skills participants found most likely to increase in importance were general technical skills, IT skills in particular, and social interaction skills, as well as creativity. One outlier was participant A, who asserted that "*an employee who thinks with an open mind is probably needed both now and in the future*." and that "*nearly always, automation makes work easier*." As such, participant A did not mention any skills that could become more or less important. In general, technical skills specific to jobs

were found much more important than social skills or skills such as creativity. This is, to some extent, related to the role of the participants interviewed as one of the participants mentioning social interaction skills is an HR manger, and the other works for a logistics union. Based on this, it seems that managers implementing automation or working closely with automation put less emphasis on the importance of soft skills, strongly favouring technical knowledge instead.

4.5 Employees and Automation Implementation

4.5.1 Employee attitudes initially and after automation implementation

Initial employee attitudes on automation	Number of participants reported by
Employees afraid of losing their jobs	7
Employees resistant to change	5
Employees consider automation a good thing	4
Younger employees more open to automation	2
Supportive automation reacted to positively	2
Avoiding use of automated systems (e.g., parcel machines)	1
Employees afraid of telling supervisors about concerns regarding automation	1
Employees not willing help in improvement of automation	1
Employees require reward to help in improvement of automation	1
Employees lack knowledge about automation	1
Employees are reluctant to give information about how to automate their jobs	1

Table 14: Initial employee attitudes on automation mentioned by participants

The most commonly mentioned attitudes of employees towards automation were the fear of losing jobs, as well as general resistance to change. The overarching theme was that there was a large amount of variance between which employees reacted positively to automation and which ones did not, with every participant mentioning

that there are both positive and negative attitudes towards automation amidst employees. This was not particularly surprising.

Changes in employee attitudes after automation implementation	Number of participants reported by
Employees convinced once their jobs become easier, more efficient, or more productive	6
Employees who haven't lost their jobs react positively over time	6
Some employees feel less engaged and satisfied, worried over less control over work or monotonous nature	4
Employees being part of implementation and improvement process creates positive reaction	1

Table 15: Changes in employee attitudes after automation implementation mentioned by participants

Most participants highlighted that employee attitudes towards automation tended to improve with time, as well as once automation has been implemented in a properly working way. It is unclear, however, whether the positive change comes from automation helping employees, getting used to automation, or perhaps both. Half of the participants mentioned that some employees could feel less engaged or satisfied or become worried about automation. Participants found this to be dependent on the job in question, as some jobs were suspected of becoming perhaps more monotonous as a result of automation, and that this would affect the employees doing those jobs. According to participant F, "*Some employees certainly can become worried about their future and if a more interesting and challenging tasks changes so that a machine does it in a minute and afterwards [they] get to do the more monotonous task*."

4.5.2 Inclusion of Employees in Automation Implementation

How employees have been included in automation implementation	Number of participants

	reported by
Widespread messaging about automation to employees	4
Plenty of meetings with employees about automation	4
Employees have not been included in planning but instead in improving implementation	2
Employees perhaps less included in multinational corporations	1
Employees have been included in multinational corporations	1
All employees have been made to take part in improving implementation	1

Table 16: How employees have been included in automation implementation as reported by participants

Interestingly, participant G reported that in their company employees have been made to take part in improving the implementation of automation: "*As an employer our jobs is to widen people's minds that it is everyone's task to take part in this, to give, at least on some level, their input on [automation].*" Participant G also mentioned that while some employees want to participate in the planning of automation, there are also those who do not. Furthermore, participant H asserted that the right employees need to be found to take part in improving automation instead of forcing every employee to participate. As such, there appear to be multiple approaches to including employees in the planning and improving of automation in the industry, from not being included at all, to being able to take part, or even being forced to do so.

How employees should be included in automation implementation	Number of participants reported by
Employees being part of the implementation creates better outcomes	8
Messaging about automation important	4
Automation needs to be started with a strong decision, flexibility with employee comments later	1
Employees should at least be made to feel like they are heard	1
Right employees need to be found to take part in improving	1

implementation	

Table 17: How employees should be included in automation implementation as reported by participants

Employee inclusion in automation	Company 1	Company 2
Employees included in planning of automation	X	
Employees included in improving automation	X	X

Table 18: Employee inclusion in automation in companies 1 and 2

There was a difference in the inclusion of employees between companies 1 and 2, that being employee inclusion in the planning process of automation. While company 1 included employees in both planning and improvement of automation, company 2 only included employees after the initial planning and implementation process. Having less employee inclusion than company 1, participant D asserted that company 2 perhaps did not include employees as much in the planning and implementation of automation as they should have. Participant D's reasoning for this was that having employees plan the implementation of a technology that will lower the amount of some of their jobs was difficult as "*the first [step towards automation] is usually such that if you ask employees, few [want to answer]*." This is in line with answers of other participants, as highlighted earlier. Participant D does explain that employees need to, however, be consulted in improving automation and that company 2 will likely do more of that in the future.

5. DISCUSSION AND ANALYSIS

In this section the research findings are discussed and further analysed in contrast to the literature published and available in the field.

5.1 How Is the Logistics Industry Being Automated?

The Finnish logistics industry is automated to a relatively small extent with none of the participant companies having physical automation. Additionally, all of the

research participants found Finland to be behind in physical automation. As such, the findings are in line with the findings of Dekhne et al. (2019) who stated that most logistics companies have not heavily invested into automation. Furthermore, like in their findings, some participants had concerns about which automated technologies will prove to be good long-term investments and found that Finnish logistics companies tended to wait for others to implement automation before doing so themselves, reinforcing the findings that companies are hesitant to further implement automation, at least in Finland.

The technologies used in the logistics industry in Finland proved to be mainly robotic process automation, with systems such as automated guided vehicles being considered by companies but ultimately not adopted due to not being particularly compatible with the needs of the companies operating in the space. Additionally, participants found that there were several financial and non-financial barriers to the adoption of current automated technologies, similarly to what Parschau and Hauge (2020) found to be the case in South Africa. Some participants noted that due to these barriers and other factors, partial automation with more flexible automated solutions like shuttles is likely the way to go in Finland due to the generally smaller size of companies, as well as lower volumes, making automation require less investment and hence have lower risk. While the barriers identified do not make larger scale automation impossible, they do significantly lower the cost effectiveness of traditional and full-scale automation implementation. These findings about the logistics industry, at least in Finland, strongly support the findings of Arntz et al. (2019), Willcocks (2020), and Borland and Coelli (2017) who emphasised that it is increasingly necessary for researchers to not only analyse the capabilities of automated technologies but also analyse the overall feasibility of adopting those technologies in order to accurately evaluate the potential of automation in different countries. While there are automated technologies that could be used to substitute for employees in the industry, they are likely not commercially or otherwise viable for the vast majority of companies in the space.

The finding that partial automation is likely the most feasible form of automation adoption in logistics, at least in Finland, is additionally supported by Gruchmann et al. (2020) who found that partial automation allows for high process flexibility and is

highly relevant for improving working conditions in logistics professions while also having a relatively high rate of acceptance by blue-collar workers. The findings of several participants regarding a high level of potential for automation in the Finnish logistics industry are also supported by the findings of Dekhne et al. (2019) that automation has the third highest potential for automation out of any sector. Given these findings, it seems that automation is likely to rapidly increase in the logistics industry as technologies such as shuttles and other partial automation become available for more logistics companies, allowing them to gain significant advantages at lower cost and with more flexibility than more traditional automated solutions.

5.2 The Positives and Negatives of Automation

Several participants reported that automation has led to higher cost efficiency, higher productivity, and less human errors in processes, being agreed upon by Nitsche (2021). Some participants, however, did not find there to be less independence from individual employees as one participant found that the lower number of employees in a task, resulting from automation, makes each employee hold proportionately more responsibility, potentially leading to vulnerabilities in the supply chain. Another participant, however, highlighted that as employees' work becomes easier through automation, employees have less responsibility, allowing for flexibility in cases where employees were not capable of working, such as in a case of sickness. Many similar discrepancies were found elsewhere in analysing automation's effects on the logistics industry, highlighting that the effects of automation in the industry are highly dependent on the specific job, task, and role, among other factors.

Interestingly, one participant found that automation can have several tangible advantages depending on what automation is used for in a company, and in what ways it is implemented. Some of the advantages mentioned included cost efficiency, flexibility, speed, precision, and responsibility. In a sense, automation highly conforms to the operational strategy of a company, given proper planning and implementation. The answers of other participants strongly supported this, as there was a significant amount of variance in what different participants considered the main advantages of automation for their companies, or for the logistics industry in general. Similarly, researchers have also emphasised that automation is not only an

answer to problems related to productivity or efficiency but can also help solve a worker shortage (Dekhne et al., 2019; Efthymiou & Ponis, 2020), as well as the lack of an infrastructure supporting growing ecommerce needs (Dekhne et al., 2019). Both of these factors were mentioned by participants, with an emphasis on how automation allows companies to reach the needed level of precision and efficiency to be able to keep up with market demands. Especially the low number of available logistics workers in Finland was mentioned as one of the reasons why automation is important in being able to facilitate growth in the logistics industry.

Interestingly, one participant specifically mentioned that in automated warehouses, for example, the slightest anomaly in packaging sizes can stop the entire chain from working. This ties into the previously discussed problem with lack of flexibility in traditional full automation solutions. Additionally, it was emphasised that the lack of flexibility of automated supply chains could be a major vulnerability for cyber-attacks, for example. Given how crucial functioning supply lines are to countries, the cybersecurity-aspect should not go unnoticed.

Additionally, automation was also found by some participants to have the capability of mitigating negative health effects from strenuous tasks. This is especially topical in the logistics industry as there are still some strenuous tasks such as loading, unloading, and similar that require human labour. Some participants recognized the possibility of bettering employee health, but it appears that no participants have seen such effects in practice as there was found to be a lack of working automated solutions for these tasks in particular due to them requiring manual dexterity and being done in cramped workspaces, also identified as bottlenecks to automation by researchers such as Frey and Osborne (2017).

5.3 The Effects of Automation on the Number of Jobs

Research conducted by researchers such as Frey and Osborne (2017), OECD (2018), and to some extent Efthymiou and Ponis (2020) found that the labour substitutive effects of automation were especially prevalent in routine tasks. Similar sentiment was echoed by participants, who overwhelmingly found that routine work was one of the most likely to be automated. Interestingly, despite the participants'

belief that routine tasks are the most automatable, Coupe (2019) found that only the concerns about automation were higher for routine or repetitive jobs. The participants highlighted that most often only routine tasks are eliminated, and that the entirety of a job being substituted by automation remains considerably rare. As such, it seems that Coupe is, to some extent, right in his findings, depending on how his methodology considers the changing nature of initially repetitive jobs.

When considering the effects of automation on the overall level of employment, most researchers believe that there will likely be more job creation effects than job saving effects, leading to an overall higher number of jobs (Arntz et al., 2016; Nedelkoska and Quintini, 2018). Considering that all the participants found the substitution of entire jobs to be relatively rare and that mainly specific routine tasks are substituted, it appears most likely that automation will not negatively affect the level of employment in the logistics industry, at least in the long run. In fact, based on the findings of some participants, automation could in some cases be creating more jobs even in the short term due to not entirely substituting existing employees' jobs but working alongside them. Similarly, automation was considered by some participants to facilitate the growth of the logistics industry, leading to higher labour and product demands, being in line with the findings of Arntz et al. (2016).

5.4 The Effects of Automation on the Nature of Jobs

5.4.1 Retraining and Employee Skills

With concerns over employees losing their jobs, the idea of wider-scale retraining has become a topic discussed by many researchers, as discussed in the literature review. The need for retraining is heavily visible in the findings, as nearly all participants highlighted an increased need for retraining as one of the main effects of automation. Interestingly, participants highlighted that retraining would mainly need to give employees more technical skills and, for example, ICT skills instead of social or creative skills, as only two participants mentioned social skills or creative skills being needed more in the logistics industry. This deviates significantly from the suggestions of researchers who have found that employees should try to acquire creative and social skills if they wish to stay employed (Frey & Osborne, 2017;

Manyika et al., 2017; Brynjolfsson & McAfee, 2014). However, considering that most of the managers were working in transportation or parcel delivery management roles, it could be that they do not see social skills as being especially important whereas people working in HR management or similar roles find those skills more important. In fact, the one HR manager in the sample specifically found the importance of interpersonal skills to become more pronounced with more automation. Considering other findings by participants, such as the fact that employees could have to interact with customers more due to automation, or that the creative use of different skills will be needed from logistics employees not replaced by automation, it appears likely that a combination of different skills such as technical skills, ICT skills, creativity and interpersonal skills will continue to be needed in the future.

5.4.2 Changing Roles of Employees

Half of the participants identified that automation leads to movement form executive roles to supervisory roles, as identified by Gruchmann et al. (2020). With this movement should come higher skill requirements for employees, as well as lower turnover (Min, 2007). However, not all participants found the movement to necessarily be towards supervisory roles, with one participant bringing up the lowering of employee skill requirements as automation could not do certain routine or monotonous work due to lacking in flexibility. In such a case, the participant found that employees' turnover would likely increase. Given the large number of different employee roles in the logistics industry, while the majority of employees are expected to move towards supervisory roles with higher skill requirements, there will likely be certain jobs that can have the opposite happen. However, considering that routine jobs are predicted to be among the first ones automated (Frey & Osborne, 2017; OECD, 2018), agreed upon by participants, it seems that such occurrences will become less common with the further advancement of automation.

5.5 Employees as Part of Automation

5.5.1 Employees' Initial Concerns Regarding Automation

With more tasks traditionally done by employees being replaced by automation, researchers have found workers to be increasingly worried about the future of their jobs (Castellacci & Schwabe, 2020; Abeliansky & Beulmann, 2019; Nazareno & Schiff, 2021). This was reflected in participants answers as they found that employees tend to initially be afraid of losing their jobs, as well as resistant to change when faced with automation being planned and implemented in their workplace. Additionally, participants found that it is important to inform employees about automation in order to lower the amount of fear or resistance towards automation, akin to findings of Bhargava et al. (2019). Furthermore, participants implied that the initial reactions of employees were not related to their jobs as much as their age or general attitude towards automation, being similar to findings of Abeliansky and Beulmann (2019) who found that it is mainly the exposure to automation that makes employees worried about job security and those of Bhargava et al. (2019) in that workers are perhaps unable to assess how automation will affect their jobs due to lack of knowledge on the topic.

Interestingly, some participants found that often younger employees had a more positive attitude to automation than older employees, contrary to Abeliansky and Beulmann's (2019) findings that older people were less concerned about automation. The situation reported by some participants could be a case where specific older employees bothered by automation had gotten used to doing their job in a certain way and were as such bothered by that specific instance of automation forcing them to change their approach. Similarly, young people might have reacted more positively to automation due to being better skilled and as such able to gain employment unlike some elderly employees, as proposed by Nedelkoska and Quintini (2018). Interestingly, one participant found that automation had lowered the number of jobs specifically through retirements, potentially supporting this theory. As a result, it remains likely that both younger and older employees are affected by automation in different ways, with older employees being perhaps forced into retirement due to their jobs changing, and younger people having less available jobs due to the nature of jobs being automated.

5.5.2 Change in Employee Attitudes

When asked about the effects of automation on employees, participants found that employees tended to start reacting positively to automation sometime after it had been implemented, contradicting the findings of Nazareno and Schiff (2021), who found that job satisfaction did not increase at all through automation, either decreasing or remaining neutral at best. Furthermore, the researchers found that automation led to employees experiencing a loss of meaning at work. Interestingly, while most participants thought of automation as increasing employees' job satisfaction through substituting for routine jobs, some participants highlighted that, on occasion, automation could first substitute less-routine tasks, leading to the loss of meaning at work, as well as generally less autonomy at work, being in line with Nazareno and Schiff's (2017) findings of automation mainly leading to negative job satisfaction through less autonomy. The researchers do, interestingly, mention the possibility of automation having positive effects on workers if it increases autonomy which, in this situation, seems to be the case. As such, based on the participants' answers, automation has increased in a way that increases autonomy in the logistics industry. There could, however, be the possibility of employees not speaking up about their concerns regarding automation, as mentioned by one of the participants. Because of such effects, there remains a possibility of participants incorrectly evaluating the attitude of employees. As such, while it appears that employees are generally satisfied with how automation is affecting their jobs, there could very well be concerns as well.

5.5.3 Employee Inclusion in Automation

Given that job insecurity could be increasing due to the fear of automation, it would make sense that workers would be more interested in having more say in how automation is planned and implemented in their workplaces, being able to affect their positions in the company as discussed in the literature review. Similarly, employees would likely want a share of the benefits that automation brings to the companies. When participants were asked about employee inclusion, most believed that it is of utmost importance in implementing working automated solutions that are accepted and competently used by workers. Surprisingly however, some managers had faced issues with workers not wanting to take part in the improvement of automation, but still enjoying the upsides of automation such as less routine work or similar. This has

created a challenge for managers in trying to find the right balance in including employees in automation implementation and planning, with the consensus seemingly being that of not necessarily forcing employees to participate.

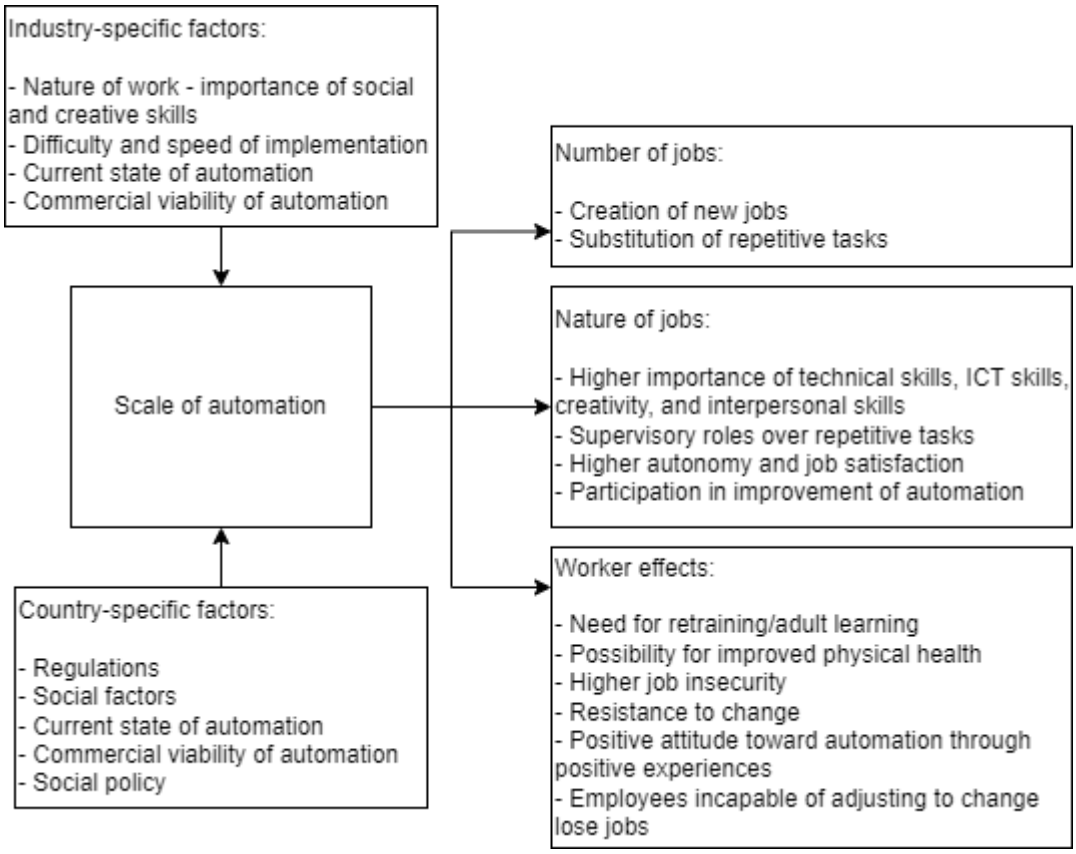
5.5 Improved Conceptual Framework

Based on the answers of research participants, the conceptual framework was modified to include new effects of automation on the number of jobs, nature of jobs and on workers. Regarding the effects on the number of jobs, no cases were found that specified the loss of low- or medium skill jobs, as mainly tasks were found to be automated, with jobs very rarely being entirely substituted. As such, the model was corrected to instead consider the substitution of repetitive or routine tasks.

Regarding change in the nature of jobs, it was found that in addition to social intelligence or interpersonal skills, technical skills, ICT skills, and creativity become more important for employees in the logistics industry due to automation. Furthermore, there was found to be a significant increase in the amount of needed retraining and participation as part of employees' jobs in the logistics industry. Additionally, there was found to be an increase in autonomy and thus job satisfaction for employees in the logistics industry. There were no findings supporting the growth of internship over summer jobs, leading to it being removed from the framework.

Regarding change in worker effects, there was found to be an overall positive attitude on behalf of employees regarding automation, given that automation is implemented in a way that considers employees. Furthermore, an initial resistance to change was identified on behalf of workers with the implementation of automation. No findings supporting the general worsening of mental health or worsened wellbeing in general were found. While there were no findings to support these effects, neither were there sufficient findings to reject them either. As such, further research should be done to confirm whether these effects exist in the logistics industry. The improvement in physical health mentioned in the original framework was modified to account for the fact that while there exists a possibility for automation to lead to improved physical health, it is highly dependent on the way automation is implemented. Additionally, there were no findings supporting an

increase in youth or migrant unemployment, with not findings to dispute them either. As such, further research should also be conducted on the effects of automation specifically on these groups. Finally, it was found that employees incapable of changing their ways of working are likely to lose their jobs as a result of automation, as employee expectations and requirements inevitably change.



Graph 2: Revised conceptual framework based on findings in the logistics industry, showcasing the factors affecting the scale of automation and, as such, the effects automation can have in the logistics industry.

6. CONCLUSIONS

6.1 Main Findings

The objectives of the research conducted were (1) to identify to what extent the logistics industry is currently being automated, (2) to identify what effects the automation of the logistics industry has on the number and nature of jobs in the

industry, (3) to identify what effects the automation of the logistics industry has on workers, and (4) to identify the specific factors in the logistic industry that affect the amount of change in the number and nature of jobs.

A conceptual framework was developed based on the literature reviewed in the field and then improved based on research findings, identifying the ways in which automation in the logistics industry is changing the number and nature of jobs, as well as how it is affecting workers. As part of the conceptual framework, certain industry-specific factors that affect how much automation changes the number and nature of jobs were identified. These industry-specific factors are the general nature of work and the importance of social and creative skills, the difficulty and speed of implementing automation, the current state of automation in the industry, as well as the commercial viability of automation. The state of each of these factors was analysed and identified in the logistics industry in order to evaluate the extent of automation's effects in the industry. Additionally, the likely effects of automation in the industry were evaluated.

In the case of the logistics industry, at least in Finland, it was found that the industry is being mainly automated by way of software automation used for office work and accounting, with limited used of physical automation such as parcel machines and automated sorting. Companies are implementing automation for route planning and marketing, but progress is generally slow. The low level of automation was found to be because of the lack of flexibility offered by current automated solutions, resulting in the typically relatively small Finnish logistics companies not willing to invest in further automation due to high risks and costs. However, partial automation and new automated solutions were identified as something that could significantly change the level of automation in the industry.

The specific factors affecting the change brought by automation were found to be, in the case of the logistics industry, that successful automation implementation requires a high level of technical and IT skills from employees, as well as likely some creativity and interpersonal skills for employees in specific tasks. Furthermore, automation was found relatively difficult and slow to implement in the industry, in part due to a lack of infrastructure compatible with available automated solutions and lack

of automated solutions available with the required functions. Finally, automation in the industry was found to currently not be very commercially viable due to the generally low volumes in the industry, alongside with high resource costs and risks associated with automation, such as the long-term viability the automation technologies currently available. Due to these factors, the effects of automation on the Finnish logistics industry are currently relatively small. All of these factors were, however, found to possibly be on the verge of changing due to new, more flexible, and cheaper automated solutions becoming available. Coupled with the immense automation potential in the industry, it is possible that the effects of automation will become significantly more pronounced in the near future.

6.2 Implications for International Business

The possibly quick increase in the effects of automation in the logistics industry could have significant effects on many stakeholders, such as employees in the logistics industry, logistics companies, or even governments. As the logistics industry is a crucial industry for the global economy, automation's effects need to be carefully measured in order to ensure the continued stability of the industry, avoiding negative outcomes such as the mass unemployment of employees due to lack of retraining opportunities, or even the breakdown of automated supply chains due to possible vulnerabilities to cyber-attacks. For logistics companies, the advantages offered by automation need to be carefully evaluated against all the possible effects it can have, in order to successfully implement automation both efficiently and responsibly. Automation is, after all, one of the most significant developments in the logistics and supply chain industry right now (Nitsche, 2021).

6.3 Limitations of the Research

One limitation of this study is its small sample size, being based on interviews with five managers, two union representatives, and an association representative. Furthermore, all of the participants were Finnish, and mainly working in the Finnish logistics space. Because of this, there is both a relatively small sample size, and that sample size can only effectively evaluate the state of the logistics industry in Finland. Due to this, the effects noted in the Finnish logistics industry might not be the same

in the logistics industries of other countries. Additionally, only participants from three Finnish logistics companies participated in the study, opening up the possibility that the study does not perfectly represent the Finnish logistics industry. However, the companies represented are some of the largest in the space, with some participants having had experience in multiple other logistics companies in the past, as well as having significant experience in the Finnish logistics space.

When participants had to analyse the overall state of the Finnish logistics industry, and to some extent the state of other countries logistics industries, they had a limited amount of data and experience, providing answers that were sometimes mostly based on their personal opinion, experiences, or research they had come across. As such, there remains inconsistency between the credibility of different participants' answers relating to certain topics or questions, depending on how familiar they are with each topic covered in the interview questions. The questions were made available to participants before the interview, however, so they had the opportunity to research certain topics and questions if they felt the need to do so.

6.4 Suggestions for Future Research

Future research could study the mental health and wellbeing effects of automation on workers specifically in the logistics industry as there remains little research into the matter. Additionally, the topic of the effects of automation in the logistics industry specifically on youth or migrant unemployment remain unclear as well, offering possibilities for further research.

As this research was done in a qualitative manner, further research could be done in a quantitative manner, more properly covering topics such as the extent of change in the number of jobs, or the number of hours of work done by employees currently being substituted by automation in different tasks.

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APPENDICES

Appendix 1: Manager Participants' Interview Questions

1. To what extent is automation used in your company?
2. What have been the main benefits your company has gained from automation?
3. What has been difficult in automation your company?
Follow-up question: If there have been difficulties, how have they been overcome?
4. What automated technologies are used in your company? E.g., drones, exoskeletons, shuttles, etc.
5. Have certain tasks been especially difficult to automate? Which ones?
6. How automated would you consider the Finnish logistics industry compared to other European countries?
Follow-up question: Why? Can you explain the differences?
7. What have been the main financial or non-financial barriers in implementing automation in your company?
8. Have certain employee skills or qualities become more or less important due to automation? E.g., social interaction skills, creativity or specific technical skills
9. How has automation affected the level of employment in your company? Do you have less employees or have some employees switched roles due to automation?
10. How has automation affected the nature of existing jobs in your company? E.g., Increased importance of retraining, upskilling, general trends.
11. What has been the reaction/attitude of employees to the implementation of automation in your company?
12. Did the reaction/attitude towards automation change after implementation compared to beforehand? How?
13. How were employees involved in the automation of your company? i.e. How was the change communicated? Were employees consulted on the changes?

Appendix 2: Union and Association Participants' Interview Questions

1. What are the main benefits and drawbacks to automation in the Finnish logistics industry?
2. How automated would you consider the Finnish logistics industry compared to other European countries?
Follow-up question: Why? Can you explain the difference?
3. How highly automatable do you estimate the Finnish logistics industry to be?
4. Have certain employee skills become more or less important with the increase in automation? E.g., creativity or social skills, certain technical skills
5. How has automation affected the level of employment in the Finnish logistics industry?
6. How has automation affected the nature of existing jobs in the Finnish logistics industry? E.g., retraining, upskilling, etc.
7. What has been the reaction/attitude of employees to the implementation of automation in the Finnish logistics industry?
8. How have employees been involved in the automation of Finnish logistics companies? i.e. How has the change been communicated? Have employees been consulted on the changes?
9. How has employee productivity and motivation been affected by automation in the Finnish logistics industry?