Lappeenranta-Lahti University of Technology

LUT School of Engineering Science

Industrial Engineering and Management

Logistics of North European companies regarding eastern markets of China and Russia

Rajan Kumar V K

Supervisor: Professor Olli-Pekka Hilmola

Examiner: Professor Marko Torkkeli

ABSTRACT

Rajan Kumar V K

Title: Logistics of North European Companies Regarding Eastern Markets of China and Russia

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Supervisor: Professor Olli-Pekka Hilmola

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Logistics activities have become more uncertain amid current trends like the COVID-19 pandemic and new environmental regulation. The role of technology has become more important in handling these uncertainties. This thesis aims to investigate the current state of logistics activities in North European companies regarding their trade with China and Russia.

The research applies a mixed method with a survey strategy to collect the data. The survey was targeted to logistics and manufacturing companies and was divided into two parts: the first survey was targeted to multinational companies from Finland, Norway, Sweden, and Estonia while, the second survey was specifically focused for regional companies from Finland. A web-based questionnaire was sent to all the targeted companies.

Both literature and survey results show that the semi-trailer followed by the container is the most important transport unit. For freight, the road is a preferable mode for shorter distances, and sea is the dominant mode over longer distances while, railways are expected to have potential growth throughout the decade in the future for logistics activities between North European companies and eastern markets of China and Russia. Research reveals that COVID-19 has a moderate impact on companies' logistics operations while environmental regulations will increase their transport costs and the vitality of cutting-edge technology is expected to rise. This thesis contributes to theory development for research as additional information.

In a nutshell, proper planning and adopting new trends of technologies, strategic changes to prepare for the future encounters of the pandemic, epidemics, and other risks can help to keep the momentum of logistics and supply chain operations in North European companies.

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Rajan Kumar V K

Lappeenranta, 2020.

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LIST OF ABBREVATION

AI	Artificial Intelligence
AR	Augmented Reality
COVID-19	Coronavirus Disease 2019
DHL	Dalsey Hillblom and Lynn
EU	European Union
EV	Electric Vehicle
FEU	Forty-foot Equivalent Unit
GDP	Universal Plug and Play
HCT	Universal Serial Bus
ICEV	Wireless Fidelity
IEA	International Energy Agency
IMO	International Maritime Organization
IoT	Internet of Things
LDz	Latvijas Dzelzcels
LNG	Liquefied Natural Gas
LUT	Lappeenranta-Lahati University of Technology
RQ	Research Question
SARS	Severe Acute Respiratory Syndrome
SOx	Oxides of Sulphur / Sulphur Oxides
TEU	Twenty-foot Equivalent Unit
UK	United Kingdom
UNICEF	United Nation International Children Emergency Fund
UPS	United Parcel Service
WHO	World Health Organization

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1. INTRODUCTION

Development in the sectors of communications, technology, global markets, customer service, and various other areas is attracting new demands of industries regarding supply chain and logistics (Waters, 2009) of the companies. Logisticians are in demand than ever, working in a fast-moving, ever-changing environment and the supply chain has become center stage, providing a competitive advantage to those who can master procurement, supplier management, inventory, warehouses, and distribution networks (Richards, et al., 2020). The importance of warehousing has increased and has become a more significant enabler for globalized production networks (Hilmola et al., 2011). Businesses are getting extra competitive and at the same time, also facing many challenges in sustainability, environmental issues and legislation, cybersecurity issues, as well as other uncertainties and risks (Grant et al., 2017).

Logistics and supply chain management continues to transform the competitive landscape and to stay ahead of a competitor, companies must be updated with technology, innovation, and core strategy (Harrison & Van Hoek, 2008). The global market has become more saturated than before and companies need to innovate their products and services with the reconstructionist strategies and seek to shape the environment to create new opportunities (Kim & Mauborgne, 2005).

Over the period, technology has pushed the boundaries and limitations of the businesses from one country to another such that the market is so competitive and saturated with many players in the same industrial category, so it becomes utterly important that companies adopt innovative strategies and new technologies (Ross, 2016). Technology, innovation, and communication networks are the key factors that push the business headlong and make it more competitive (Aqlan & Lam, 2015). With the advancement of technology in sectors like transport, information, etc., the supply chain has become a more global and complicated network leading to increased competition throughout the globe and this has changed the business environment. Therefore, it has become additionally important to meet the customer demands in time to stay ahead of the competitors (Ross, 2016).

Adoption of technology like blockchain can bring an essential addition in the ecosystem of the supply chain for ensuring transparency, traceability, efficiency, interpretability, and security for effective and easing some of the global supply chain problems (Saberi et at., 2019). Furthermore, technologies like augmented reality (AR), artificial intelligence (AI), the internet of things (IoT), machine learning algorithms, and cloud computing can be powerful accelerators for the industries to have competitive supply chain advantages (Shah et al., 2019).

Every organization`s logistics activities play a prominent role in delivering the customer´s needs in time so logistics becomes one of the most essential components of supply chain management for any business (University of Michigan, 2019). Logistics, meaning every aspect of handling the product from packaging and grading, warehousing, to transportation and product safety, is the very important aspect of the supply chain system, to reach millions of people with the value that the firm generates (Ghiani et al., 2004). A combination of different technologies, strategies, and sustainability of supply is of utmost importance for the companies to meet customer requirements in time and stay competitive (Min, 2015). Moreover, the different products and services that are purchased and consumed each day depend on the efficiency of the entire supply chain activities (Harison et al., 2008).

Logistics activities are the most important integrated and strategic part of modern society (Ghiani et al., 2004) for delivering the value created by the firms from their products and services and meeting customer's requirements on time. Building an efficient supply chain through an effective logistic strategy and integrated supply chain is necessarily important for building global logistics networks (Jüttner et al., 2003). Moving the materials through the supply chain involves major requirements to be fulfilled like controlling the flow of materials, procurement, distribution, inventory management, warehousing and material handling, transport, measuring and improving performance, and managing the key issues and risks involved throughout the process (Waters, 2009).

Warehousing is an important part of the supply chain and a major topic to study under supply chain research. A warehouse is any location where the material stocks are stored during their journey through the supply chain (Waters, 2009). Thus, managing warehouses and selecting

their locations is an essential part of the supply chain strategy. Survey-based research conducted by Hilmola et al. (2011) regarding warehousing in Northern Europe, shows that the importance of warehousing has been significantly increased due to globalization and it tends to increase further in the future. Therefore, it is necessary to study any changes in the trends of warehousing activities in recent years and what will be the trends in the future.

One of the major activities of the logistics in the supply chain is transportation and the modes used for it. Typically, road transport mode is the most visible issue from the greener supply chain´s perspectives (Grant, Wong & Trautrims, 2015). The goal of the logistics is based on the effective transport system and the different modes used for it. Transport has been always a key factor in transferring goods from one place to another and plays a vital role in the economy (Hilmola et al., 2012). Freight transportation is the major activity of logistics and therefore, the emissions from the transportation sector are mainly due to freight transportation (World Economic Forum, 2020). The transportation sector accounts for a large share of greenhouse gas emissions (Leinbach, 2007). All modes of transportation emit greenhouse gas, however, the most predominant one is the road mode since, whatever mode is being used for the logistics activities, the road is often involved at least to some extent during the movement of the materials.

Maintaining sustainability is the major challenge since, there are many challenges like increasing trend of population, which ultimately increases the demand from every aspect, other challenges like climate change, global warming, traffic congestion, etc. have seriously challenged the vector supply of the commodity, shipments, and demands (Leinbach, 2007). Managing the intelligent transportation system will benefit and add more value to the citizens, economy, and society. Moreover, the implementation of environmental regulation like the 2020 sulfur regulations by International Maritime Transport (IMO), can bring benefits to minimize the sulfur gas emitted from the ships and thus can bring the environmentally friendly management strategies which can be beneficial from all aspects of sustainability (International Maritime Transport, 2020). However, the carbon emission will not be affected by the sulfur emission regulation.

Since maintaining sustainability is a huge challenge nowadays accordingly the concepts like circular economy can be very advantageous to mitigate the various challenges of sustainability (Rajeev et al. 2017). New models of business based on circular economy meaning that the flow of materials taking place in a closed loop of the economic system, is needed to be applied and thus green logistics concepts can link between resources and products and products and consumers (Campos et al., 2015). The concept of green logistics can be a positive catalyst for boosting the likes of a circular economy. According to the World Economic Forum (2020), the practices of the circular economy in our economic system concern about 8.6 % of the material throughout the world, which is even 0.5 % less than what it was two years ago. Furthermore, alternative fuels like LNG and electricity for transportation possibly can lower the environmental impacts of logistics activities (Lähdeaho & Hilmola, 2020).

New technologies and innovations play an important role in the modern global supply chain and logistics activities. Advanced technologies like blockchain can accurately track the shipment and can bring more efficiency in the communication between actors in the supply chain and reduce the extra cost of the mediators between two parties (Lähdeaho & Hilmola, 2020). Moreover, increased computer vision, artificial intelligence, and machine automation has changed the efficiency of the logistics department and brought huge effectiveness in the supply chain system by helping to construct more accurate and compete for artificial systems and obtain new reliable and effective handling plans (Shen et al., 2019).

1.1 Background

This thesis is based on survey research conducted in the LUT Kouvola unit to understand the major challenges in logistics and warehousing activities at the North European company level regarding the eastern markets of China and Russia. Continuous research has been carried out to understand the actual situation and future perspective of logistics and warehousing activities in North European companies. Some previous research works were made in the year 2010 (Sutela & Hilmola), 2011 (Hilmola & Lorentz), 2012 (Hilmola, Lorentz, & Laisi), and 2015 (Holopainen), where similar surveys-based research was made to understand the logistics activities concerning Northern European companies. Holopainen (2015), found in his research

that the transport flow from China to Europe was higher than vice versa. Similarly, the traffic from Russia to Northern Europe is greater than vice versa. Moreover, his results also showed that most of the import for Finland and Sweden from Russia is mainly lubricants and fuels. If those products would not be taken into consideration, then the direction of net flow would be the opposite (Holopainen, 2015). However, the impact of newly implemented environmental regulations on shipping for logistics activities was not addressed. Hence, more detailed research on the environmental challenges of logistics operations is needed.

In a recent publication of Hilmola (2020), it was found that inventory performance plays a significant role in financial success and value creation for the shareholders as well. Therefore, it is important to study the major aspects of supply chains like inventory management, logistics activities, and warehousing management. This thesis research in 2020 will carry the previous research further as a continuation to fulfill the gaps and recommendations and to provide valuable updated insight. The major motivation for this research is to continue the previous type of research work by investigating new areas of problem and seek their solutions for logistics and warehousing activities for the North European companies regarding the Chinese and Russian markets.

Complexity, volatility, and evolving technologies constantly challenge all the aspects of the business (Min, 2015). Thus, the companies need to be ready for the uncertainties of the future in the supply chain system and identify the potential risks, which could be internally or externally driven (Bode, et al., 2013). As Bode et al. (2013) also indicate, it is the catastrophic type of risk that is likely uncertain and uncontrollable as it can appear in such form as natural disasters like earthquakes, tsunami, wars, epidemics, or pandemics.

Uncertainties like pandemics, epidemics, etc. have always been one of the biggest threats for the economy of any country (Remuzzi et al., 2020). At the beginning of the 21st century, epidemics named Severe Acute Respiratory Syndrome (SARS) caused a very large impact on the health of the people creating extreme emotional stress and only in six months it infected 8000 people throughout the globe out of which 700 died just in that period (Qiu et al. 2018). Moreover, the epidemic also impacted society very badly and it was reported by WHO (2004)

that from November 2002 to July 2003, 648 people died only in China and Hongkong from the total case of 8082 only in those countries. This leads to heavy suffering in those countries and gradually in Southeast Asia, as a result, the consumer's buying power was highly affected and international business suffered a lot as it spread in 26 countries causing heavy losses (Overby, et al., 2004). About $ 30-100 billion on the global macroeconomic scale from the impact of SARS could be considered a noticeable loss, and this was a setback in the economy at the very beginning of this century (Qiu et al. 2018).

Uncertainties are unpredictable, but it is important to find and assess the potential risks for the successful supply chain and efficient logistics flow. The emergence of the COVID-19 in 2020 is one of the major global threats for the economy of the world (The World Bank, 2020c). COVID-19 is an abbreviation for “Coronavirus Disease 2019” as it was discovered in Wuhan, China in December 2019. On 11th March 2020, The World Health Organization (WHO) declared it as a pandemic meaning that it is widely spreading and out of control internationally. Back in 2004, research carried out by four researchers concluded that infectious disease such as SARS or any other epidemic or pandemic in the future can emerge easily and can spread widely, causing an inverse impact on the economy (Overby et al., 2004). Moreover, the authors also stated that the SARS-like epidemic brought some positive economic impact on some companies. Currently, the world is facing quite a similar situation, which can create even worse situations in the late part of the year 2020, although it’s too early to point out unless there is a reliable amount of data concerning its impact on various sectors. However, the impact on transportation modes by the current COVID-19 pandemic has already caused trouble in the mobility of the passengers as well as freight (UNICEF Supply Division, 2020). This current issue is highly motivating to include as a part of the study in this research to show, how much impact these kinds of pandemics can have on the future of logistics for the companies and what major technological trends could appear to handle such a significant impact in the future.

1.2 Research gap

This research is a continuation of the previous research work made by Sutela & Hilmola (2010) and Holopianen (2015). The works of those authors are equally crucial from the perspective of

investigating the situation of transportation mode, inventory management, warehousing activities, environmental regulations, etc. in North European companies regarding Russia and China. However, in the research of those mentioned authors, the influence of modern cutting-edge technology (like blockchain, artificial intelligence, internet of things, electric vehicles, etc.) was missing. Furthermore, the COVID-19 is the newly born pandemic in 2020, whose impact on the logistics activities and operations of the North European companies has not been widely researched concerning the eastern markets of China and Russia. Therefore, this is another missing aspect (research gap) from previous works which is needed to be addressed. Moreover, at the beginning of January 2020, IMO implemented new regulations to reduce sulfur oxides (SO_X) emissions from the ships so it incredibly essential to investigate the impacts of the new sulfur regulations on the transportation cost for North European companies. These research gaps are investigated in this thesis through the research questions presented below in Sub-Chapter 1.3.

1.3 Research questions

Based on the previous literature study, identified research gaps, and further recommendations of previous works on the same domain, the thesis will address the following research questions as given below:

Q.1 What are the current state and issues in the logistics activities of North European companies concerning inventory, transport mode, warehousing, and impact of environmental regulations?

The first question is to investigate the current state and issues of the three major sectors (inventory, transport mode, and warehousing) of the logistics activities. Furthermore, the question also potentially investigates the impact of environmental regulations on logistics activities. Since the logistics activities are composed of several other areas, it is needed to explore the different areas of logistics to understand the overall situation going through the logistics activities.

Q.2 What are the impacts of the COVID-19 pandemic in the logistics activities and operations of North European companies?

Q.3 Can modern cutting-edge technologies like Artificial Intelligence, Blockchain technology, Internet of Things, and Electric Vehicles, enhance logistics activities and improve processes to better meet customer demands?

1.4 Aims and objective

This thesis aims to investigate the current activities concerning warehousing, transportation, inventory management, and potential issues in the logistics of Northern Europe regarding the eastern market of Russia and China. The thesis will also evaluate the impact of environmental regulations on logistics activities as well as how new cutting-edge technologies can enhance the need for customer's requirements. Moreover, the thesis is also aimed to examine the impact of the horrible coronavirus pandemic 2020 on the logistics activities and operations of the North European companies.

The research of the thesis will be based on the primary data gathered from surveying different companies from Northern Europe mainly focused on Finland, Estonia, Sweden, and Norway. Besides this, the secondary data will be also used to investigate the literature review. The results will give an update about the current state and prospects of the transport modes, inventory management, warehousing activities, changes in transport cost due to various reasons, and will be valuable for finding the logistics solutions for North European companies. Furthermore, it will also help to understand the risk associated with the logistics activities and help to assess the impacts of the new environmental regulation, COVID-19 pandemic, and future technological trends.

1.5 Scope of the study

The focus area of the thesis will be freight transport, warehousing activities, inventory management from the perspective of the contemporary environmental legislation, impact of the COVID-19 pandemic, and new cutting-edge technology. An investigation will also concern warehousing and logistics solutions for the North European companies to have a better understanding of the possible ways of trade opportunities between North European companies and eastern markets like China and Russia. The study on the transportation part will be mainly

focused on freight container flows back and forth between North European companies and China and with Russia. However, the detailed cost analysis of different stages of the logistics and warehousing will not be a major concern, but transportation cost, transportation units, and different modes of transportation will be analyzed and will be used in the empirical part for comparing the changes in the transport sector during different timelines to understand the current situation as compared to past and also to analyze the prospect of it. Furthermore, the thesis will investigate and conceptualize the key terms like warehousing, transport, and its modes, inventory management, global logistics, and risk associated with the logistics activities.

1.6 Structure of the thesis

The study is designed around three major research questions (see Sub-Chapter 1.2) through exploratory research. It started initially with preliminary research on previous works within the domain of logistics. Table 1 summarizes the flow of the thesis sequentially one after another. The study begins with the introductory chapter to give an overview of the thesis with background information, objective, scope, and the relation of the thesis to previous studies and the structure of the thesis.

The literature review in Chapter 2 is an evaluation of the previous research in the same domain or related topic and attempted to find the research gap so that it can be fulfilled through this study. There are six main topics in this chapter. The first topic is further divided into four sub-topics to have a deeper investigation of various logistics activities. The second topic provides a holistic view of the influence of technology and communication in the various logistics activities. Meanwhile, the third section introduces the concepts of sustainability and investigates the impact of environmental legislation on logistics activities.

The fourth section of the literature review explores the impacts of the most unexpected pandemic diseases COVID-19´s on the logistics and supply chain regarding different industries. Besides this, it tries to compare the situation in terms of how the logistics, supply chain and the global economy has been affected than that of SARS in 2003 Moreover, the section five and six describe the logistics activities regarding the market of China and Russia. Combining the

literature from six topics in Chapter 2, the study intends to provide an understanding of the overall logistics scenario from past research works.

Chapter 3 is the methodology chapter that outlines the paradigm of the research, methodological choices, step-by-step description of how data was collected, how the data analysis was done in the empirical part, and shows how the choice of design made and why the chosen research methods are suited to answering the research questions. Chapter 4 outlines what was found out concerning the research questions and breakdown of the result obtained from the empirical part helping the reader to evaluate and compare the data with clear visualization. Chapter 5 is the discussion chapter that includes the analysis and interpretation of the gathered data, comments on the results, and explains the finding and their significance. Furthermore, it also points out the limitations of the study and provides explanations for the unexpected results and note downs the questions that remain unanswered. Chapter 6 is probably the most important chapter of this study as it highlights the research objectives that have been achieved and summarizes the overall thesis in a nutshell. Table 1 below is the input and output chart of the thesis, which describes what has been the main inputs in each of the chapters and what was the outcome from it.

Table 1. Input-Output of each Chapter.

Input	Chapter	Output
A preliminary study, important background information overview.	**Introduction**	Aim and Objectives, Research questions, Scope, and Structure of the thesis.
Literature review on logistics and supply chain, Sustainability, Technology, COVID-19, secondary data.	**Literature Review**	Concepts of the Supply chain and various logistics activities, impacts of COVID-19 on transportation modes, different concepts on a different kind of technology used in the supply chain, logistics activities in China and Russia.
Research context, Methodological choices, data collection, primary and secondary data.	**Methodology**	Clarification of the applied methods, sample, and context, data analysis from primary and secondary data.
An empirical analysis of the collected data from both surveys.	**Result**	illustration of analyzed data, visualization of data, and presenting information from the analyzed data without bias.
Discussing what was found in the results from the survey to answer the research questions and comparing what was found in the literature review.	**Discussion**	Presenting and discussing the originality of the results, discussion of benefits of the study, and how stakeholders can use the result. limitation of the research, and further research suggestions.
Assessment of the results.	**Conclusion**	Summary of the thesis.

2 LITERATURE REVIEW

This chapter is a review of the literature of previous works and evaluates the previous research on the same domain and introduces the important concepts and various activities of logistics and supply chain. Also, it includes some of the major topics and concepts of logistics, supply chain, sustainability, warehousing, and inventory management. Furthermore, the chapter also explores the basic concepts of blockchain technology and its working mechanism, artificial intelligence, IoT and electric vehicles, and theory under the sub-chapter "role of technology in logistics activities and operations". According to WHO (2020), Coronavirus COVID-19 is one of the serious pandemics seen in many years and can affect almost every field of the modern economy and the world might have to bear one of the major economic losses after the 2008 recession. Therefore, it is vital to study the impact of the current pandemic COVID-19 in logistic activities, so it is also covered in this chapter. Moreover, the chapter also includes the logistics activities and operations of North European companies in Chinese and Russian markets.

2.1 Supply chain and logistics activities

Waters (2009) defines logistics as an essential part of the supply chain that is best organized as an integrated function, responsible for all aspects of material movement to meet the customer's requirement. Logistics aims for the timely positioning of the resources to meet customer demand. Moreover, Richards et al. (2020) explain that agile mobility is very essential for the effective movement of material from one point to another, and to meet such efficiency, transportation plays a vital role. Logistics and distribution have always been a key activity of the supply chain system as after manufacturing and operational activities the logistics play a pivotal role in customer service (Kim & Mauborgne, 2005).

Over a long-time, firms have pivoted their consideration on the adequacy and productivity of isolated commercial capabilities such as obtaining, generation, showcasing, financing, and coordination (Christopher, 2016). These capabilities should be connected to accomplish the objectives of an organization effectively, because the lack of connectivity among those functions, can lead to suboptimal organizational objectives and make wastefulness by

duplicating organizational effort and resources (Hugos, 2018). So, the firms have begun to realize that, arranging, controlling, and planning a supply chain has become a significant part of staying competitive in the global marketplace (Min, 2015). Today the global market has been surrounded by complexity, volatility, and evolving technologies that challenge us at every corner of our business (Shah et al., 2019) and businesses need to make even more decisions sooner and faster than before (Bricher and Muller, 2020). Therefore, supply chain activities play a pivotal role in enabling these functions to reach successful value creation and keeping the companies competitive.

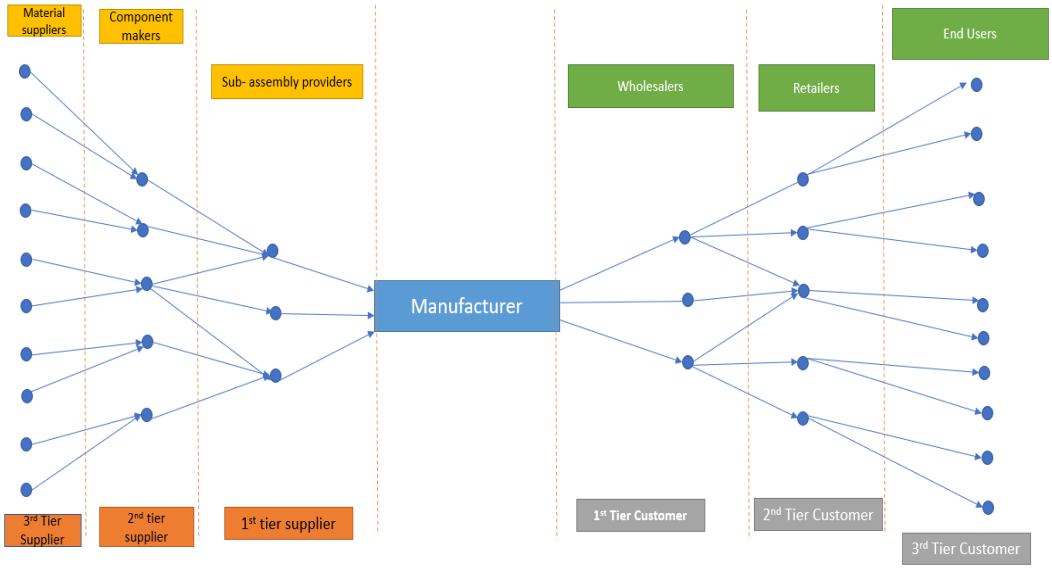

Figure 1. Typical supply chain around a manufacturer. (Waters, 2009).

Waters (2009) explains that almost every organization acquires raw materials from several different suppliers, which are then sold to many customers. In this manner, each sees supply chain meetings on its operations as crude materials move in through levels of providers, and at that point separating as items move out through levels of clients. A typical supply chain around a manufacturer can be seen above in Figure 1. As an essential part of the supply chain part of the organization, supply chain management delivers a competitive advantage (Waters, 2003). However, increasing megatrends in the last decade in logistics markets, the advancement of technology, and customers' requirements have consequently increased the complexity and

volatility of the supply chain network, which have further resulted in a more complex system (Bode, et al., 2013). Therefore, the probability of supply chain disruptions, risks, and vulnerabilities are also raised.

Many business models have become more complex and their network of the supply chain has been widening up due to the integration of modern technology (Hugos, 2018). Nothing is static in this world; every business must face the uncertainties of the dynamic future and thus risks are present for every kind of business entity. Therefore, risk identification by the process of discovering, defining, documenting, and communication at any phase of the process is an essential part of creating a successful supply chain. (Aqlan & Lam, 2015). Large scale organizations are difficult entities for figuring out the risk and equally difficult to estimate uncertainties to them, but the startup edges at this point because of flexible nature, easy reach, and more enthusiasm among the small team players (Scheer, 2001). Therefore, it can be said that more responsibilities and a larger ecosystem involve greater uncertainties and risks.

Bode et al. (2013) categorize the supply chain risk into two major aspects: Internal-Driven and External-Driven. These authors include the demand side risk, supply-side risk, and infrastructure risk to the internally driven risks, whereas regulatory, legal, bureaucratic, and catastrophic risks are devoted to the external driven risks.

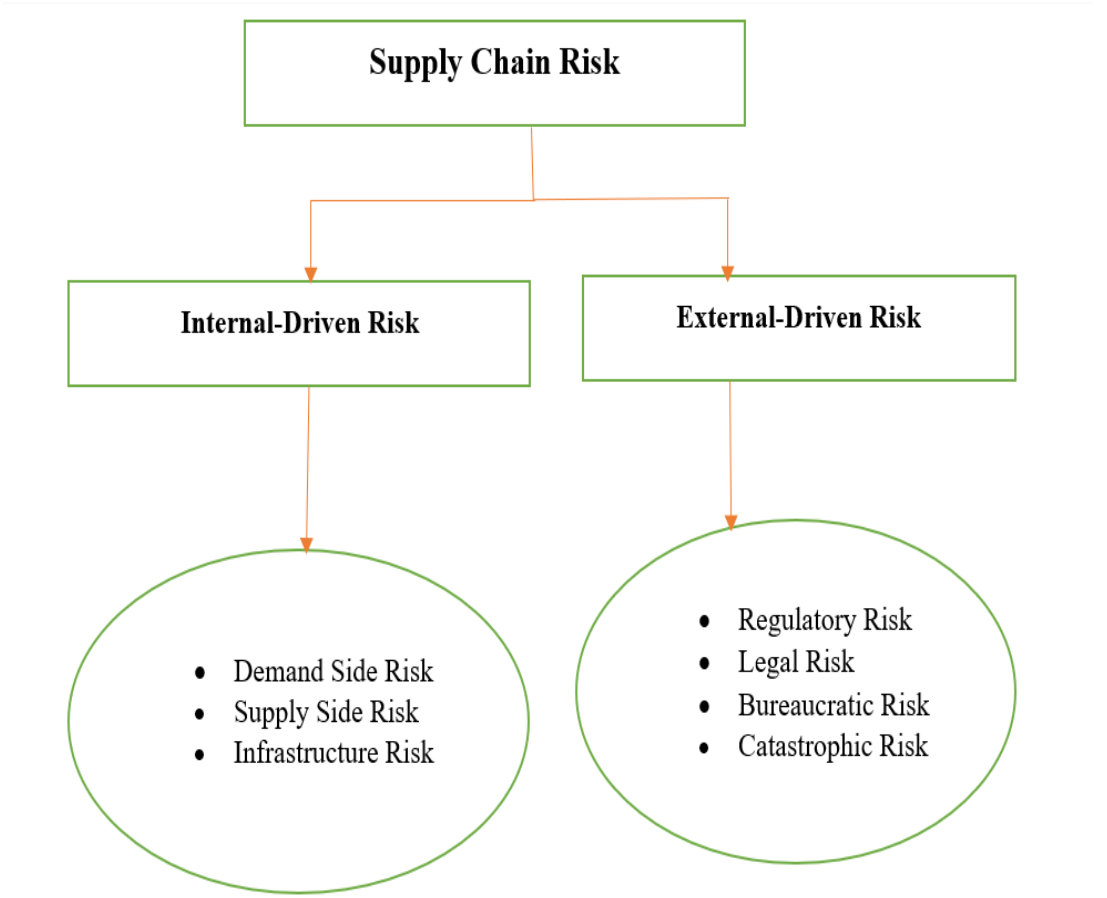

Figure 2. Types of supply chain risk, which an organization can face (Bode et al., 2013).

All risks are equally important to assess the successful supply chain system (Jüttner et al., 2003). However, it is not possible to assess all the risks at the same time or even later. The external driven risks like the catastrophic risks are likely to be uncertain as they are difficult to predict (Kleindorfer et al., 2005). They are often devastating in nature and can occur due to natural calamities (e.g. earthquakes, hurricanes, tsunami, wars, epidemics, or pandemics). These disasters can make a heavy loss in the economy of any country, business, or even on a global level. One of the notable examples can be found in a 2004 published research article on an epidemic named Severe Acute Respiratory Syndrome (SARS), which spread in 26 countries at the beginning of the 21st century and caused a greater economic loss and trade fluctuation (Overby et al., 2004). However, some companies did not suffer and even profited economically

due to SARS, (Overby et al., 2004). In context to 2020, the situation is relatively similar, but in a larger perspective due to the global spread of COVID-19. Waters (2009) mentioned China as a "factory of the world" since the major business world and multinational corporates heavily rely on China for manufacturing their product. It would not be a surprising factor that, the entire supply chain throughout the globe will interrupt, therefore, the companies and the countries need to be ready for such risks in the supply chain (Remuzzi et al., 2020).

Activities of the logistics are performed with a set of facilities (sites where raw materials are processed like manufactured, stored, sorted, sold, or consumed), which are linked by the transportation services (Ghiani et al., 2004). Management of logistics activities has become a greater global challenge since it is a key core for economic growth and competitiveness. A survey carried out by the World Bank (2014) showed that the Northern European countries like Sweden, Norway, and Finland performed well. They ranked quite high in the performance indicator, where Sweden ranked 6th followed by Norway on 7th. Although Finland was a bit behind these two countries, it still was ranked relatively high on 24th, which was still above global giants like China, having a position of 28th at that time.

2.1.1 Procurement and purchasing

Procurement is responsible for acquiring all the materials needed by an organization since every organization needs a reliable supply of materials and is responsible for organizing this supply, so it forms a crucial connection between vendors and purchasers and provides a mechanism that prompts the movement of the materials (Waters, 2009). In research conducted by Large et al. (2013), it was discovered that purchasing organizations set an excessive value on social and ecological factors. However, the perceived significance is no longer related to the buying companies´ very own contributions grant chain service providers´ sustainable things to do and besides, their result showed that purchasing corporations exert only a minor have an impact on logistics carrier companies involving ecologically and socially sustainable actions. Waters (2009) describes the activities of the procurement as follows:

- Identifying users' needs for materials
- Describing the materials
- Deciding the type of purchase
- Reviewing market conditions
- Forming an extensive list of companies
- Forming a concise list of suppliers
- Evaluating the concise list
- Choosing the suppliers
- Ordering the materials
- Recording the materials
- Recording the arrival
- Expediting
- Reviewing the purchase

Today it is obvious that e-procurement has become the essence of the procurement process as most of the companies have moved to e-procurement. It is estimated that e-procurement saves time and costs and brings effectiveness in the process allowing instant access to suppliers anywhere in the world.

2.1.2 Inventory management and Warehousing

All business enterprises hold at least some kind of stock whether it is small-, medium- or large-sized businesses, all need to hold their stocks for their customers with the main purpose of allowing for the uncertainty and variation, giving a buffer between supply and demand (Waters, 2009). In every industrial sector, a company's inputs and finished products are the core of its business and the company's inventory is one of the most valuable assets (Leinbach et al., 2007). A huge stock conveys the danger of deterioration, burglary, harm, or moves sought after. Stock must be protected, and if it is not sold in time it might need to be discarded at freedom costs or wrecked (Ross, 2016). This is the main reason that inventory management becomes incredibly important for any sized firm. Hence, inventory management can be defined as the process of managing the raw materials, components, and finished products, including the warehousing and processing of such items (Investopedia, 2020).

A research carried by Hilmola (2020) shows how inventory management plays a vital role in the economic success and value creation for the shareholders. Thus, management of inventory could be a highly beneficial and cost-saving process for the company, which can bring the value

back to the shareholders. The main purpose of inventory management is to ascertain the stock level to reduce the total amount of operating costs while satisfying the customer's service requirement. According to Ghiani et al. (2004), a good practice of inventory management should consider five issues which are as follows: the relative importance of the customers, the economic significance of the different products, transportation policies, production process flexibility, and competitor´s policies.

Different distribution strategies must be adopted to fulfill those above-mentioned issues. Inventory and transportation strategies play a vital role in managing effective inventory management for the logistic system (Water, 2009). Three major kinds of strategies that can be adopted, while distributing the product, can be seen below (Ghiani et at., 2004). Good inventory management always plays a key role in creating value for the stakeholders within an entire ecosystem of the B2B and B2C businesses.

Findings from Hilmola, Li, and Tolli (2020), suggests that the efficiency of the inventories in Finland and Baltic countries (Estonia, Latvia, and Lithuania) is less concerned for SMEs than that of Large companies. These findings are valuable to note that inventory sizes are declining in small size companies. Moreover, their result also suggests that due to the lower interest rate in a decade, holding the inventory can be effective for the stakeholders' value creation.

Direct shipment: This type of strategy is used when goods are shipped from the manufacturer to the end-user (retailers, as in Figure 3, a).

Warehousing: This approach is a widely used and particularly important strategy for distributing the products. In this process, the goods are received from the plants by warehouses and they are then stored in the yanks, pallets, racks, or on selves and when the order comes, they are delivered to the right customers (Water, 2003). Warehouses are expensive and they need sophisticated planning. It can be one of the main effective logistics strategies for managing inventories. Warehouses can be defined as the location for storing the stocks of materials, which are held on their journey through the supply chain (Waters, 2009).

Managing warehouses is one of the key aspects of the supply chain. Hilmola & Lorentz (2011) concluded from their research that companies from Finland are keen to focus on Eastern European markets, while companies from another North European country, Sweden, keen to focus on Western Europe. Their result also shows that in the future, the average size of the warehouse tends to increase, despite the fact both small and large size warehouses have their explanation for their existence. However, to understand the current warehousing activities, it is important to investigate it from the concern of possible change in size near in the future regarding Chinese and Russian markets.

Warehouses are completed part to manage within the logistics system and can be an equally expensive thing to handle. Pauluk and Olah (2017) showed in their results that the cost-effective solutions, like the application of lean based tools like 5s, standardized work, etc. can be adopted by the companies in their warehouses without any significant investments. Moreover, integrated technologies and better strategies for warehousing could also be equally helpful for managing cost from warehousing activities. Implementation of the flow of goods from one supply chain to another and primary storage is the major purpose of the warehousing (Ackerman & Brewer, 2008). Therefore, it is a very essential part of the supply chain and an equally important aspect of meeting the customer's requirement.

Cross-docking: This is a new logistic technique, and it is used widely and has been adopted by many international firms. The idea is to deliver the product just in time meaning that, a transshipment facility where incoming shipments are stored, consolidated with other products, and then it is transferred directly to the outgoing trailers without intermediated storage or order picking in this way the shipment has to spend just a few hours at the facility. Therefore, this type of strategy requires high volume and low variability of demand and easy handling of the products otherwise it will be difficult to match the supply and demand. Moreover, the right and proper information system cannot be omitted. (Ghiani et at., 2004).

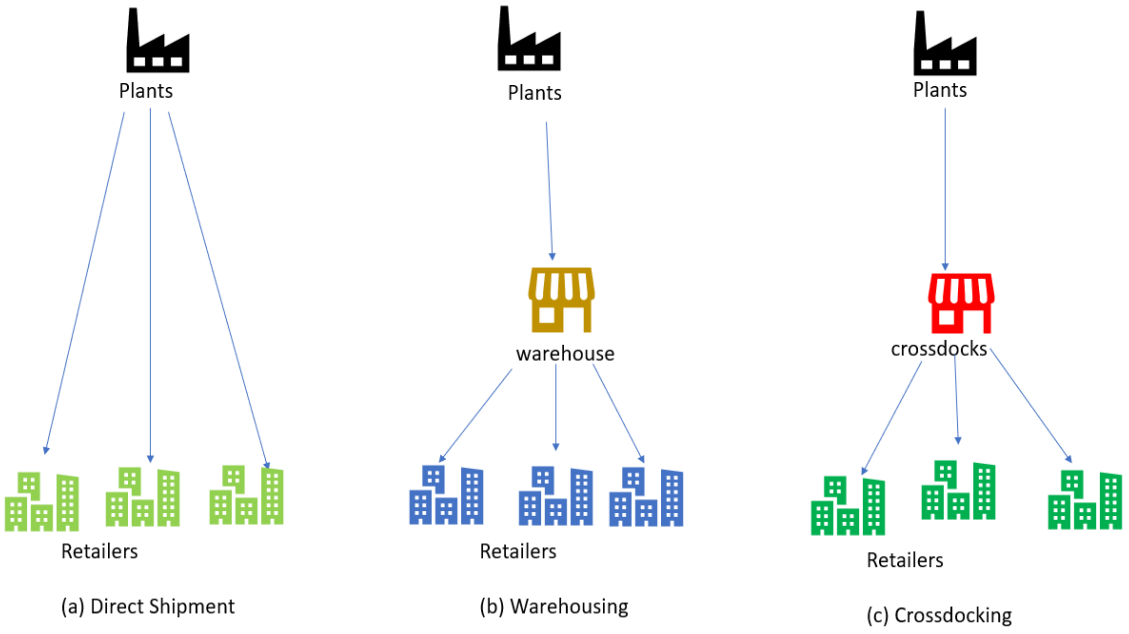

Figure 3. Distribution Strategies (Ghiani et al., 2004).

Figure 3 above shows different kinds of strategies for managing the inventory. Whichever is to be used depending on the requirement of the business entities and the method that is suitable for them. However, if a warehousing strategy is used then it is necessary to decide whether to select the centralized or decentralized system. In a centralized system, the market is divided into different zones each of which serves as a different size warehouse mainly bigger (Water, 2009). This kind of system is generally characterized by lower facility cost, because of the long economy of scale. On the other hand, decentralized warehousing leads to reduced lead times since warehouses are much closer to customers (Ghiani et al., 2004).

2.1.3 Freight transportation and different types of modes

Transportation is meant to overcome space and time, which are shaped by different human and physical constraints and mobility has become much easier since transportation has arrived (Leinbach, 2007). Therefore, the market is easily reachable for the companies now with the help of different modes of transportation. Transport has become a major concern for the global economy, transferring goods from the place of production to consumption and due to the rapid

globalization, production is shifting towards low-cost countries (Laisi et al., 2012). However, there are many challenges and hurdles in the transport sector that the world is going through, and mobility has become one of the great challenges. European Commission (2019) stated in their report that, multimodal, safe transport infrastructure networks and low emission mobility are the main challenges that the transport sector in the EU is currently facing.

According to Lorentz et al. (2012), in today's world economy, freight transportation plays a key role as it allows production and consumption to take place at even several thousand kilometers distance locations. Freight transport is usually responsible for two-thirds of the total logistics cost. According to the result published from research by Laisi et al. (2012), it was found that the outlook on transport flows between North European companies and China will continue to grow and to Russia, traffic is stated as a slight increase in demand. This shows that transportation is always in high demand and its congestion will continue to grow.

Freight consolidation can be achieved in three ways, first is the facility consolidation in which small shipments, which must be transported over a long distance may be consolidated to transport large shipments over long distance and small shipments over short distances. Second is the multi-stop consolidation, where the deliveries can be served by the vehicle on a multi-stop route (Jüttner et al., 2003). And the third type of consolidation is temporal consolidation, which can be scheduled forward or backward to make a single large shipment than alternatively in numerous smaller ones (Ghiani et al., 2004). Table 1 below shows the main features of the most common containers used for transporting solid goods.

Table 2. Main features of the containers used for the transportation of solid goods (Ghiani et al., 2004).

Type	Size (cubic meter)	Tare (kg)	Capacity (kg)	Capacity (cubic meter)
ISO20	5.899x2.352x2.388	2300	21700	33.13
ISO40	12.069x2.373x2.405	3850	26630	67.80

Modal split

When it comes to transportation, the mode selection is very essential for every business to transfer their products from one place to another. The mobility of goods depends on five modes of transportation, which are also called the basic modes of transportation. The freight transportation model split shows a clear performance for all types of modes used (European Commission, 2019). Based on the report published by the European Commission (2019), the modal split of the European Union and the countries from North Europe can be seen below in Table 3.

Table 3. Modal spit for freight transportation of EU (incl. the UK) and North Europe (European Commission, 2019).

	Road	**Railways**	**Waterways** (inland)	**Pipeline**
EU-28	72.8%	16.6%	5.9%	4.6%
Estonia	57.1%	42.9%	0.0%	0.0%
Finland	72.9%	26.8%	0.3%	0.0%
Sweden	70.5%	29.4%	0.0%	0.0%

When it comes to the modal split for logistics activities it can be seen from Table 3 that road is the most prominent mode for freight transportation in all countries in the European Union (before the Brexit of the UK). However, the fact is also true when the individual country is taken into the consideration. The above data in Table 3 from European Commission (2019) also shows that in each of three countries taken into consideration railways portion is higher for inland logistics when it is compared to overall EU´s inland logistics activities.

The modes for freight transportation can be water, rail, road, air, and pipelines.

The road is the most popular and widely used transport mode for carrying the goods from the production line to various other locations due to its flexibility and accessibility. Within the European Union, there are more than 5 million kilometers of road, which also includes the 62

thousand kilometers of motorways. The road is the most used transportation mode in any logistics system because it is used to support all other modes of transportation for the efficient flow of the materials from the manufacturer to the different ports and also within the company for inbound logistics (Water, 2009). Some of the most used road vehicles for logistics activities are as follows:

- Delivery vans
- Flat-bed lorries
- Box bodied lorries
- Articulated lorries
- Lorry and trailer (combined a rigid lorry pulling a two-axle trailer)

In the EU, the regulation for the normal average weight limit is around 40 tons, however, in exceptional cases very large loads like 100 tons of load can be carried that are moved for oil companies on the Arctic, like HCT trucks in the case of Finland (Finnish Transport and Community Agency, 2020). Although the road is the easiest way of transport, there are some issues, like environmental regulation of carbon dioxide emissions limits, the rising cost of equipment and fuel, shortage of skilled drivers, regulation in driving hours, traffic congestion, driving empty on return trips, etc. which are making challenges for the roadways (Gant et al., 2015; Waters, 2009). It can be seen from Table 3 that, the road is the most used mode for Finland, Sweden, and Estonia in inland logistics activities. More exploration is needed to find out the modal split of these countries when the market is from the east like China and Russia. However, past research on the traffic flow from North European companies conducted by Sutela and Hilmola (2010) shows that road transport mode is the most used mode of transportation for companies in Finland and Sweden. Also, the findings of Hilmola (2019), concluded that the most representative mode of transportation unit used is semi-trailer/trailer and followed by container. Moreover, Hilmola (2019) also added from his research on “Longitudinal Survey Findings from Northern Europe” that road transport is the dominant transportation, and it will continue to dominate the future too.

The railway is another mode of transportation that is used for the heavy and bulky load to carry over a long journey. Rail freights are considered a slow method of inland transportation however due to its fixed infrastructure; it is less prone to disruptions. (Grant et al., 2017). Sutela el at.

(2010) found that the railway is the number one mode for the transportation of freight followed by the road in the case of Russia. However, the case is not the same for the North European Countries, like Sweden and Finland. Despite the complex and expensive infrastructure of rails, the impact it on the environment is lesser than that of road transports. Moreover, the overall cost of freight transportation through the railway can be less expensive than road and airways in context to the logistics activities of North European and China and can be faster than marine transportation. The calculations of Schramm & Zhang (2018) show that the Eurasian rail freight is about 80 % cheaper than the use of airways for freight transportation and convenient over the conventional sea freight in context to the transit time. Waters (2009) also mentioned in his book that rail terminals have facilities to link with road transports. Another intermodal possibility is rail delivering to sea transports at major ports. Holopainen (2015) found in his results that when the warehousing location is chosen, railways aren´t the most important connections and very few railways connections exist in Finland. However, when it comes to the modal split in context to Finland, European Commission (2019) mentioned in their report that the modal split (by railways) shared by Finland for freight transportation is much higher than the EU average.

Water is the most widely used model for global trade. About 42 000 km of canals, rivers, and lakes are used for freight transport within the EU. Almost 90 % of external freight trade of the EU is through the sea, making maritime transport a catalyst for economic development and prosperity throughout history enabling trade between all the European nations (European Commission, 2020). Moreover, waterways account for 90 % of the global trade which is done through shipping and is considered as the least effecting mode when it comes to harming the environment (International Maritime Organization, 2020). All the water sources like lakes, rivers, and oceans are being utilized as routes for millions of ships around the world for logistics activities. Many goods and raw materials are carried from one country to another with the help of waterways at least cost than other modes. Inland waterways also indeed very important for the economic development of the many communities and regions as well as many major cities are linked to the rivers, on the bank which they were founded. (Rhenus Logistics, 2020). In the EU (before Brexit of the UK) about 5.9 percent of freight transportation was accounted for the inland waterways of which 0.3 percent was accounted for Finland whereas inland waterways were not recorded in the case of Estonia and Sweden (see Table 3).

Sea has been a major source of waterways for freight transportation when it comes to trade between two countries sharing some portion of the sea. According to Sutela et al. (2010), sea transport is the main mode from Europe to China and vice versa with a large amount of the goods transported in container ships, which are specially designed to carry standard containers with their rated capacity being in TEU (Twenty-foot equivalent units) or FEU (40-foot equivalent units). Twenty-foot equivalent units (or TEUs) are the standard units of measurement for the industry which denotes the capacity of the standard freight container (Statista, 2020a). A normal container ship can be up to 5 000 TEUs (Waters, 2009) however, nowadays the biggest container can be around 23 000 TEUs or even more. (International Transport Forum, 2020). On a global scale, waterways have become the most important channel for freight transportation between important trade partners and most of the shipping ports are in Asia, the largest one being in China (Shanghai), Singapore, and Hongkong (Statista, 2020a).

Over the years the international sea trade has been in a growing trend, but the maritime volume was able to grow only around 2.7 percent in the year 2018, which is 1.6 percent less than what was achieved before that year. Moreover, the shipping has been slowed in the year 2020 as new sulfur cap regulations in early 2020 by International Maritime Organization have hurt the companies as shipping companies further incur the shipping cost to comply with the cost raised by the new sulfur cap regulations (Statista, 2020c). Moreover, the trade and supply chain disruptions caused by the ripple effect of the COVID-19 pandemic tend to resonate with the entire economy as well which will further create the interruptions. Furthermore, the container ships are also under the pirate attack threat as pirates are capable of cutting off crucial transit chokepoints and Africa has emerged as a new piracy hotspot, threatening to the international shipping companies as well as the economic prospects of the continent (Statista, 2020b).

Air is the fastest mode of transportation over longer distances. When it comes to time and quick reach to the customers, other modes of transport are slower in comparison to air mode and this is where the air transport comes into play, despite that it was way expensive than what it costs for other modes of transport. Although the passenger almost accounts for the airlines, some special freight airlines like DHL, FedEx, UPS, etc. serve for freight transport (Waters, 2003). Usually air freights are expensive but when it comes to the transit time it has an edge over other

freight modes because the cargo must move rapidly through the airport, it has short transit time (The World Bank, 2020d). Therefore, the delivery of the goods can cover in a short period. however, factors like the speed of the aircraft also play a vital role in it.

Pipelines are the rare modes for trade and are specially used by the oil and gas industry for transporting oil and gas or sometimes pulverized coal in oil and clay slurries. In the EU there is about 35 000 km of oil pipelines that manage about 135 billion tonne-kilometers a year. EU and Russia are extremely interdependent in terms of their energy policies respectively and the pipeline infrastructure plays a vital role in their interdependence to secure the energy supply through this mode of transportation. Both land and sea routes are used between the EU and Russia for the supply of oil and gas (Borisocheva, 2007). Pipelines are absent, when it comes to the mode of transportation for North European companies like Finland, Sweden, and Estonia (see Table 3). The statistics from Table 3 shows zero percent of usage of pipeline mode for Northern European companies for transportation. However, in years, Finland has developed interconnected pipeline networks for natural gas distribution that covers southern and south-eastern Finland. (GASGRID, 2020). As eight percent of Finland´s energy consumption accounts from natural gas, Finland imports natural gas from Russia through a pipeline which is injected into the Imarta reception station and through an interconnector between Estonia and Finland through the Inkoo compressor station (GASGRID, 2020 and Gasum, 2020). At the beginning of 2020, the Baltic connector between Finland and Estonia was opened, and companies like GASGRID Finland Oy as a responsible entity for the Finnish gas network and acts (Gasum, 2020). Therefore, the importance of pipelines for the transmission of natural gas cannot be denied.

2.1.4 Logistics and supply chain risk

Uncertainties and disruptions have always been a prime factor of risk in the globalization of business operation and logistics system (Shen et al., 2019). For global companies, stable logistics management is essential for their business continuity and corporate competitiveness (Colin et al., 2011). Unexpected situations can happen anywhere, anytime and the solution to these challenges lies in risk management through logistics visibility. The combination of modern

technology, infrastructures, and the organization's effort is significant in managing the risk comprehensively and systematically (Kersten et al., 2017).

Risk can form from any kind of uncertainties in a process or the environment. Natural calamities, serious accidents, and natural disasters all around the world have resulted in logistics activities and have caused a lot of disruptions (Choi et al., 2016). Therefore, it is important to have an effective and efficient risk management strategy for the companies to mitigate the various forms of sudden and projected risks. Also, technologies are the key to synchronizing supply chain planning with logistics activities to maximize the visibility of global logistics (Tang & Tomlin, 2008).

A wide range of IoT (Internet of Things) technologies can facilitate tracking of cargos location in real-time as well as a comprehensive analysis of the vast amount of data secured through global logistics operation using big data analytics to detect anomalies in advance. These technologies are optimized for the global control center, which controls the entire cargo volume in an integrated manner and monitors global logistics operation status and possible risks of managing logistics in real-time. Monitoring the entire global end-to-end logistics movements has become necessary as it enables the detection of anomalies and identification of the risk factors, which are shared with the relevant regions and partners beforehand for preemptive actions (Velichko et al., 2016).

Rao & Goldsby (2009), said that different sources are involved in the supply chain risk factors like environmental factors, industrial factors, organizational factors, problem-specific factors, and decision-making factors, these factors are equally important to challenge supply chain networks. However, more possible risks and uncertainties factors concerning the logistics activities of Northern Europe will be investigated with further investigations through the survey. Management of risk has essentially become important as it powers the supply chain to move faster and deliver on time according to the customer's demand and helps the company detect delays, avoid extra costs and access the best routes and rates in real-time (Wieland & Wallenburg, 2012).

2.2 Role of technology in logistics activities and operations

Modernizing the supply chain and concurrent planning are important to drive transformation and create better business results in the supply chain, which is a very crucial part of staying competitive with the competitors (Hugos, 2018). Setting up oneself for future challenges requires being ready to take advantage of further technological advances. According to Merkaš et al. (2020), concurrent planning for the modern supply chain is based on modern technology, which can integrate different components of the supply chain and it consists of three main parts-data, process, and people. Out of the three main parts the data side is all about accessing, linking, and making the sense from that data. As the new types of sensors are developed and used, the Internet of Things (IoT) comes into play for getting more data quickly, with a greater volume and more consistently (Yu et al. 2019).

Since so many devices and the things in the world contain sensors, which collect that data and are interconnected, companies can now collect that data from those elements that are part of their global supply chain (Hugos, 2018). On the other hand, the process side is all about using the collected data to produce valuable and reliable information to make the decisions faster and adding this quicker decision-making ability with the help of is machine learning and artificial intelligence (Merkaš et al., 2020). Machine learning and artificial intelligence can take the large volume of data they receive and use it to make predictions and when these predictions influence changes and supply chain processes, major benefits can be realized (Bricher et al. 2020). The people side is all about the social, context-driven interactions between people, who need to team up to make the decision together, sharing knowledge about what kind of decision they are making, understanding impact across the supply chain, and building harmony on the best decision for the entire corporation. All the three parts of data, process, and people are needed fundamentally for modernizing the planning (Merkaš et al., 2020).

The integration of the three factors (data, process, and people) and how does it work can be understood with the help of an example (Merkaš et al., 2020). Let us suppose a company named "**A**", transporting a temperature-sensitive product in containers on a cargo ship, the sensors can tell the company authorities about the current readings and give an approximation of how many

items will arrive in unusable conditions due to being out of the temperature range for a specified period. While this is the user data and the supply chain management system of the company "**A**" will have to update that quantity as non-usable inventory (Merkaš et al., 2020).

In the scenario, what the company "**A**" wants to know for the supply chain planning is, if there are any patterns in the yield estimation for how many units reach the other end in saleable conditions. If it is routinely noted that five out of every 100 units fail in transport, then company "**A**" must regulate their supply and demand plan accordingly (Tufano, 2020). In this case, if the planned failure is two units, but demonstrated failure consistently is five, then the plan is off by 3% even before it starts. The self-healing supply chain recognizes this discrepancy and suggests the required changes to the process (Tufano, 2020).

Supply chain technologies are developing day by day and a wide range of new information-based technologies has been industrialized that create opportunities to implement more integrated dynamic solutions for logistics activities (Taniguchi el at., 2020). It is up to companies to adapt and rapidly familiar with modern technologies available to get more advantage of it. Stimulating with advanced technologies such as the Internet of Things, artificial intelligence, robotics, blockchain, and 5G, DSNs are designed to foresee and encounter future challenges and hurdles (Shah et al., 2018).

Modern technologies are shifting the paradigm of logistics activities. The existing monitoring system and data transmission technology can be practically significant for monitoring and managing the logistics processes effectively, which can also be valuable for lowering the transportation costs, improve logistics efficiency and avoid needless economic loss (Sun, 2017). Moreover, such integrated technology can effectively manage the goods and improve the efficiency in the transportation management of the goods. Information technology has become a backbone for any kind of business activities and logistics in the area, where the integration of information technology has shaped the supply chain and logistics model into a new framework (Merkaš et al., 2020). According to the research conducted by Agyabeng et al. (2019): "Firms that adopt logistics information technology have a greater possibility of influencing their

performance through customer satisfaction, and both internal and external integration with customers and suppliers."

2.2.1 Artificial intelligence and its application in logistics

Artificial intelligence (AI) is making rapid strides, and it can be a new evolution that could fundamentally change life on our planet (Agyabeng et al., 2019). Artificial intelligence (AI) has the potential to revolutionize every aspect of daily life, work, mobility, medicine, the economy, and communication. Artificial intelligence (AI) is modeled after the human brain, a gigantic network of almost 100 billion interconnected neurons and each neuron is a separate entity, but is connected to other several neurons (Jackson, 2019).

A typical brain cell of a human brain has three main parts: the dendrites, the cell body, and the axons. The dendrites are the parts that bring the information into the cell body. This is the part, where the information is processed, and the processed information is then carried by axon to the other and so on to form a network of neurons. The brain cell works, when incoming impulses are passed in a domino effect from one neuron to the next and the resulting circuit connects the neurons.

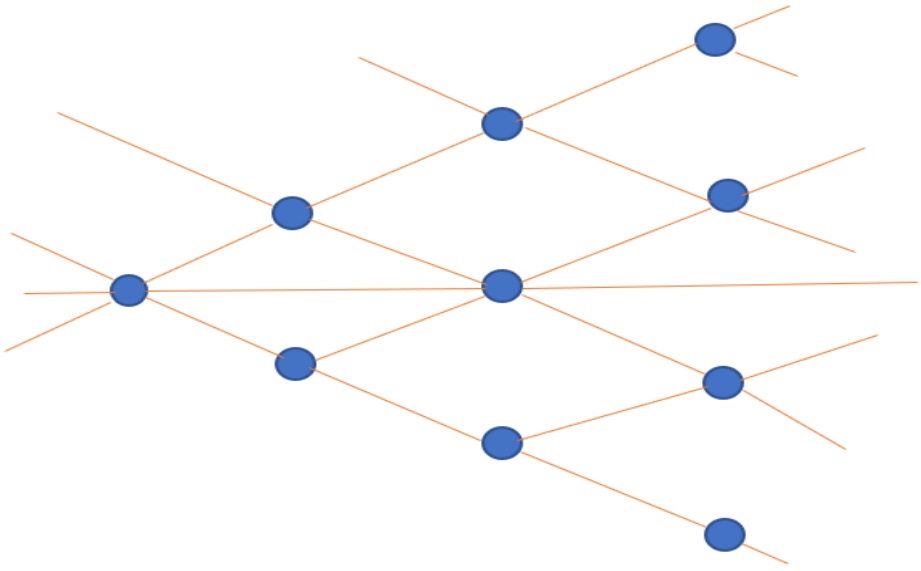

Figure 4. Circuit of a neutral network.

Figure 4 is the circuit of the neural network formed in a brain that artificial intelligence tries to simulate as a digital neural network. Artificial intelligence (AI) has undergone an enormous development, since its appearance in the 1950s (Kota, et al., 2018). Technology is gradually increasing with a wide range of applications not only in the industry but also slowly these technologies are conquering the households as well (Kota, et al., 2018).

The supply chain and logistics activities are growing with a tremendous volume of data generated every day therefore, it is necessary for having more sophisticated processing solutions. Hence, AI computing techniques as machine learning, deep learning, and natural language processing has become more important to support modern logistics and supply chains (Klumpp, 2018). Warehousing operations are other aspects of the logistics activity, where the application of artificial intelligence can play a vital role and enhance the potential of the warehousing functioning in the logistics, management, and coordination (Pandian, 2019).

According to Harvard Business Review (2020), companies are more attracted to the idea of using AI as a part of their ecosystem and are getting more popular throughout the globe. Figure 5 is the finding of Harvard Business Review (2020) and it shows how companies around the world are using artificial intelligence in the different sectors of their ecosystem.

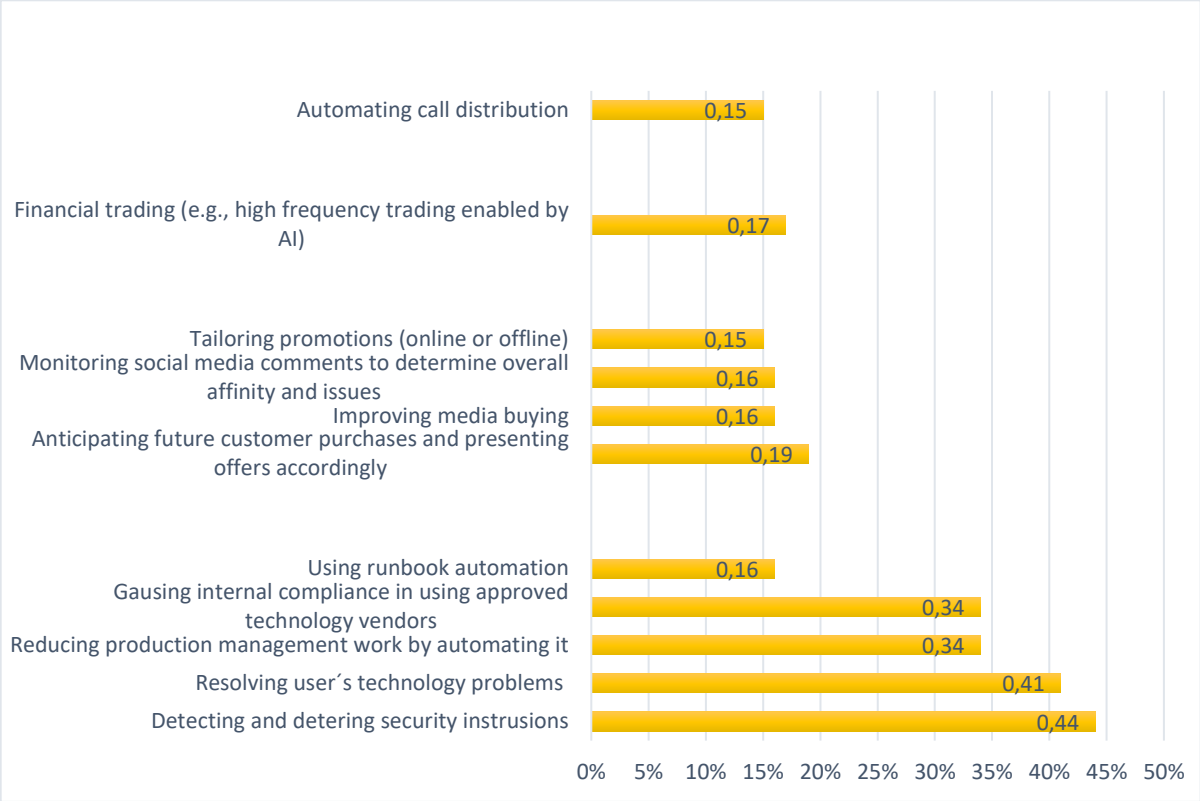

Figure 5. Use of AI by companies around the world (Harvard Business Review, 2020).

The result of the study made by Harvard Business Review, 2020 (see Figure 5) shows that about 34 % to 44 % of the global companies are using artificial intelligence in the information technology sector more in comparison to other industrial sectors like marketing, finance, accounting, and customer service. On the other hand, customer service is the area, where artificial intelligence has the least impact or less likely served. This is very useful information concerning the RQ3 of this thesis.

The capabilities of artificial intelligence (AI) are seriously building up company efficiencies in the areas of predictive demand and network planning (Harvard Business Review, 2020). The technology of artificial intelligence (AI) uses data to its full potential to better anticipate the events, avoid risks, and create solutions (Jackson, 2019). Robotic companies embed deep learning algorithms into robotics and bring autonomous decision-making to warehouse processes e.g., picking is one of the most labor-intensive parts, using the robot is this scenario

with artificial intelligence (AI) identifying a package type in less than 0.2 seconds and physically moving the item to the desired location. The insights of big data especially, when processed by AI can improve many facets of the supply chain, like route optimization and supply chain transparency (Klumpp, 2018). Visual inspection, which is powered by AI, can identify freight damage categorizing the damage type, and determining the appropriate corrective action faster than ever before (Lazaro et al. 2018).

Machine learning for supply chain planning uses massive computing power to recognize patterns and data that humans could never see and then learn from every new piece of data it receives to get smarter and more accurate in real-time (Zhang, 2019). This means shipping freight over time as exceptions from the normal occur and thus machine learning can apply predictive changes allowing to statistically overcome inefficiencies and plan freight thus providing better management of freight exceptions (Zhang, 2019). However, the high cost for the implementation of complex machines, personnel cuts, ethical issues, no improvement with experience, and lack of creativity, can be some of the challenges of implementing AI in logistics operations (Jackson, 2019).

2.2.2 Blockchain technology and its application in logistics activities

Blockchain is a disseminated database of various histories of transaction record that keeps all the events in the form of digital blocks that have been implemented and collectively shared among contributors (Crosby et al., 2016). Furthermore, Saberi et al. (2019) stated it as a distributed/decentralized network that is clear, verifiable, and accessible by all the connected parties where all the values of each other can be exchanged. All the values generated within the system of blockchain is stored in the digital blocks that are linked together uniquely with their own digital identity and are linked one after another like a chain (Pilkington, 2016). Therefore, it is also called the blockchain.

One of the major factors that make the blockchain so secure and trustable in the digital world is due to its hashing ability (Gupta, 2017). Hashing is the process of forming a hash, which is a unique digital code generated by the application of some algorithmic process (Seok et al., 2019). The generated hash is an output of the input data with a unique code. Figure 6 shows how the

input data, whatever it may be, is hashed into a hashing algorithm and thus forming an output data called a hash.

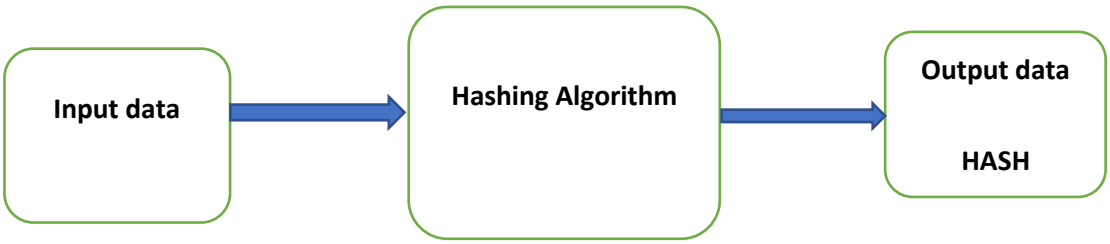

Figure 6. The hashing process from input data (Struttmann, 2018).

Figure 6 is a simple diagram showing the processing of hashing from the hashing algorithm using the input data. The data which is kept as input data can be anything in terms of number with infinite possibilities meaning that any kind of data with any number of bits can be processed as input data (Seok et al., 2019). According to the needs, the hashing algorithms can be selected which are available easily with high security and reliability to generate their unique mathematical number called hash (Struttmann, 2018).

The hashing algorithm applies a mathematical calculation after intaking an infinite number of input data as bits and processes it to form a finite bit of output (Struttmann, 2018). e.g. two hundred fifty-six bits fingerprint files (also known as checksums) are an example where this hash is commonly used today meaning that unique code (hash) is utilized here to confirm that those files are not interrupted or modified by any other unless by authority him/herself.

For instance, a certain website suppose "**ABCD……**" issues a conventional set of files with their hash in it (Suppose PQ5 is a certain file with a hash) if this file is tried to download or is downloaded then it can validate those file´s original sources who have published it in real (Seok et al., 2019). When the downloaded file´s (suppose PQ5) hash is calculated, it must authenticate the original publisher of that file and must resemble the original hash and if it does not resemble the previous hash then the files must be modified in some way (Gupta, 2017). When such hashing has used this acts as an important security system. The hashes are used in blockchain to characterize the current state of the world. Thus, all the exchanges that have taken a position so far are the key input in the blockchain system and hash formed as output represents the present

state of the entire blockchain system (Gupta, 2017). All the parties use the hash to form an agreement between them which is stated as one or the same by the world (Seok et al., 2019).

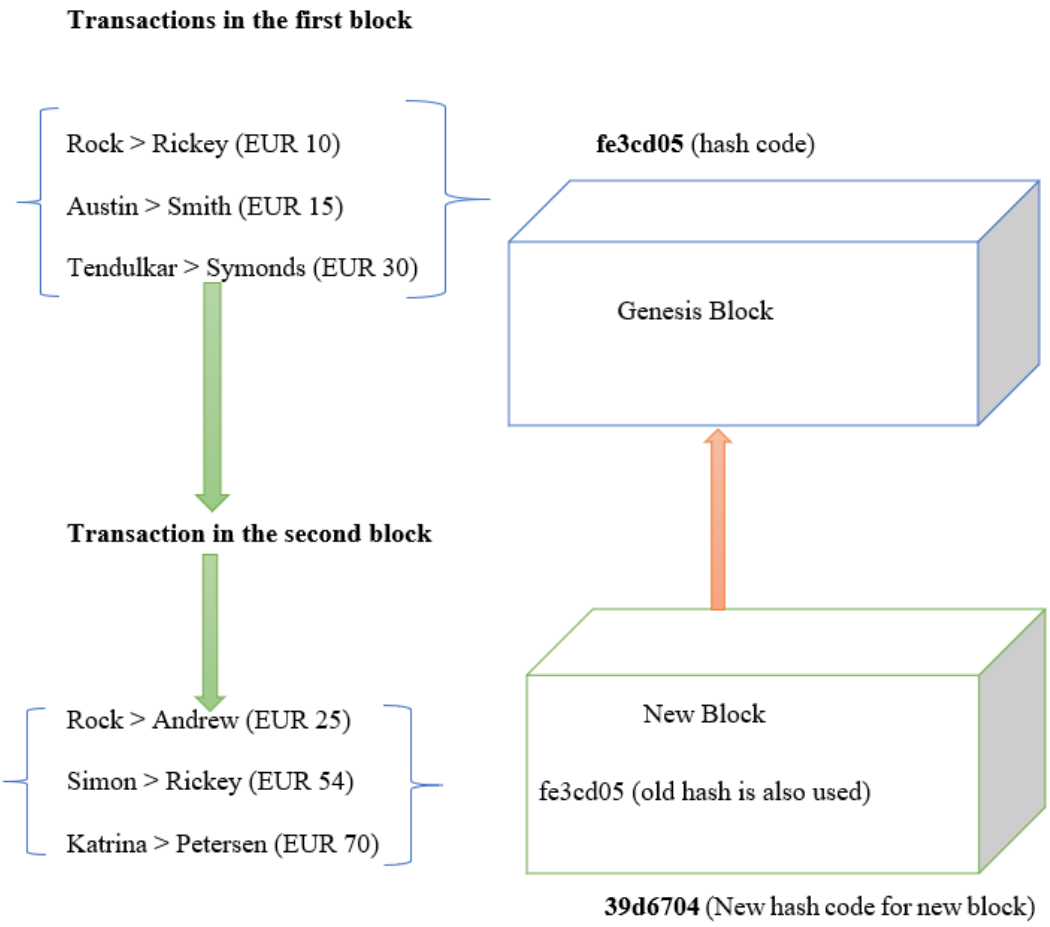

Figure 7. The process of forming hashes in the blockchain (Seok et al., 2019).

Figure 7 is the process of formation of hashing in the blockchain technology. During the process of forming new hashes, at first, the hash is calculated for the first genesis block by utilizing the transactions inside that block. To calculate a block hash for the genesis block/first block, the sequence of initial transactions is used. To determine the hash of the newly generated block, the hash and transaction input of the previous block is also utilized. Each block is formed in a similar way leading to form a chain of the block where all newly formed block directs to the previous hash which came before it (Yao et al., 2018). This guarantees with high securities assurances

that, none of the transactions in the past has been tried to manipulate or interfered with. In the case of any interfere in any single part of the transaction, the hash of the block to which it belongs also varies (Yao et al., 2018). Therefore, it would be easy to catch any interfering activities since one can compare the hashes with previous.

A peer-to-peer network is shared in a blockchain technology system, which is automatically updated regarding any changes in the system and keeps tracking who owns what (Shah et al., 2019). Anything can be tracked in the system of blockchain technology within a specific point in time. The ledgers are protected by using mathematics, which is then shared with the entire ecosystem of computer networks rather than static to single providers (Yaga, 2019). This means, data cannot be interfered with without knowing by anyone. Initially, it was the technology predestined to enable bitcoin transactions, but it is beyond the realm of bitcoins and its applications are numerous and probably the next most revolutionary factor for industry 4.0 (Crosby et al. 2016).

The blockchain technology acts as a chain of scattered ledger technology, which can be programmed to record and track anything of value at any specific point in time. In general, it can be said as a scattered database that everyone can get as a copy, and every person with the copy can add new information to the database and cannot modify the information, which is already there (Zheng et al., 2017). Blockchain technology can be an important technology ever invented by human intellect (Pilkington, 2016).

The following are the reasons why blockchain technology can be considered as the next revolutionary form of technology concerning the way we interact with each other (Pilkington, 2016):

Tracking and storing the data in its system: The information is stored sequentially in a block of Chains in small bits with its unique addresses. In the case of any changes or tempering is made that changes are recorded in a new block which shows that something has been changed at a particular date and time. Therefore, it is easier to track and secure to store data in the blockchain technology system (Zheng et al., 2017).

The blockchain creates trust in data: Few complex things must happen just before the block can be added. For instance, during the creation of a new block, at first, a cryptographic puzzle must be solved whose solution is then shared to all other computers on the shared to all other computers on the network (for vital proof of the work) which is then verified by the network for the final proof to form a new block (Crosby et al. 2016). The integration of mathematical puzzles and compulsion of verification by many computers ensures that it creates trust in data among the users in adding them to interact with their data directly in real-time (Saberi et al. 2019).

Blockchain can remove the intermediators between parties: In a current scenario, the business between two parties involves mediators which can be a bank, lawyers, etc. and keeps the information confidential (Wright et al. 2015). These mediators build trust between the parties and can authenticate the claims for which the intermediator has been hired. This kind of traditional way creates more time consumption and high cost. However, if the information of two parties during the businesses in blockchain technology than the mediators can be cut off completely and no more mediator is required since, the technology stores both parties' data with a high assurance of security in its blocks which are verified and cannot be tampered with and one can simply show their information to another (Pilkington, 2016). Hence, blockchain can save time and money by cutting off the mediators.

Blockchain technology is an important technology regarding its wider and dynamic applications. It is vital to note that this technology does not work based on a single network but on numerous connected network selected groups of authorized users like private blockchains or it can be completely open to everyone (public blockchain) to view (Shah et al., 2019). The public blockchain data can be seen openly but only those who have access to add new inputs can add new data or information. Thus, the edition of this technology can be an auspicious enhancement that is suitable for benefiting all the different actors involved in the entire process of the logistics and supply chain ecosystem (Zheng et al., 2017).

Tsiulin et al. (2020) found in their results that blockchain technology can be very efficient and have a dynamic range of applications. They argued that adopting blockchain technology for maritime shipping especially by focusing on three major aspects like financial process workflow

documents and connecting devices can be highly beneficial. However, the authors also stated in their result that, none of the reviewed projects considered all three at once despite having a vibrant interconnection. Similar, Yang et al. (2018), simulated the trust factors in their research with the gathered data and said that blockchain-based decentralization can play a pivotal role in the management of the trust in a vehicular network. In 2015, researchers Wright and De-Filipppi (2015) showed that how a block technology can enable the creations of decentralization in every aspect allowing a new system to form which is not under the control of any authority.

A research document published by Tian et al. (2016), presented that blockchain technology was able to keep effective guarantee for food safety by collecting data, transferring and sharing all the authentic data covering all the ecosystem of the agri-food logistics system, and allowing all the stakeholders to see the reelevated information concerning the food safety and was worthful in context to the entire agri-food supply chain. These finding from the authors shows, the utility of the blockchain technology is countless and can be the most reliable technology in the coming future with a wide range of applications in the logistics activities as well as maintaining the smooth and trustworthy supply chain system. and perhaps the most inventive technology in from human mind.

2.2.3 Internet of things (IoT) in logistics activities

The Internet is one of the most auspicious and revolutionary inventions of mankind. Ever since, its invention, it has drastically changed the world by connecting people through digital fabrication in one or many ways (Tian, 2017). In the age of information, the internet not only connecting people, but it is also connecting things, which is again transforming the world into the dawn of a new civilization (Zhou, 2012). Logistics and supply chain activities accumulate heavy loads of information which is too difficult to handle and much complicated for companies. Therefore, it is important that supply chain and logistics activities should be handled by intelligent means for the longevity, sustainability, and smooth operation of those activities (Sun et al. 2019).

Hopkins et al. (2018) explained in their result that IoT is still in its early phase but it is taking hold in the realm of the industrial management industry and playing a humongous role for the

companies to revolutionize the business strategies concerning transport safety, safe driving, low cost of operation, reducing greenhouse gas and other environmental impacts in transport vehicles of the companies. IoT platforms are very efficient due to its ability to connect things together and bring efficient circulation in the logistics activities of the companies (Lu et at., 2012). IoT becomes of utmost importance when it comes to the safety of the drivers running the freight transport vehicles for longer distances (long ride can cause fatigue truck drivers), capturing the most important events and storing all vital information in clouds, which can be later utilized for improving the truck routing connections as well. Thus, IoT becomes equally essential concerning fatigue management (Hopkins et al., 2018). The IoT provides fundamental transparency to the management of logistics and supply chain activities by envisioning the infrastructure of networked physical objects (Tu et al. 2018).

Some of its application for logistics activities are as follows (Jeschke, et al. 2017):

- Visibility improvement through connected devices and things. Thus, provides better control when needed.
- Due to the interaction and communication of the different devices within the ecosystem of IoT, it helps to minimize the human effort.
- It enhances data capturing opportunities and analytics.
- IoT keeps the security at the top.
- It helps day to day data deluge and the way to increase the efficient utilization of resources.

2.2.4 Electric Vehicles in logistics activities

Logistics and transportation activities are key activities in worldwide economies. Green logistics is the main development trend currently in the sector of modern logistics and the growth of electric vehicles are the most important part of green logistics. (Seroka et al. 2019). Electric vehicles are in the developing phase and have not been able to capture the market like that of conventional internal combustion engines however, the innovations, design, comfort, usability, and environmental regulation have increased the demand for the production of electric vehicles. The players like Nikola Corporation, Tesla Motors, Nissan Leaf, etc. have popularized electric vehicles in the last ten years from its innovative products, design, and technology (de Mello Banderia et al., 2019).

According to European Commission (2020), about 21% of carbon dioxide gas emission within the territory of the EU was contributed by internal combustion engine vehicles (ICEV) from road transport in 2017 out of which heavy-duty vehicles around 6% of total EU emissions. These findings of the European Commission (2020) are disturbing things to the environment and not efficient from sustainability's aspects. Therefore, Electric Vehicles can be a long-term sustainable solution as these vehicles deliberate lesser carbon emissions comparing to ICEVs in the overall cost of ownership of 20-years (Brennan and Barder, 2016). Tietge et al. (2016), sees the high potential of EV in European markets and shows how electric vehicles are growing in the European regions. However, the likes of North European countries are yet to figure out the concerns of using a heavy-duty electric vehicle in the logistics operation from those companies.

2.3 Sustainability and influence of environmental regulations in logistics

An increase in the demand for the products has pushed pressure on the industrial outputs (Rajeev et al. 2017) and the businesses are rapidly growing to fulfill the demand in the global market making it more competitive from one another (Campos et al., 2015). Since demand for consumer products has increased ultimately the more energy is required to fulfill the demand of the consumers. Therefore, it is uttermost important to integrate the social, environmental as well as economic aspects (IEA, 2020). The environmental attention should be getting more attention from the sustainability perspective (Campos et al., 2015). Low emission mobility has become a greater challenge in the modern world, strategies like digital mobility, frameworks for alternative energy, fair and efficient pricing in the transport sector (freight & public) are some of the strategies that the European Commission (2019) discusses in their publication.

Climate change is affecting the lives around the globe. Increasing the temperature of the planet by a certain quantity has caused extreme weather conditions, a rise in the sea levels, which risks lower sea level lands, and can bring droughts to many regions of the world (United Nations, 2020). Climate change cannot be stopped without decarbonizing the transport sector. Since transport contributes about 23% of the total carbon dioxide emissions, responsible for global warming, it is utterly essential to decarbonize the transport (International Transport Forum, 2020).

According to International Transport Forum (2020), without immediate action, the share of the greenhouse gas (responsible for global warming) from the transport sector will increase from 23% percent to 40% by 2030 and 60% by 2050. Over the past 50 years, the rate of emission of carbon dioxide has increased more rapidly than before. Since most of the transport energy depends on oil, which is the main source of realizing carbon dioxide gas, it is very difficult to decarbonize the transport system. The road freight is the fastest growing carbon dioxide emitter, since moving the goods from the road consumes about 50% of the diesel produced (International Transport Forum, 2020). Unlike other sectors, it has not yet succeeded to reduce the intensity level of carbon. The EU's emissions fell by about 20% from 1990-2016 whereas the transport emission increased by 27% (International Transport Forum, 2020). The findings from Li et al. (2015) shows that the carbon emission regulations (carbon cap) will meaningfully affect the fright routing decisions, carbon emissions, and overall cost of the companies.

Concerning the carbon dioxide emission, about 6% of the total CO_2 emission is represented from the heavy-duty vehicles (including buses, lorries, and coaches) within the European Union and these numbers are expected to grow by around 9% between 2010 and 2030 (EUR-Lex-Access to European Union Law, 2020). Therefore, it is important to have fuel economy standards for lowering the emissions from the vehicle´s tailpipe. In Europe, there are Euro Standards for regulating the emission norms. According to The International Council on Transportation (2020) " Representatives from the European Commission, the European Parliament and the European Council agreed for setting the carbon dioxide (CO_2) emission standards for new heavy-duty vehicles (HDVs) in the European Union with a target of cutting carbon emissions from the highest emitter HDVs segments by 15% in 2025 and by 30% in 2030". These emission norms are applied to four vehicle groups which include all the rigid and tractor trucks (4 x 2 or 6 x 2 axle configurations) that exceed 16 metric tonnes of maximum weight (TransportPolicy.net, 2020). The Euro standards for heavy-duty vehicles in Europe were first introduced in 1992 to account for emission from the vehicle's tailpipe.

World Economic Forum (2020) estimates that most of the carbon emissions from the logistics activities are caused by freight transport, such as heavy trucks, on long haul trips. Nevertheless, the road offers a level of flexibility, accessibility, and overall service level at competitive costs.

Still, a cost-effective and sustainable alternative is lacking. Over the recent decade, freight transport disproportionately outgrew economic development due to the increasingly global supply chain. However, the impact of freight transportation on the environment at the same time is also higher (Campos et al., 2015).

According to the United Nations Climate Change (2020), climate change has been one of the greatest challenges that humanity has to face in the coming year, if not the precautions are taken right from now to strengthen the global response to this threat. The temperature rise in this century must be below two degrees Celsius above pre-industrial levels and ambitiously even further to 1.5 degrees Celsius (IEA, 2020). Thus, the Paris Agreement came into action in 2016, aiming to strengthen the ability of countries to deal with the impact of climate change. Environmental regulations must require regulations for controlling climate change.

IEA (2020) suggested in their report that there is an increasing trend for road freight transportation from 2000 – 2030 for larger carbon dioxide emission and is responsible for more accountability of carbon emission than other sectors whereas rail accounts the minimum release of the carbon emissions and is supposed to account even less in the coming decade. These finding from IEA (2020), suggests that it is very important to apply the strategies for regulation this emission for achieving sustainability. Freight transportation is an essential part of the logistics activities for meeting the customers' demand in time as well as supplier-manufacturer business. Therefore, the implementation of environmental regulations to limit carbon emission becomes more important for protecting the environment. However, the study from Lähdeaho & Hilmola (2020), suggests that companies are not well prepared to face these regulations of environmental demands in their logistics activities. Moreover, these companies do not actively pursue the possibilities of new technologies.

Maritime transport is a global business through shipping and Sulfur dioxide (SO_X) is the harmful chemical emitted by the ship's combustion engines (International Maritime Organization, 2020). These chemicals can cause harmful impacts on the environment resulting in acid rain and can generate fine dust, which can cause cardiovascular diseases in human health and can shorten the lifespan of the people. According to the International Maritime Organization (2020): "From 1

January 2020, the maximum sulfur content of marine fuels is reduced to 0.5% (down from 3.5%) globally reducing air pollution and protecting the health and the environment."

The EU has been strict and has taken the firm's action concerning the sulfur directives and sulfur emissions reduction directive for maritime transport has become a heavily debated policy issue in Northern Europe from the perspective of the future competitiveness of transport dependent industries (Korhonen et al., 2018). The EU´s approach to controlling maritime transport emissions is an example at the regional level. These strict regulations from the EU are generally effective and are environmentally advantageous and even more effective in the long-term. (Korhonen et al., 2018 and International Maritime Organization, 2020). The results of Hilmola (2019) indicated that the strict environmental legislation will increase the freight transportation cost, which will have more impact on the Finnish companies as they are well hurt by the strict legislation on the sulfur emission. However, the impact is further examined through this thesis.

2.4 Influence of COVID-19 in logistics activities and operation

The world has faced many panic situations over the period, leading the disruption in almost every sector that directly influences the economic aspects of the countries. Due to numerous interconnecting wide networks of firms, the supply chain has become more complex and riskier (Manuj et al., 2008) and uncertainties in these conditions become higher with many risks ascending uphill. In history, the waves of the outbreaks like SARS in 2003 has proved that uncertainty's disruptions cannot be omitted, and it tends to generate its impacts in the global economy. Qiu et al (2018), showed in their results that the impacts of SARS were threatening to the global economy and thus disease outbreaks are so critical for any country´s economic and social aspects that it takes an extended period to accomplish the loss made in such outbreaks. Subsequently, a decade and a half later, the globe was attacked by another outbreak in 2020 named COVID-19 after it was first identified in China in late December 2019. With the widespread global scale, WHO (2020) named COVID-19 as a global pandemic. A research carried out by Handfield et al. (2020) suggests that the COVID-19 outbreak will hit the future flow of the supply chain and will create new obstacles in trade. However, the actual impacts on

real-time are difficult concerns to figure out what actual aspects and variables of the supply chain this pandemic of 2020 will impact.

A survey conducted by the Institute of Supply Chain (2020) in March 2020, reported that nearly 75 percent of the companies reported supply chain disruption due to the coronavirus issues related to the transportation restrictions and this is expected to increase in the coming months rapidly. The report suggested that more than 44% of respondents do not have any plan yet on how to address the supply disruption issues from China and 62% of respondents experienced a delay in receiving the orders from China (ISM, 2020). The result concerns the delay deliveries, delay in procuring in goods, unanticipated transit halts, and shortage of manpower (Entrepreneur India, 2020). The COVID-19 pandemic is imposing high and rising human costs worldwide. Protecting lives and consenting health care systems to cope have required isolation, lockdowns, and widespread closures to slow the spread of the virus. The coronavirus in the world has created a lot of challenges in mobility. This finding indicates the post corona will change the expectations of the supply chain and logistics activities. However, the post effect of the COVID-19 is yet to figure out after the second waves of the coronavirus pandemics end.

According to the European Commission (2020), the mobility and the transport sector response include the restrictions on the transport activities for many member states, which have been badly impacted by the economy of the countries by a large. The global economy and the businesses dependent on global sourcing are facing difficult choices in the management of their supply chains and have to plan with a different strategy to mitigate the impact of supply chain disruption and the consequences are that the businesses have to bear additional costs to keep running the continuous supply chain network through the globe (K@W, 2020).

The pandemic is impacting so high that the government authorities all over the world must do a lockdown. The great lockdown has changed the shape of the economy just in a few months in such a manner, that the projected global economy in 2020 will sharply contract by three percent, which is even worse than that of the financial crisis back in 2008-09 (International Monetary Fund, 2020a). During the financial crisis in 2009, the GDP growth was negative only by 0.1 percent (International Monetary Fund, 2020a). According to the International Monetary Fund

(2020a), In 2020, it is likely expected that the COVID-19 pandemic health crisis is having a severe impact on the economic activity which resulted in the global economy projected to contract more sharply approximately about negative 3 percent (Table 4). This is a worse situation than the financial crisis during 2008-09. The COVID-19 pandemic will have a more negative impact on activities in the first half of 2020.

Table 4. Overview of Economic out projections- Percent changes. (International Monetary Fund, 2020a).

	Projections		
	2019	2020	2021
World Output	2.9	-3.0	5.8
Euro Area (Advance Economies)	1.2	-7.5	4.7
China	6.1	1.2	9.2
Russia	1.3	-5.5	3.5
India	4.2	1.9	7.4

Table 4 is the economic outlook projections for three years 2019, 2020, and 2021. It can be seen from Table 4 that in 2020, advanced economies of Europe, Russia, and the overall world´s economic output projections seem negative as compared to that of the year 2019 due to the impact of the coronavirus pandemic effect. But, at the same time, the economic outlook of China and India seems not to have a negative impact and seems to stabilize the economy even in the crisis of pandemic. However, it is likely expected that in the coming year the economy seems to rise, and things will be stabilized for all these selected areas in Table 4.

It is also mentioned in the report of world economic outlook 2020 from the International Monetary Fund (2020b), there could be an uncertain recovery, which is predicted to be more gradual. “The global economy is projected to grow by 5.4 percent in 2021 as economic activity normalizes, helped by policy support” (International Monetary Fund, 2020b). However, risks for even more severe outcomes are substantial. Moreover, assumptions by International Monetary Fund (2020a) in their world economic outlook report, predicts that in a baseline

scenario, which assumes that the pandemic fades in the second half of 2020 and containment efforts can be habitually unwound. International Monetary Fund (2020a) explains that the COVID-19 pandemic poses extraordinary health and economic steadiness challenges. Following the COVID-19 outbreak, the costs of hazard belongings collapsed, and market volatility spiked, while expectations of considerable defaults led to a surge in loan costs.

According to The Economist (2020), the coronavirus outbreak will be a very serious test of the global supply chains, because slowing down on of the most important economies in the world right now and some serious constraints both on the production and supply-side as well as the logistics side will accentuate the impact of this type of the pandemic on the global supply chain will input a huge challenge. It is very hard to find the benchmark that can be reliably used to estimate the impact of this kind of effect and since the global supply chains are the highly interconnected systems of suppliers, factories, logistics activities, retailers, etc. According to the International Air Transport Association (2020) forecast, the industry's global revenues would fall by $ 314 billion in 2020, down by 55 % from last year´s analysis. This is one of the biggest impacts of 2020 in the airline industry concerning pandemic-related travel disruptions, which has resulted in the airline industry undergoing the worst scenario in the last 50 years (International Air Transport Association, 2020).

The Baltic Times (2020) reports that, despite the negative impact of the COVID-19 on the economic progress in the global market, the Latvijas Dzelzcels (LDz; Latvian railways) continues to provide regular freight transportation, which also includes the long trains from Asia to Europe. Such possibilities came with the cooperation project with the Russian Railway and the high quality of LDz infrastructure. The record-long container train consisting of 100 TEU containers, having the length of one kilometer, crossed the Latvian territory on China-Russia-Latvia-Lithuania-Kaliningrad route was also recorded in April 2020. This indicates that despite many challenges the technology and the advanced technological infrastructure has tried to cope up with such a pandemic situation making the successful carriage between Europe-China.

Over time diseases, wars and natural calamities have affected the global population. SARS is one of the first epidemics of the 21st century, which appeared at the very beginning of this

century spreading to 29 countries and 3 regions, with total cases over eight thousand alongside (Siu and Wong, 2004). The epidemic led a heavy loss to emerging economies at that time and made negative impacts on the Chinese economy. Countries like China, Taiwan, Singapore, and Hong Kong (China) were triggered so much by the SARS waves such that the ripple effect was experienced in their economies in post effects of the SARS (Brahambhatt and Dutta, et al. 2008). Reduction in foreign and domestic tourism as well as reduced domestic traffic for different services sectors like retail, hotels, restaurants, etc. was considered as some of the immediate actions taken at that time to account for the ripple effect of the SARS waves (Brahambhatt and Dutta, et al. 2008). The impacts of the ongoing pandemic are still unknown to a larger extent. It has already interrupted the various modes of transportation to such an extent that it has become difficult to meet the demand through supply.

2.5 Chinese market and operation

China is the third-largest country in the world which shares its border with fourteen other countries and the Pacific Ocean. It is situated in the middle of Asia (Tian, 2016). Beijing city is the political capital of China. However, Shanghai is the center for business hub and where the main stock market is located. From the population´s perspective, it has more inhabitants than any other country on the planet with 1.4 billion people. Ever since Deng Xiaoping opened the economic system in 1978, China became open to the global market for manufacturing with low labor cost and slowly it began to reform its economic system which led over 850 million people out of the major poverty line (The World Bank, 2020e). However, about 373 million people are still living below the upper-middle poverty line (The World Bank, 2020e). On a per-capita basis, it is the 76th largest economy (World Economic Outlook, 2020). Over the period, the economic expansion growth rate of China has fallen from double-digit to the single-digit growth rate in a few years. However, the country is still in the growing curve despite the fall in the growth rate of economic expansion (Tian, 2016). As regarded as the manufacturing factory of the world due to its cheap labor market, China has gone to a huge transition from import to export (He et al., 2019).

In recent years, China´s urbanization has rapidly grown to a massive extent that even small cities like Chongging, Wuhan, Qingdao, Chengdu, etc are creating a bunch of opportunities for new businesses. With the development of good infrastructures and the addition of advanced technologies, these cities can be very good sites for doing business in Asia (The World Bank, 2020a). China´s high growth was mainly based on its large resources intensive manufacturing exports and lower labor costs. But over the period these factors have reached the limitation point which in result creating the impact of China´s economic, social as well as environmental aspects (The World Bank, 2020e). Thus, raising concerns about sustainability. Because of its large size by land and population, China is the largest greenhouse emitter on the planet (The World Bank, 2020e).

Today in global business, China's impact can be seen almost everywhere. The Chinese economy is in the transition phase especially from the export and this is led growth to domestic consumption and the economy would take 10-15 years for the complete transformation to a new global economic leader, but if the global industries and global companies can identify these future trends and if these factors can be positioned well then there is a huge business opportunity in China (World Economic Forum, 2020). Although there has been a gradual improvement in the international trading surroundings given that 2010 following a consistent restoration of the world economy, multiple challenges for the international economy nonetheless lie ahead with controlled trade protectionism becoming a trend (Shanghai WTO Affairs Consultation Center, 2011).

Ever since China joined the membership of the World Trade Organization (WTO) in late 2001, it has been growing fast in overseas trade, which must grow to be the foremost using pressure at the back of its surging monetary development (Tian, 2016). The rise of China as an economic superpower in the world market has pulled the attention of countries worldwide for potential business in the Chinese market (Tian, 2016). However, the 2008 economic crisis has left China with unstable in the international market and primary suffering (Shanghai WTO Affairs Consultation Center, 2011).

In most recent times China has faced immediate challenges mainly concern with the impacts of the COVID-19 pandemic. The COVID-19 outbreak was originally originated from China´s Wuhan city, which was later recognized as a pandemic by WHO after its high impact and rapidly spreading throughout the globe (McCloskey and Heymann, 2020). The Outbreak highly distorted the economic, social, and health aspects of China. Moreover, the supply chain was disrupted, and the logistics activities were slowed concerning trade with other countries (McCloskey and Heymann, 2020).

Over the years the Chinese market has seen many fluctuations, different outbreaks like SARS, H7N9, COVID-19, etc. have hit China and caused a significant negative impact on its health, the economy as well as global supply chain networks (Qiu et al., 2018). These uncertainties hit over the period on the Chinese market impacted trade and commerce, unequal distribution of supply and demand ratio, forcing to increasing in the lead time, and late customer deliveries for many companies based in China. However, responses from such outbreaks in the past have made China learn many lessons from the previous sufferings and implement bold attempts to control the impact of an outbreak like the COVID-19 pandemic (McCloskey and Heymann, 2020).

2.6 Russian market and operation

Russia is the largest country in the world (in terms of territory) located in the north of Eurasia with exceptionally rich natural resources. According to the International Monetary Fund (2020), Russia ranks 12th in terms of nominal GDP. The economy is predominantly based on raw materials that come from its well-known enormous natural reserves. It comes in first place in the world in natural gas and forest reserves, sixth place in oil reserve, and second place in coal reserves. The World Bank (2020b) estimates the value of Russia's natural resources at 75 trillion dollars. This is such an impressive figure and is likely that the manufacturers will seek suppliers from Russia. The availability of abundant resources and the wider potentiality of the Russian market can be the huge business bridge between Russia and Northern Europe (Krasnopolskaya, 2020). However, the dependencies on the supplier are based on the manufacturer’s requirements.

The presence of such huge resources in Russia would seem logical that the average salary in the country should be no less than it is in Europe, but that's not the case as the average salary in the country is about $ 400-650. (The World Bank, 2020b). Even professions that are well-paid in the west get paid little in Russia. For example, the average salary of a doctor is just $ 700 per month and $ 450 for a nurse. Nevertheless, the economic growth in Russia is expected to be 1.6 percent in 2020 and 1.8 percent in 2021, mainly because of the less restrictive monetary policy and increased spending on national projects (The World Bank, 2020b).

Russia is one of the major producers of crude oil. A recent attack from the coronavirus pandemic throughout the world has induced a decrease in demand for the oil, a decrease in the economic activities due to the COVID-19 pandemic spread has led the supply chain to slow down. Russia is one of the main oil exporters, and the country is heavily hit by the COVID-19 pandemic as its foreign activities slowed down (Ponkratov et al., 2020). Results from Ponkratov et al. (2020) suggested the state of the Russian Oil Industry under the influence of supply and demand factors during the COVID-19 pandemic, are under tremendous pressure. However, Jefferson (2020), argues that though it is heavily impacting the oil industry, disruption in supply-demand with intensifying pressure, still it is too early to predict the actual consequences of it in social and economic interaction. Whatever the argument be the ripple effect of the COVID-19 has already been noticed in the Russian market for foreign activities. A conclusion made by Petrov and Petrova (2020) suggests that Russian cities are already under immense pressure facing the difficulties in the target function of the city management, leading to high costs in maintaining the level of transportation processes resulting in additional financial expenses due to COVID-19 pandemic effect.

Simola (2016) said in this publication that Russian markets are growing with increase in its international trade relationships with many countries including China, though the possibilities of healthy relations between these two countries seem to increase with time it needs more strategic planning and challenges to overcome for the harmonic relationship to increase the potential trades. Europe and Russia have been dependent on each other for their economic welfare and prosperity. Ever since the development of the different modes, the trade between the two regions has been improved. It was found from previous research works of Holopainen

(2015) and Sutela and Hilmola (2010), the road is the most dominant more when it comes to freight transportation between Russia and Northern Europe. However, in recent times the interest besides the road has been noticed as railways are getting popular. One of the major concerns when it comes to freight transportation is the sustainability issue. In a publication by the authors, Korovyakovsky et al. (2017) show the outcome from their paper regarding the Russian railways on the Eurasian Market, a typical sustainability issue. In the research, their result suggests that supply chains should indulge in the future railways or intermodal connections for containerized and associated cargos (Korovyakovsky et. al., 2017).

3 RESEARCH METHODOLOGY

This chapter aims to provide a detailed description of the methodologies used in the study of the thesis. This chapter is followed by the four other sub-chapters which further present the detail-oriented descriptions to illustrate the context and the methodological choices along with the concise explanation of those choices. The last two sub-chapters of this chapter provide information about how the data for this thesis were gathered and then further processed to analyze.

3.1 Research paradigm

The philosophical roots used for the research were constructivism and interpretivism concerning more subjective to the more human experience and mostly focused on the experience of the authorities of the companies. This paradigm was appropriate because mostly the research was critically approached qualitatively. Since qualitative research is mainly associated with a diversity of strategy and each of them has a specific emphasis, scope, and set of phenomena (Saunders et al., 2016). Moreover, the qualitative is concerned with experiences and understanding which is more important than looking for an outcome (Glesne, 2016). However, the research was also approached quantitatively with some positivist philosophy, where it tried to explore, the undependability of the physical phenomena in the logistics department within the company by benchmarking the frequency and magnitude of some logistics activities concerning the sales, transportation cost, size of warehousing, etc.

The research is exploratory by nature. Generally, these types of studies are valuable means to ask questions for discovering what is happening and gain an understanding of the theme of an interesting topic (Saunders et al., 2016). Moreover, Exploratory research is more flexible by nature and it is adaptable to change.

3.2 Methodological choices

This research follows the survey method for investigating the logistics situation of the North European companies and mainly the companies were targeted from Finland, Sweden, Estonia, and Norway. The survey was designed qualitatively as well as quantitatively so both methods are applied in the survey to seek the data for answering the research questions set in Sub-Chapter 1.3. The mixed method was approached for better insight. The goal of this research was specifically focused on understanding the current logistics situation from three different perspectives: environmental, technology, and COVID-19. However, to measure some aspect (like freight transportation cost, increasing or decreasing possibilities of warehousing size, number of sales of the company product, etc.) for future perspective, the research was also approached quantitatively at some point to indicate the future perspectives in some of the main logistics activities concerning the size of the warehousing, number of employees, impact of new regulations on freight transportation cost. Moreover, to develop a richer theoretical perspective than what already existed in the literature, an inductive strategy was applied to add more information after a series of literature review investigations and analyzing the data from the survey. Considering the vast amount of research done in the field of logistics activities in North European companies, the methodologies utilized by other researchers were unaffectedly adapted for this research with specific data from Finland.

A survey method was used to collect the primary data for this research. To figure out the trustworthiness of the data, a considerable amount of data was gathered by surveying two parts. The first part was the survey for large multinational companies from four North European countries (Finland, Estonia, Sweden, and Norway) whereas the second part of the survey was for regional companies from the South Karelia and Kymenlaakso region of Finland. The secondary data was gathered by reviewing literature from previous research, books, articles, newspapers, reliable websites, and various scientific journals within the same domain. A cross-sectional time horizon was selected for the survey meaning that the new sample size was taken for surveying within a specific period.

3.3 Data collection

This part of the methodology explains step by step, how the data were collected during the research. Initially, the literature search was conducted using some useful keywords like supply chain, logistics, transportation modes, sustainability, technology, warehousing, environmental regulation, COVID-19, carbon emissions, sulfur directive, and other related words in context to the research topic. This part was crucially important for forming the grounding of knowledge within the domain of supply chain and logistics. The main databases that were used for the literature search were Scopus, Science Direct, Emerald Journals, EBSCO-Academic Search Elite, Sciendo, LUT finna, Springer eJournals, etc. The preliminary research was completed by reviewing various research articles and e-books from those databases. The physical books and previous thesis in the same field were also reviewed from the LUT University library. The initial literature review was conducted to collect the secondary data which was valuable for carrying research forward. Moreover, it also helped to grab some useful claims and find the research gaps as mentioned in the Introduction chapter under Sub-Chapter 1.2. Many researchers were working in the field of logistics and supply chain and carrying research in those areas to understand the situation of North European companies concerning their logistics activities like transportation, warehousing, inventories situations. Some of the most prominent ones are Hilmola (2020), Hilmola et.al (2015), Hilmola (2016), Hilletofth et al. (2016), Lorentz et al. (2011), and many others.

To answer the research questions (see Sub-Chapter 1.3), the primary data was very important, and the strategy applied was the survey method. The survey was done by an electronic questionnaire, which can be widely used in this type of research for collecting data for further processing (Saunder et at., 2016). This method was suitable because it has a specific range of time to get the responses from the respondents so generally takes less time to collect the data. Moreover, it gives more insights for investigating the research questions (see Sub-Chapter 1.3). A closed-end web-based questionnaire was set to send the targeted manufacturing and logistics companies for both surveys.

The survey required to interpret the results was conducted in two parts. The first was for big multinational companies from Northern Europe (Finland, Estonia, Sweden, and Norway) and the second Survey was conducted from the regional companies of South Karelia and Kymenlaakso regions of Finland. At first, the companies were chosen from four countries of North Europe (Finland, Estonia, Sweden, and Norway). The name list of large Finnish, Swedish, and Estonian companies was gathered from the previous research done by Hilmola et al., (2010, 2011, 2012). Moreover, additional inquiries were also made through a google search engine to find out the email addresses of the large companies. At first, a list of the top 500 companies was searched from google for Finland and Sweden. Some companies address for those two countries (Finland and Sweden) were also made available from the previous works of Hilmola (2012), while other companies list and email addresses were collected from the google search engines by visiting the company's official websites. In addition, the list of top companies from Estonia was also made available from the previous works of Hilmola (2011, 2012, 2019). However, the addresses for the companies of Estonia were cross-checked from the companies´ official website and most of the old email which was not valid and was replaced by the new one.

To find the list of companies from Norway, a database from an online website named Largest Companies (2020) was used. However, the emails of all the companies were collected from the company's official websites. The number of logistics and manufacturing companies selected from those targeted countries are shown in Table 5. The type of questionnaire generated for the survey was an internet-based questionnaire, which was made on the Webropol platform of LUT University and was delivered through the company's emails in the form of web-browser, mobile, and tablet version. The questions were mainly the closed-end questions that were scaled to 5-point Likert-scale and respondents were given the choice to skip any question they do not want to answer. Moreover, there was an open question presented for free writing concerning the effect of COVID-19, environmental regulations, and new technology in logistics activities (see Appendix 2, Q 22). Since the survey was conducted in two parts one from the big international companies and the other from the regional companies from South Karelia and Kymenlaakso regions of Finland, therefore it was necessary to collect the data from large companies (first survey) and the local companies of Finland (second survey). A detailed explanation of how data was collected is presented in the next Sub-Chapters 3.3.1 and 3.3.2, of this Chapter.

3.3.1 Data collection from large companies (first survey)

For investigating all three research questions of this thesis (see Sub-Chapter 1.3), The questionnaire was sent through emails to the targeted logistics and manufacturing companies from North Europe (Finland, Estonia, Sweden, and Norway). The questions were mainly focused on transport mode, warehousing activities, freight transportation cost, environmental regulation, interest in using modern cutting-edge technology, and the impact of the COVID-19 pandemic in the logistics activities for those companies from North Europe. The questionnaire was sent through email to the specifically targeted companies through the Webropol platform of LUT University. Mainly the questions (see Appendix 2) were new however, some similar questions from previous research were also taken into consideration which was conducted in 2010 (Sutela and Hilmola, 2010) and 2015 (Holopainen, 2015) in the same domain of the logistics and supply chain.

To collect the data through questionnaires from large companies of North Europe, 261 companies from Finland, 179 companies from Sweden, 351 companies from Estonia, and 94 companies from Norway were contacted for the first round on 3rd June 2020. The first reminder to these selected companies was sent on 9th June 2020 as a second round. After these three more reminders were sent. The second one on 15th June 2020 and the third reminder was sent one week after on 22nd June 2020. The final reminder was the fourth reminder to those companies which was sent on 28th June 2020 as a final round for the first survey. After this, the survey was closed the very next day. Table 5 below shows the number of participant companies and the total response received from them.

Table 5. Number of companies from Northern Europe to whom the questionnaire was sent and how many responses were received.

Country	Total number of companies contacted	Number of Responses
Finland	261	6
Estonia	351	2
Sweden	179	1
Norway	94	0
Total	**885**	**9**

3.3.2 Data collection from small companies (second survey)

The share of responses from the large companies was about 1 % of the total participants (885) which was very low. Those data from large companies may create some issues concerning reliability. Therefore, another survey was done with the regional companies from South Karelia and Kymenlaakso regions of Finland specifically targeted to the logistics and manufacturing companies of these regions.

The list of the logistics companies from the South Karelia region was made available from previous research works of Lähdeaho & Hilmola (2020). Also, a new list of the manufacturing companies in the Kymenlaakso region was gathered by searching them in google and after making a list of the manufacturing companies from the Kymenlaakso region, the emails of those companies were collected and filed in the Microsoft spreadsheet known as excel sheet. Mostly the general info email was available from the internet search which was filed into the excel sheet alongside the name of the companies. The targeted companies were mainly from the transportation, logistics, and manufacturing sector. After the availability of a list of companies, web searching work was done to check the available emails in the list and gather the emails which were not on the list. Altogether 575 companies from Kymenlaakso and South Karelia

region were targeted. The total number of companies from Kymenlaakso was 311 and from the South, Karelia was 264.

The same procedure was followed as it was for large international companies to collect the data and the questionnaire was sent through email to the targeted 575 companies of those previously mentioned local regions of Finland. The first survey contact was made on 17th June 2020. After one week, the first reminder was sent to those companies on 23rd June 2020. By this time, the number of responses was 16. The second reminder was sent on 30th June 2020 and the third was sent on 6th July 2020. By the end of the third reminder, the total number of respondents was 39. The fourth and final reminder was sent on 13th July 2020 and the survey was finally closed on 17th July 2020. After the final reminder, just before one day of closing the survey the total number of respondents was 53, which was very impressive for processing the data to analyze.

Table 6. Summary of email sent, and responses received.

Email survey link response	Number (N)	%
Individual recipients	575	-
The total amount of email with email survey link sent (including reminders)	2761	-
Email survey link responses	53	9

Table 6 shows the total number of the email sent with the survey link including all four reminders and the total percentage of responses received. Table 7 shows the total number of companies contacted in two targeted regions of Finland and the responses received from them after the survey was closed.

Table 7. Summary of companies contacted from each region and their responses.

Region	**Total Number of Companies contacted**	**Responses**
Kymenlaakso	311	26
South Karelia	264	27
Total	**575**	**53**

3.4 Data analysis

After gathering the data from the targeted companies, it is very important to discover useful information from it to find the research question´s answer and communicate with the audience. Because of less availability of the data gathered from the first survey, qualitative analysis was conducted for investigating the research questions (see Sub-Chapter 1.3). However, the number of respondents from the second survey, targeted to the regional company from South Karelia and Kymenlaakso region of Finland was significantly more in comparison to the first survey from large multinational companies, therefore, for investigating the RQ2 (see Sub-chapter 1.3) at some point steps for quantitative analysis was done for closed-end quantitative questions, though the respondent number from it was 53 which was also not much bigger as it is required for quantitative analysis (Ghauri et al., 2020). However, it is considerable for investigating the RQ2 (see Sub-chapter 1.3).

The RQ1 was mainly focused on the current logistics situation and issues concerning transport mode, inventory management, the effect of environmental regulations on logistics activities, and warehousing activities of North European companies regarding the Chinese and Russian Market. The RQ**2** was mainly focused on the impact of the COVID-19 pandemic in logistics activities and the RQ3 precisely focused on whether modern cutting-edge technologies can enhance the logistics activities or not.

The survey was done through an online questionnaire, which had 25 questions for large multinational companies in North Europe (Finland, Estonia, Sweden, and Norway). Question 1 and 2 (see Appendix 2) was directed to gather the general information concerning the position and working experience of the respondent. Question 3 of the survey was to explore the most important transport unit used by the companies. From question 4 to 7 (see Appendix 2) was labeled to a 5-point Likert scale in which question 4 investigates the cost of freight transportation, question 5 and 6 (see Appendix 2) investigates cargo volume for China and Russia respectively.

The mode of transportation was investigated by questions 8 and 9 (see Appendix 2) with 4 mode options (air, sea, rail, and road) and one extra option as " I do not want to answer" for those who

do not want to answer. Analysis from that two-question helped to understand the most preferred mode of transportation used for logistics activities with China and Russia, which is very important concerning the RQ1 (see sub-chapter 1.3) of the thesis.

The question from 3 to 10 (see Appendix 2) in the survey was designed to investigate the RQ1 (see sub-chapter 1.3) and whereas the question from 11 to 16 (see Appendix 2) in the survey questionnaire was mainly targeted to investigate the COVID-19 pandemic impact on the logistics activities of the North European countries. Question 19 to 21 in the questionnaire was arranged to examine RQ3 (see sub-chapter 1.3) of this thesis. All the questions from 11 to 21 in the questionnaire were labeled with a 5-point Likert scale. It can be understood from Table 8 below.

Table 8. 5-point Likert scale used for question 11-21 in the questionnaire (see Appendix 2).

Points	**labeled**
1	not at all
2	less likely / a little (used for question 17-21) [see Appendix 2]
3	moderately
4	likely / much (used for question 17-21) [see Appendix 2]
5	extremely

The only open question in the questionnaire was number 22 (see Appendix 2). This open-end question was free writing and reflects the effect of the coronavirus (COVID-19) pandemic, environmental regulations, and new technologies in the logistics activities of the respondent companies in the future. Question 23 (see Appendix 2) was a 2-point scale labeled with “Yes” (1) and “No” (2) just to understand the interest of the respondents to have a research report from the survey. Lastly, question 24 and 25 was for the participants to show their interest in a further interview on the same topics.

The Second survey was mainly focused on RQ2 (see Sub-Chapter 1.3) to investigate the coronavirus impact in logistics activities for those targeted companies. In the second survey web-based online questionnaire was sent through email to local companies of South Karelia and

Kymenlaakso region of Finland. The questionnaire for the second survey had 13 questions. The questions from 1 to 3 (see Appendix 3) had a 5-point Likert scale labeled “not at all” (1), “less likely” (2), “moderately” (3), “likely” (4), and “extremely” (5), whereas question 4 and 5 (see Appendix 3) was arranged to choose the mode of transportation with 4 modal options labeled as “rail” (1), “road” (2), “Sea” (3), “air” (4). Question 6 to 9 (see Appendix 3) follows the same 5-point Likert scale as followed by question 1 to 3 and mentioned above. Question 10 (see Appendix 3) was an open-end question mainly focused on the effect of COVID-19 on logistics activities in the nearest future. The other three questions from 11 to 13 (see Appendix 3) were general questions related to personal information to send the research report from the survey.

Computer software programs are helpful in managing, handling as well as analyzing the collected data from primary or secondary sources (Bloomberg and Volpe, 2018). Therefore, it is necessary to analyze the data collected from the survey. During this step and process, data analyzing tools and software are very helpful. Therefore, the data collected from the respondents was kept in the Microsoft spreadsheet program called “Excel” for deeper analysis. The data from closed-end questions of both surveys were converted into numbers and analyzed quantitively as according to the requirement. However, the open-end question´s response from the first survey was interpreted qualitatively.

A pivot table was constructed in the Microsoft spreadsheet using the data from the survey, which was helpful for sorting, filtering, and generating the visualizations for each question and their variables. To visualize the data bar-graph, pie-charts and histograms were used for better interpretation and understanding. The result of the analysis to find the answers to the research questions are shown in the Result chapter with visualization.

For open-end question data were analyzed qualitatively for the first survey and for the second survey the qualitative data was quantified and analyzed quantitatively. The open-end question was not limited to a predetermined set of possible answers like in the closed-end question. There was enough space provided to write their comment freely regarding the question asked. Although the open-end question from each survey was an analytical challenge to set results, however, they were helpful to collect a rich pool of genuine opinions. The answers received

from each respondent are summarized in brief with more clearance and tabulated them which can be seen in Table 9 (free comments from large companies) & Table 11 (Free comments from regional companies of Finland).

Table 9. Free comments from the respondents of the first survey for the open-end question.

Participant Number	Response (Free comments)
1.	Projects based business do not hold inventories for Future consumption since each year is different, important thing is to deliver products based on earlier agreed deadlines.
2.	New solutions and routings are implemented with their business level and freight level will remain conservative.
3.	The huge impact of IMO.
4.	Blockchain can ease and improve a lot of administrative processes and documents needed in the supply chain.

Table 9 is the free comment response for the question and the free comments from the first survey were analyzed qualitatively due to the smaller number of respondents. The analysis and interpretation are shown in the result section 4.1.4 in detail. However, the response from the second survey was comparatively greater in number than the first survey. There were 27 responses from the second survey for the free comment question. The free comment question was set in question number 10 (see Appendix 3) for the second survey where the respondents could write freely according to the question asked. The open-end question was a bit challenging to quantify and analyze to extract the information. However, the information from it helps to form a genuine opinion. To quantify the open-end question, first, the answers were collected, and themes were generated from all the responses and trying to find the common patterns in the answers to generate themes. When the themes were created, it was filed in the Microsoft spreadsheet. There were 6 themes generated from all the 27 responses (see Table 10). Out of twenty-seven responses, one respondent did not write anything but set a question mark, therefore during the quantifying process this type of response was found as an outlier and was omitted during the refinement. So, the actual response was twenty-six. After forming six themes from twenty-six responses these themes were coded with the help of alphabets, this type of coding can be seen in Tables 10 and 11.

Table 10. Themes generated with coding from the response of respondents (second survey).

Themes	**Codes**
no effect	n
inventory grow	i
effect on production and supply chain	e
small effect	s
depends on second wave	d
high effect	h

Table 10 is the themes generated from the brief answers from the respondents. Table 11 is the brief version of the answers received from the respondents for open questions in Q10 (see Appendix 3) through the second survey with regional companies of Finland. All the responses to the open-end question were briefed and tabulated in a Microsoft spreadsheet. From the brief version, similar patterns in the response were identified and common themes from them were generated which later was coded with the help of alphabets (see Table 10). After coding each of the answers from the respondents (see Table 11), the next thing was to count for the frequency of the code generated for descriptive statistical analysis. The frequency of each theme coded with the letter was counted for quantitative analysis. The total number of frequencies was 26 and the frequency for each of the themes was counted which was later converted into the proportion for easier analysis of the result. The result from analysis of the open-end question is shown in the result section 4.2.3.

Table 11. Free comments from the second survey for open-end questions with coding.

SN	Answers from the respondents	Code
1.	The negative effect of COVI-19 will be present more on the Production and supply chain in the second wave.	e
2.	Export projects are frozen and slowed down, are cancellation.	s
3.	Buffer inventories and longer lead time.	i
4.	Small effect.	s
5,	Inventories will increase	i
6.	Oil price has declined which create pressure to decrease further logistics costs.	h
7.	No effect.	n
8.	No effect.	n
9.	Market Slowdown.	s
10.	No effect.	n
11.	No effect.	n
12.	Changes in production and sales, volumes can change and affect logistical needs.	e
13.	The effects depend on second wave of COVID-19.	d
14.	No effect.	n
15.	Inventories will increase.	i
16.	Inventories will increase slightly.	i
17.	Little impact	s
18.	No effect.	n
19.	No effect.	n
20.	No changes at all.	n
21.	No big impact, logistics only in the Baltic States and in Finland.	s
22.	No significant changes.	s
23.	Profitability has declined as volumes have disappeared and no financial support from the government.	h
24.	Taking care of deviations and forecasting the future e.g. by using ERP.	s
25.	Minimum effects on operations operate only in Finland.	s
26.	Everything will be like the same before in 2021.	s

4 RESULTS

In this chapter, all answers from both surveys have been used to show the result. The result of this thesis has been categorized mainly into two sections of this chapter. The first section shows the result that was obtained after surveying the large multinational companies mainly from Finland, Sweden, Estonia, and Norway. The other section of the result in this chapter was obtained after surveying the local companies of South Karelia and Kymenlaakso region of Finland.

4.1 Empirical data analysis and survey result from large multinational companies

Out of the 885 contacted companies from North Europe (Finland, Estonia, Sweden, and Norway), 9 responded to the survey resulting in fewer percent of the response rate of 1.02 %. Out of the 9 respondents, 6 of them were from Finland, 2 was from Estonia, 1 from Sweden, and no responses from Norway. Out of the four countries considered for the survey, the response share from Finland is 67 % followed by Estonia 22 %, Sweden 11 %, and 0 % from Norway. After analysis, it was estimated that one of the main reasons for receiving the less respondent rate from the first survey could be the use of general email addresses like info@..adresses instead of more specific email direct to the company´s higher authorities.

Position of the respondent and working experience

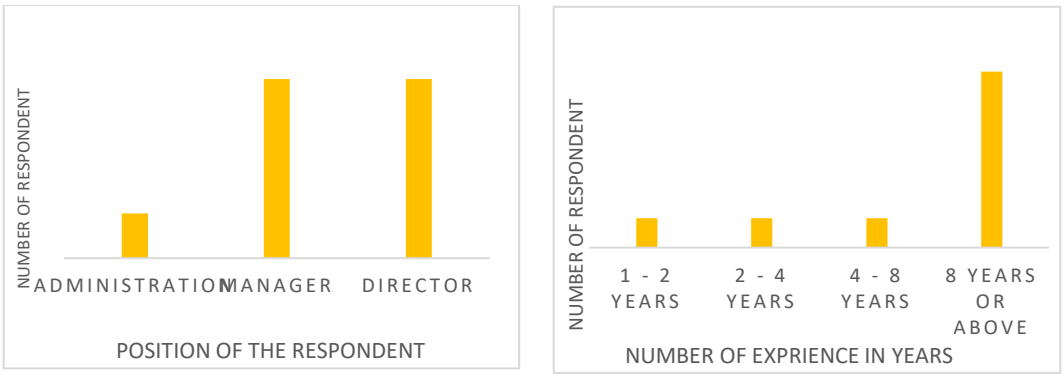

Figure 8. Position of the respondents (left) and working experience (right). (n = 9)

Figure 8 (left) is the position of the respondents in their respective companies and shows that four out of nine respondents´ positions as director, four were the manager and one was from the administration department and Figure 8 (right) shows the number of years those respondents have worked for their companies. There were six respondents with experience of more than 8 years, one with 4-8, and one with 2-4 years of experience. This means that the respondents of the survey were having a solid experience for their companies. which means that the primary data was from a decent valid source and can be trusted as well. However, the total number of participants concerning the respondent number is only 1 %, which can be a concern of reliability, especially considering the sample size (n=885).

4.1.1 Result of the survey concerning RQ1

This section covers the results obtained from the survey regarding the RQ1 (see Sub-Chapter 1.3), which was mainly concerned to investigate the inventory management, transportation mode, warehousing activities, and impact of the environmental regulations in the logistics activities of North European companies. This section shows results on each variable of the research question 1 (RQ1) step by step.

Important transport unit

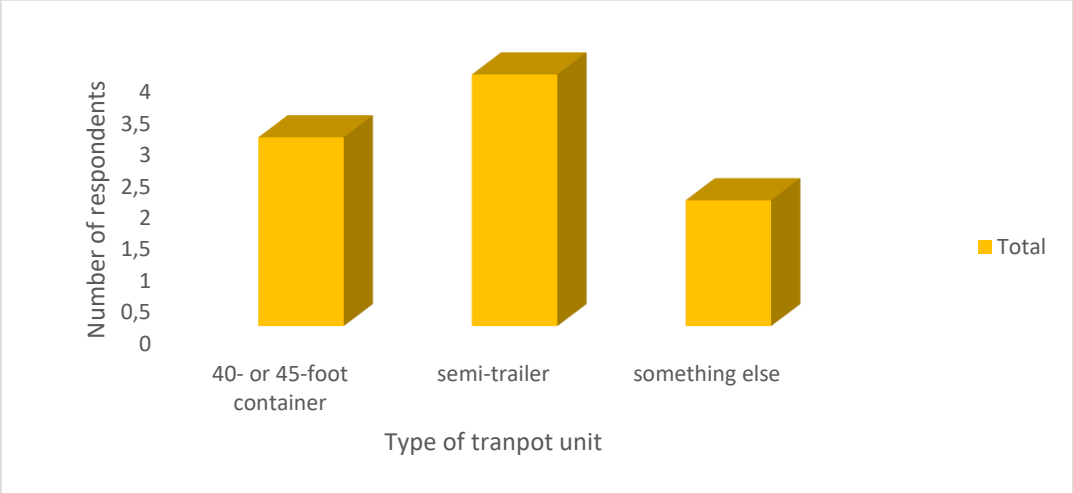

Figure 9. Important transport units in North European companies (n = 9).

Concerning the question to investigate the most important transport unit for North European companies, out of the 9 respondents, 4 of them replied that their main transportation unit is semi-trailer, 3 of them said that 40- or 45-foot container is used for their freight transportation and 2 respondent replied that something else is used for their logistics activities. The above Figure 11 indicates that mostly in the North European semi-trailer is the important transport unit for the companies for their logistics activities.

Result concerning transportation: cost and volume for RQ1

In this section two of the most important aspects (cost and volume) of transport of the RQ1 (see Sub-Chapter 1.3) have been analyzed. From the concern of cost, this section analyzes how much companies spend in the year 2019 and has planned to spend in the forthcoming year 2024 and 2029 on the transportation of goods. The cost of the warehousing is excluded in this section and not included in the survey question during the survey. Whereas from the annual cargo volume concern the estimation years were also kept as the same as that of transportation cost. Moreover, it is important to note that, the cargo volume here is in TEUs (Twenty-Foot equivalent Units) meaning that how many TEUs containers companies move for the logistics activities regarding China and Russia.

Cost of transportation for the year 2019, 2024 & 2029

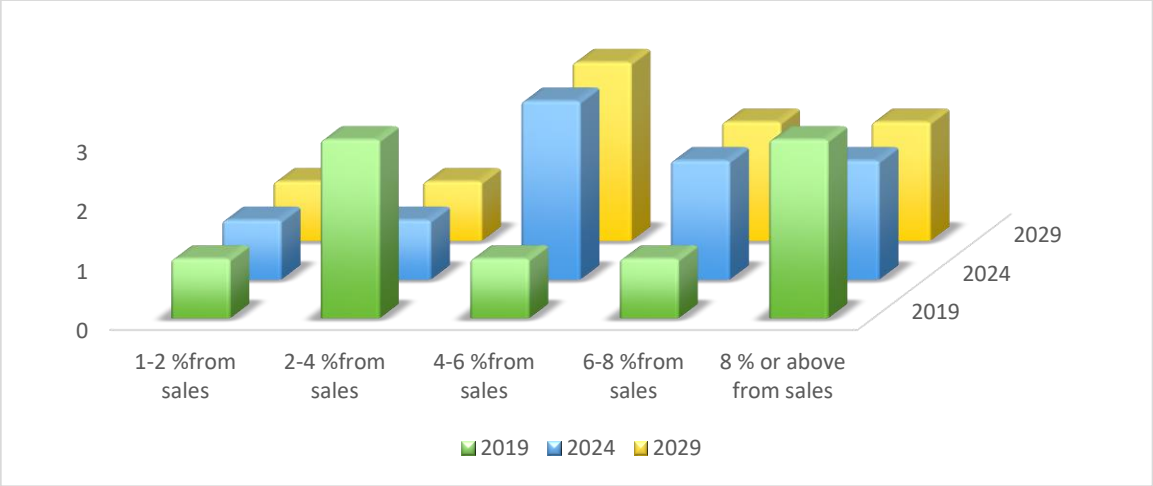

Figure 10. Transportation cost analysis for the year 2019, 2024 & 2029.

Based on research data, Figure 10 shows that, for the year 2019, three respondent said that their company´s spent on transportation is 2-4 % of the total sales, three respondent also said that the cost was about 8 % or above from their total sales, one respondent said that, their transportation cost was 1-2 % from the sales for the year 2019, whereas one respondent said 4-6% and one respondent mentioned that their company spent about 6-8 % in the transportation cost.

Similarly, for the year 2024, the prediction of the respondent concerning the transportation cost that their companies are going to spend in the next five years can be seen differently from the year 2019. Three out of nine respondent predicts that their cost for the transportation will be 4-6 % from their total sales, two respondents said it will be about 6-8 %, two respondent said it can be 8 % or above whereas one respondent predicted that, it will be 1-2% from the sales and one predicted 2-4 % from their total sales. Meanwhile, for the year 2029, the prediction for the transportation cost for the companies will be the same as that of the year 2024 as according to the respondents. The result shows that transportation costs seem to be on an increasing trend in the following decade.

Annual cargo volume concerning China

In this section, the annual cargo volume in the actual measurement unit TEU (Twenty-foot Equivalent Unit) of the companies concerning the logistics activities with China has been analyzed, which is shown in a graphical representation in the following Figure 11.

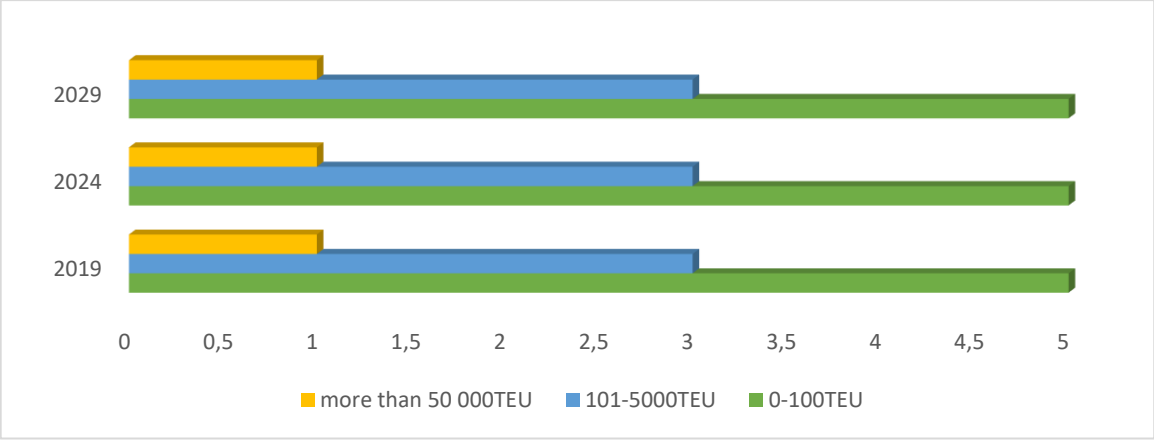

Figure 11. Annual cargo volume with China.

The respondents were asked to choose the annual cargo volume with China for the year 2019, 2024, and 2029. It was found that the number of respondents who choose 0-100 TEU was five, those who chose 101-5000 TEU were three, and those who choose more than 50 000 TEU were the same for all the given year (2019, 2024 & 2029). This can be seen above in Figure 13. The result shows that the most used container volume is 0-100 TEU and the container volume seems to be the same for the following decade.

Annual cargo volume concerning Russia

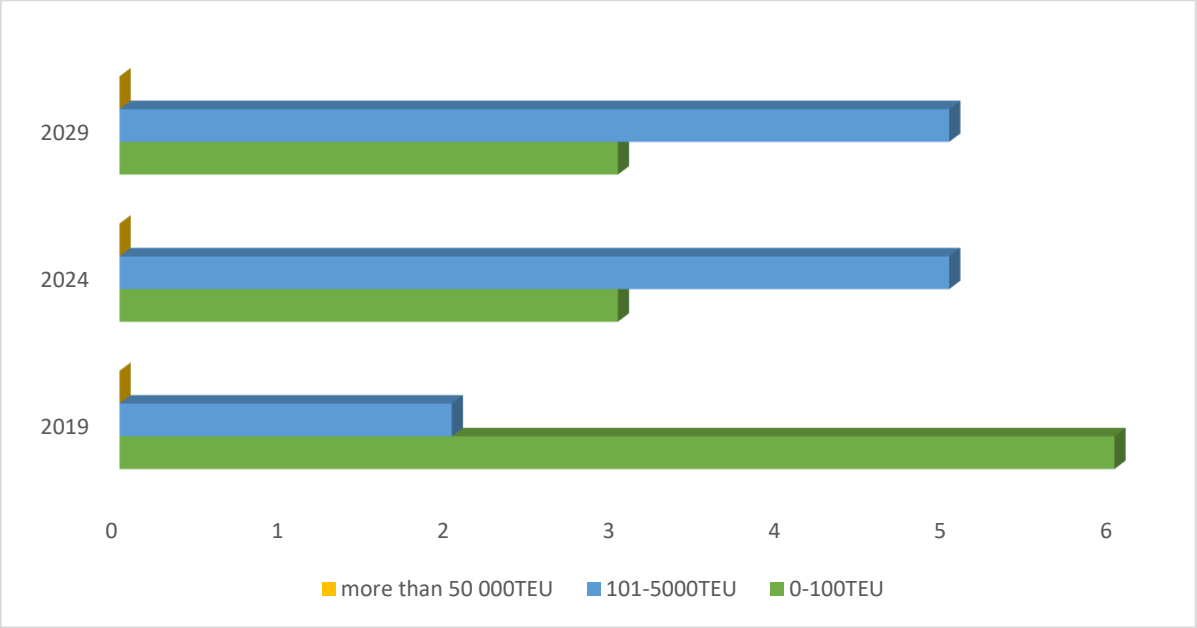

Figure 12. Annual cargo volume with Russia.

In context to Russia, when the respondent was asked to estimate the cargo volume, six of them replied that 0-100 TEU was their main container volume size for the year 2019 and three of them said the same size container will be used for the following year 2024 and 2029. Figure 12 shows that the container volume size will increase from 0-100 TEU to 101-5000 TEU for the year 2024 & and 2029. The result also shows that a large container volume which is more than 50 000 TEU will not be in use for at least the following decade.

Result concerning warehouse activities for RQ1

Concerning the number of warehouse workers, the respondents were asked to choose the labels from a 5-point Likert scale for the year 2019, 2024, and 2029. The result obtained from this is shown in the given Figure 13 below.

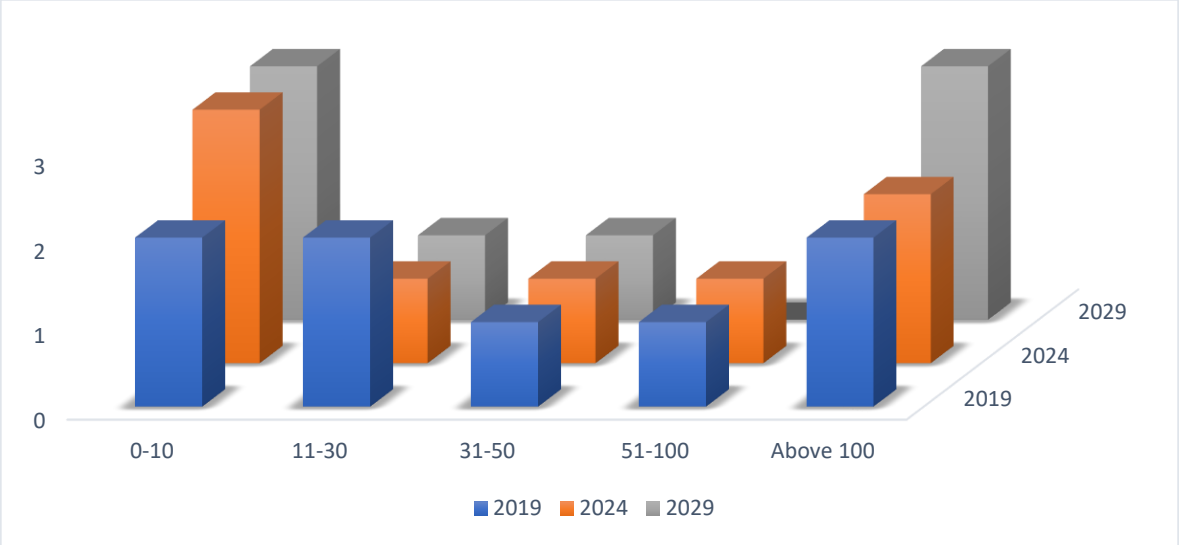

Figure 13. Warehouse workers estimation for the year 2019, 2024 & 2029.

According to the results from the survey 2020, it can be stated that most warehouses with a small number of employees are going to stay on the market. Figure 13 is the indication of that as it can be seen from the figure that most of the warehouses having the employees' number less than fifty is dense. But the results also show the possibilities of the future increase in the warehousing workers which can alter the size of the warehouse in context to the number of workers.

Result concerning inventory size for RQ1

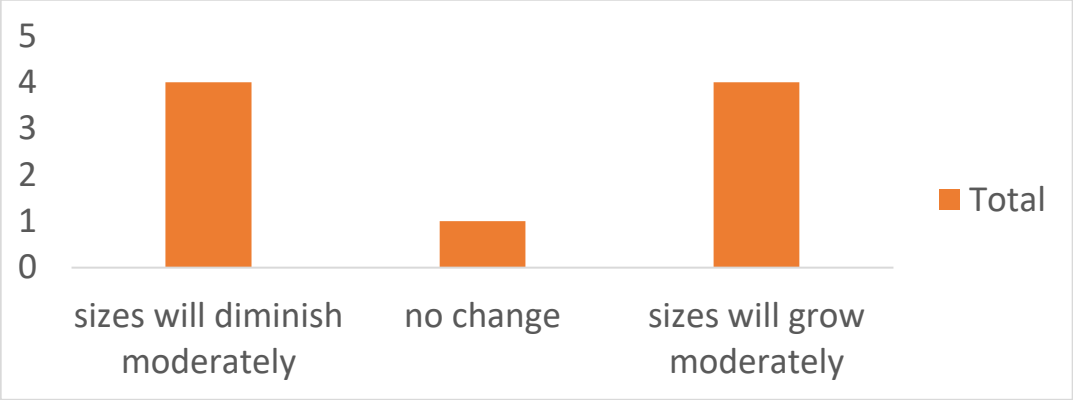

Figure 14. Split visions in the respondent on Inventory size in the coming five years.

Figure 14 shows the results from the survey relating to the inventory size. According to the survey, four respondents said that the size of the inventory holding will diminish in five years and four said that the size will grow moderately for holding the inventory, while one respondent said it will have no change in the coming five years. Thus, the result from the question which was meant to investigate the size of the inventory indicates that the inventory level (overall) will not have major changes in the long term.

Result concerning the use of transport mode for China and Russia for RQ1

When it comes to the use of transport modes for China, it can be seen in the response result obtained from the survey (Figure 15) that road and sea were the most used mode in 2019 and rail is the least used one. However, looking at the future (2024 and 2029), the railway mode gives a handsome impression of the rising trend more than all other modes. The usability of the other mode seems to be decreasing with the length of time in the future.

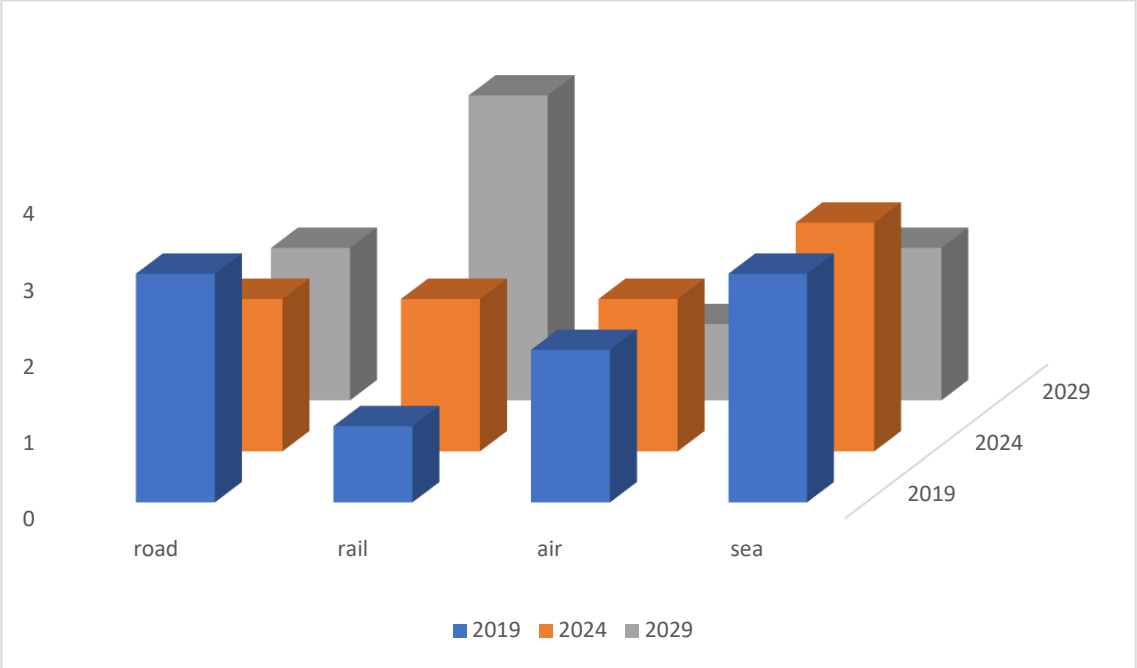

Figure 15. Answer for primary transport mode used for China (n = 9).

The results show that connecting to China is facing some variations in the future and the railway is getting more popular than any other mode. At the same time, other modes are losing significance in comparison to the railway, which shows potential growth over the period in the forthcoming future. The results also show potential growth towards sea mode in the forthcoming time. However, the railways show more potential growth in the same following time throughout the decade as can be seen from Figure 15.

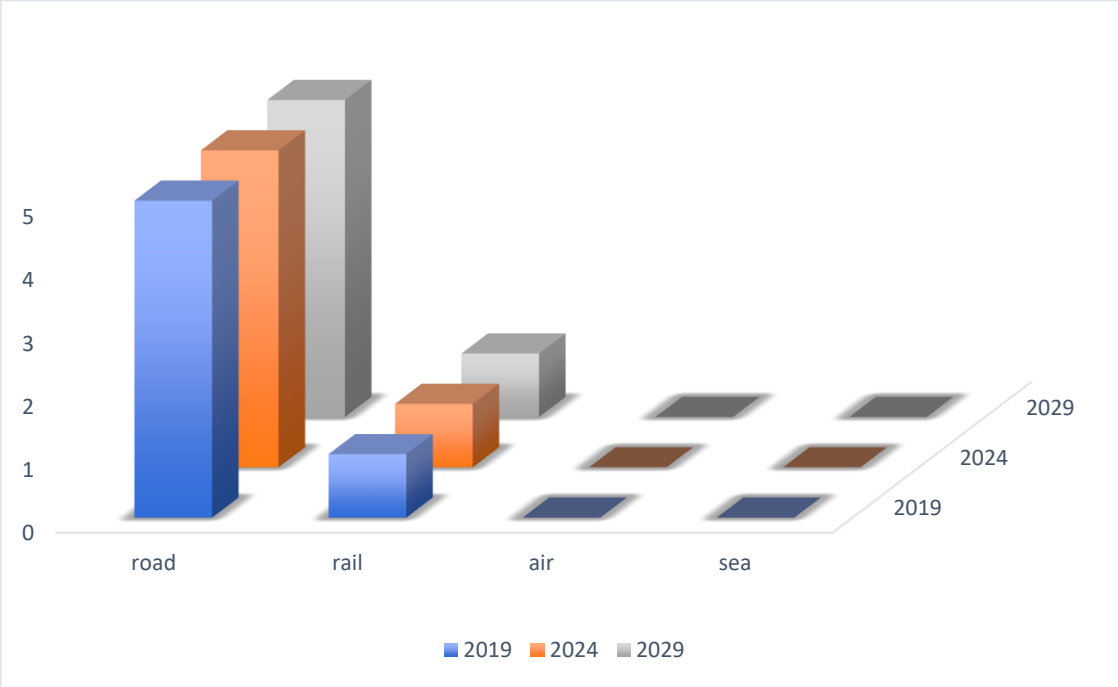

Figure 16. Answers for primary transport mode used for Russia.

When it comes to connecting with Russia, the road seems to be the most used mode of transportation throughout the decade (see Figure 16), but it is also important to note that the rail mode is also another preferable mode, but it seems steady and stays at the same level throughout the decade. Thus, the result demonstrates that roads will still be the most important mode for connecting to Russia and there are no major changes with the mode of transportation. All other modes of transportation (except road and rail) seem not to be favored.

Result concerning environmental regulations and its impact on logistics

When the respondents were asked to send their response on the effect of transportation cost due to the implementation of the 2020 sulfur directive on marine fuels (Figure 17, left), it was found from the survey that the sulfur directive implementation will have some effect on the transportation cost (Figure 17, left). The number of respondents who said it will have a minor effect was fifty-six percent, while thirty-six percent agreed it will moderately affect the cost and eleven percent of the respondent said it will have much impact on the cost of the transportation meaning that the 2020 sulfur directive implementation will make increment in the shipping cost.

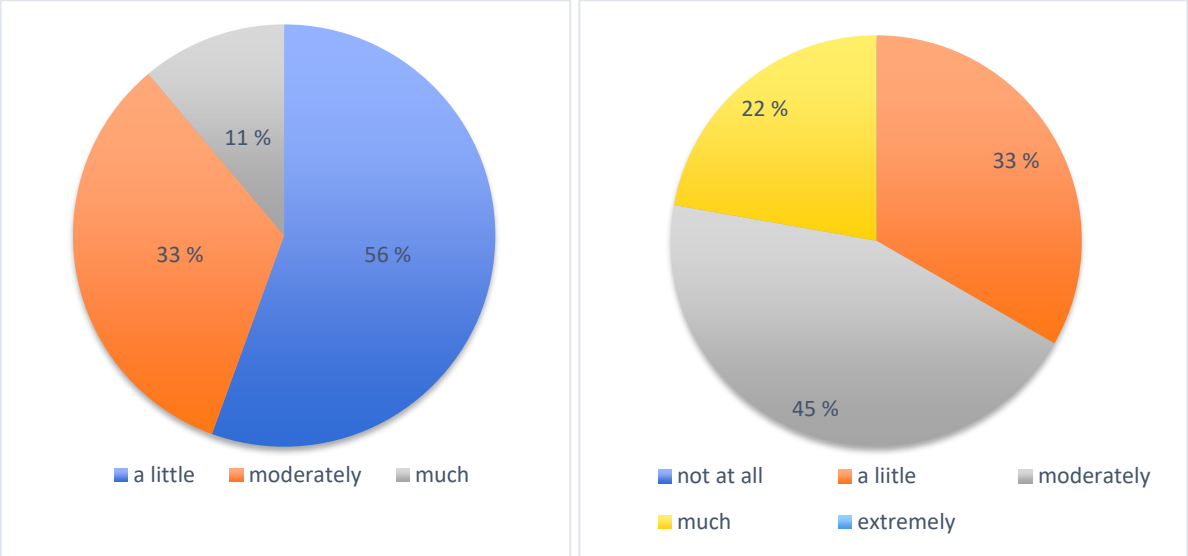

Figure 17. Respondents rate for effect of sulfur directive (left) and carbon emission limit (right) on transportation (n = 9).

Figure 17 (right) shows the answers received in percentage concerning the effect of the carbon emission limit on transportation cost. Likewise, the sulfur directive, the carbon emission limit also will have a major impact on the cost of freight transportation. It seems from the responses that the cost of the transportation will increase to some extent and 45 percent of the respondent agreed that it will affect moderately, while 33 percent of the people agreed that it will affect a little and 22 percent of the total respondents (n = 9) think that it will affect much. Thus, the survey results reveal that the implementation of environmental regulations like sulfur directive and carbon emission limits will bring changes in the cost of transportation and will increase the overall transportation cost.

4.1.2 Results from the survey concerning RQ2

In this section, the survey questions regarding COVID-19 impacts on logistics activities and supply chain operations have been analyzed and the result obtained from the survey for RQ2 (see Sub-Chapter 1.3) has been shown in detail with graphical representation.

Russian market and operation (logistics Activities after COVID-19 and Long-term supply chain dependencies with Russia after COVID-19)

According to the survey, the results in Figure 18 (left) shows that after the effect of COVID-19 the logistics activities in Russia will have some drop concerning the continuity since 34 percent of the respondents agreed that they are not willing to continue the logistics activities after COVID-19 situation, while 11 percent replied that they will be interested in continuing moderately. Moreover, 22 percent of the respondents agree that they will be likely to continue their activities while 33 percent think they will continue their logistics activities in Russia with extreme certainty even after the COVID-19. Overall, the Russian market will be smashed by the effect of COVID-19 and the logistics activities seem to decline after the pandemic ends.

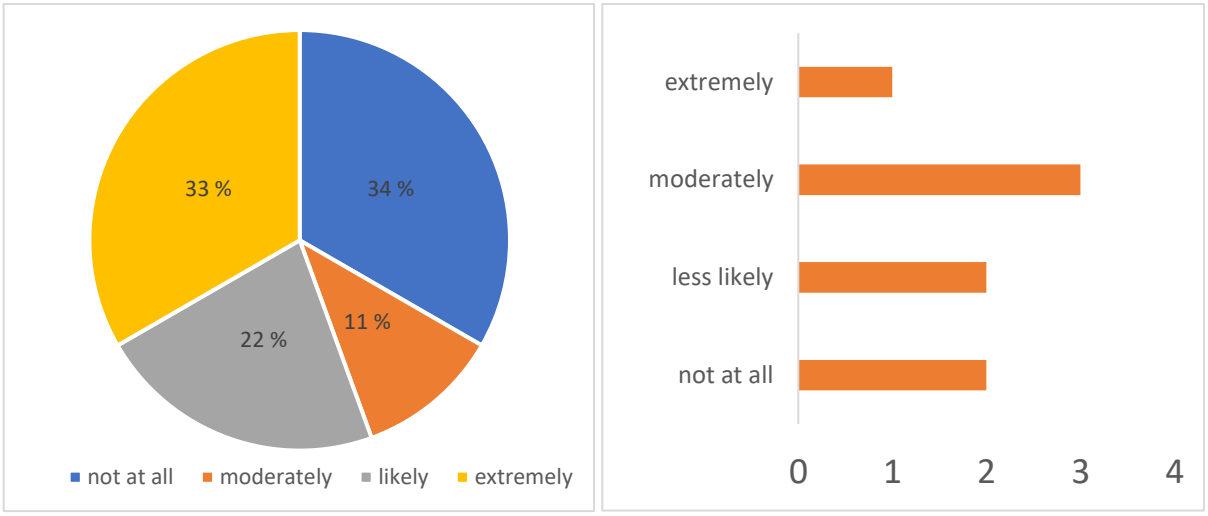

Figure 18. Answers for logistics activities in Russia after COVID-19 (left) and changes in supply chain dependencies to Russia due to COVID-19 (right), [n = 9].

On the other hand, noticeable changes also have been observed from the survey results (see Figure 18, right) concerning the supply chain operations and its dependencies on Russia after the COVID-19. Only a few respondents (n = 2) think that long term supply chain dependencies to Russia will not change otherwise most of the respondent somehow agrees that it will bring some change. Hence, it can be said from the result that the aftereffect of COVID-19 will hit foreign operations in the Russian market in the future.

Chinese market and operation (logistics activities after covid-19 and long-term supply chain dependencies with China after COVID-19)

The questions regarding logistics activities continuity in China after the COVID-19 and long-term supply chain dependencies on China was analyzed from the frequency of 9 in terms of total respondents' number. The visualized result is shown in Figure 19.

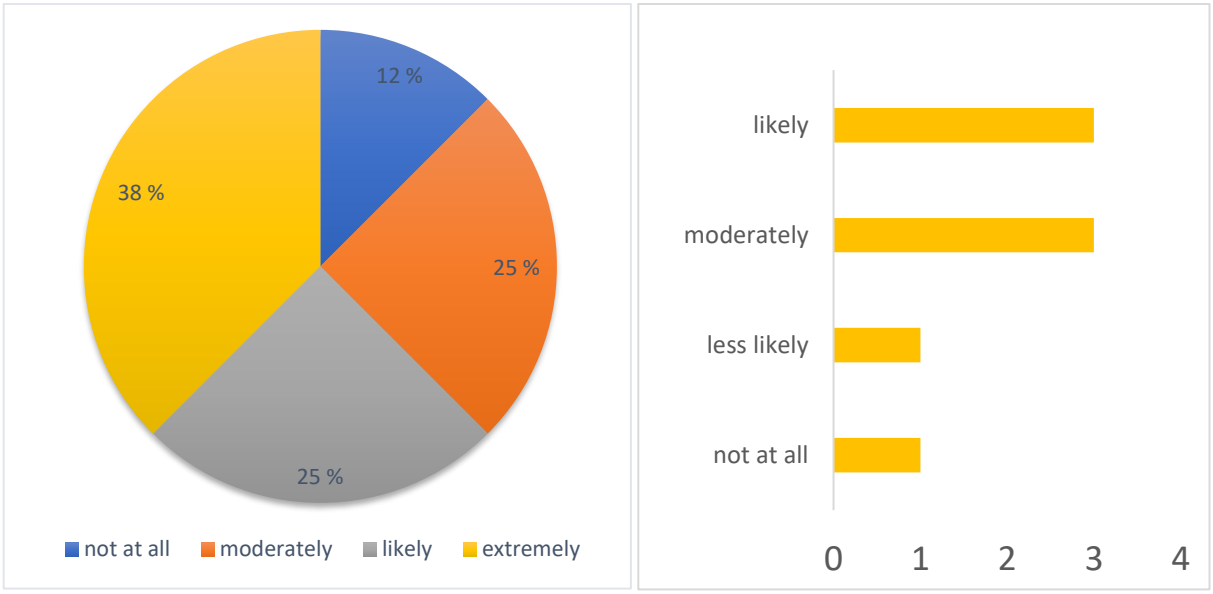

Figure 19. Answers for logistics activities in China after COVID-19 (left) and changes in supply chain dependencies to China due to COVID-19 (right), [n = 9].

Unlike, Russian market, the pandemic effect will have a small impact on the Chinese logistics activities, but concerning the long term supply chain dependencies, it is expected that the Chinese market will be affected and minor changes (see Figure 19, right) can arise regarding the dependencies to the Chinese market. On the other hand, the logistics activities will continue despite the hit from COVID-19 (see Figure 19, left). These results indicate the importance of the Chinese market to the companies even in the waves of COVID-19.

Transportation cost and meeting customer´s requirement during COVID-19

Figure 20 (left) is the analyzed result from the respondents concerning the effect on transportation cost after the COVID-19 pandemic. According to the result, it was found that there will be some changes in the cost of transportation due to COVID-19 and it is likely that the cost of transportation will increase due to the difficulties surfaced in the transport sector from the impact of COVID-19.

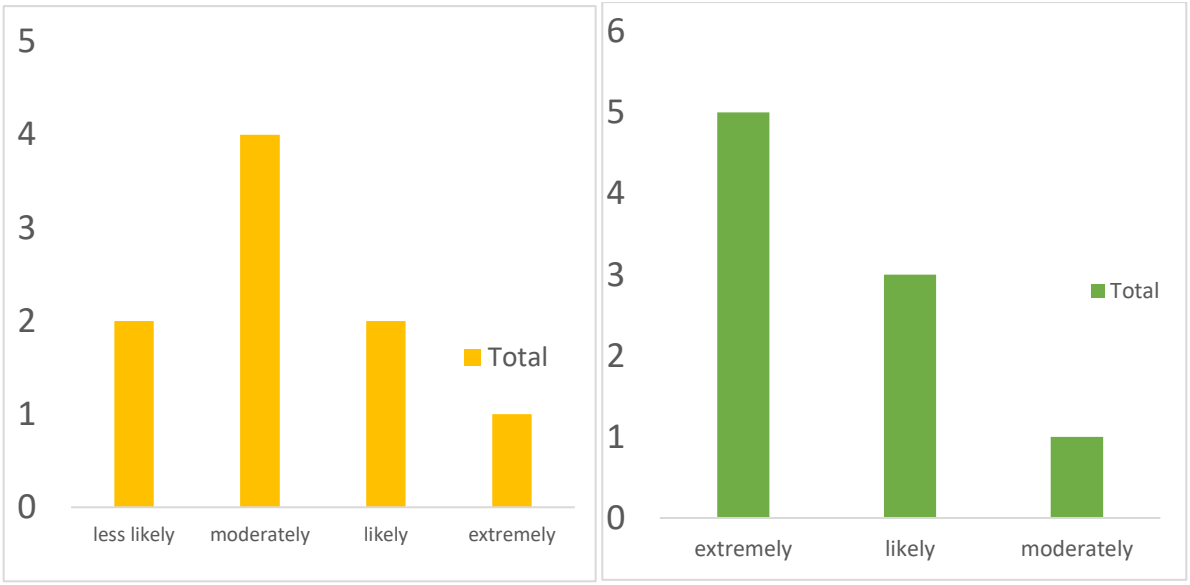

Figure 20. Answers for freight transportation cost (left) and meeting customer requirements (right) in the COVID-19 pandemic situation. (n = 9).

Figure 20 (right) is the respondent's response to the question of whether the companies will be able to meet the customer's requirement or not during the pandemic situation. The result was important to note that even during COVID-19 the respondent thinks that their companies can meet their customer´s requirement. None of the single respondents choose “less likely” or “not at all” (see Figure 20 right). This shows that the influence of the COVID-19 pandemic does not affect their service to the customers.

4.1.3 Result from the survey concerning RQ3

The section analyzes the questions that were asked for investigating the RQ3 (see Sub-Chapter 1.3), which mainly concerns to investigate the interest of using the modern-cutting technologies by the companies. The results obtained for the RQ3 have been shown in this section in a detail.

Impact of modern technology in logistics activities

To investigate the interest in using modern cutting-edge technologies like

blockchain in the logistics activities, three respondents said that their companies are not interested at all, three showed a little interest and two replied moderately interested, while one respondent said their company is extremely interested in using the blockchain technology for logistics activities (Figure 21).

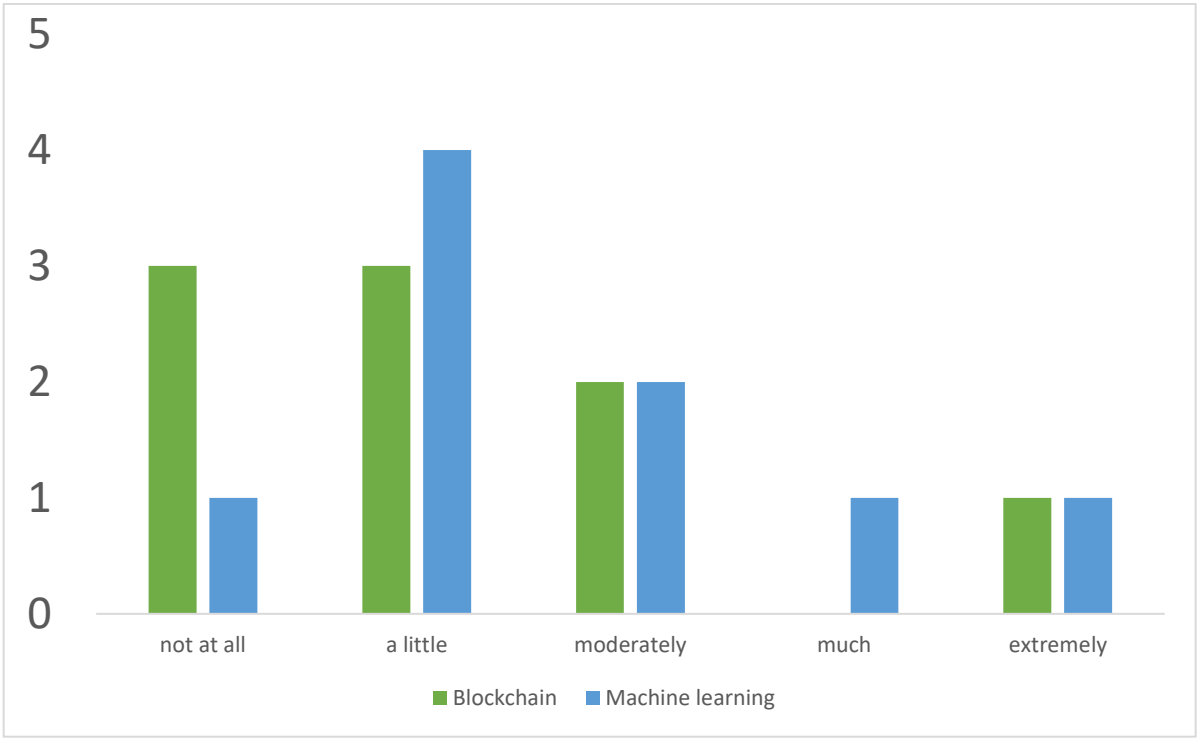

Figure 21. Answers from the survey regarding the interest of the companies in using modern technology blockchain and machine learning (n = 9).

In context to the interest in using machine learning for logistics activities (Figure 21), four respondents said that their company has a little interest in machine learning. as two of them said that, they are moderately interested. However, one said they are much interested, as also did one for a highly or extremely interested class. The result (Figure 21) displays that, companies have some sort of interest in both new technologies to be used for their companies.

Electric Vehicles for future logistics activities

Regarding the interest of using electric vehicles for future logistics activities out of 9 respondents' three people replied that their companies are not interested at all in using the electric vehicle for their future logistics activities as three said that they are moderately interested in using. Two respondents answered that they are much interested, and one respondent showed extreme interest in using an electric vehicle in the future.

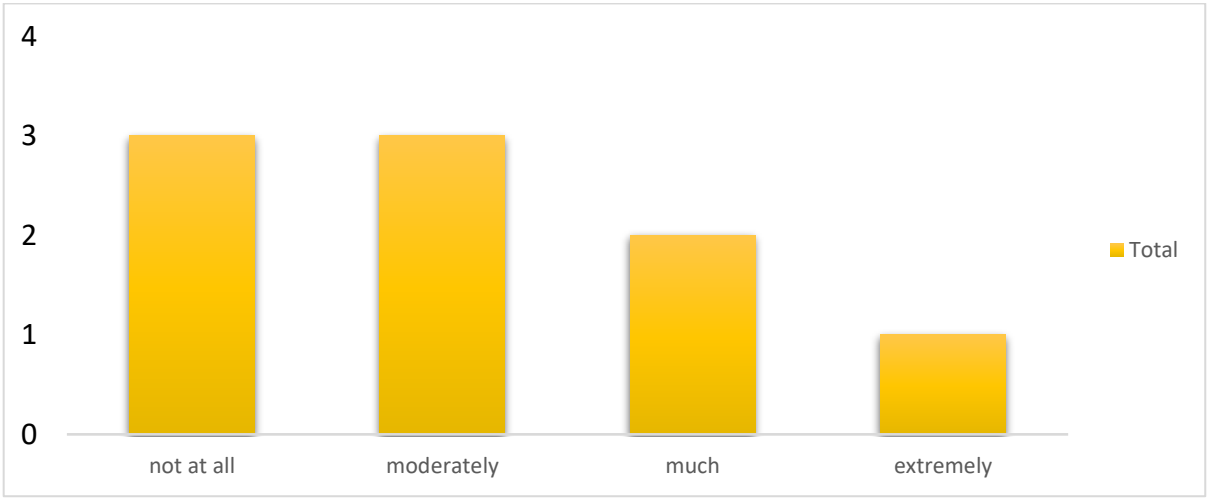

Figure 22. Respondent´s answers regarding interest in electric vehicles by their companies in the future (n = 9).

The result (Figure 22) from the survey demonstrates that companies are showing their interest to welcome electric vehicles for future logistics activities although some are denying it to use so early and still prefer a gasoline engine for freight transport.

4.1.4 Results from analysis of open-end question from first survey

On analyzing the open-end question´s response (total response = 4), it was that companies do not hold their component inventories for future consumption since their business is mainly based on the project and each year is different for them. Most important thing is to deliver products based on the earlier deadlines then only other things matter and can be brought into consideration. The freight level seems to remain conservative and new solutions and routings are implemented with their own bunnies' network. The new sulfur regulation in 2020 by IMO has a huge impact and container transportation prices will increase in the forthcoming months. It was found that the new trend of technology like blockchain could ease and improve a lot of admirative processes and documents needed in the supply chain.

4.2 Empirical data analysis and survey result from regional companies of Finland (South Karelia and Kymenlaakso Region)

The encounter of the pandemic at the beginning of 2020 was one of the key things to investigate and figure out how the pandemic in 2020 (COVID-19) impacts in the logistics activities of the companies. The data from the first survey to analyze this was not consequently sufficient thus the second survey must be conducted to get more responses concerning the COVID-19 impact on the logistics activities and operations as there was not much data available even in the literature search for the impact of COVID-19 in logistics and supply chain. The survey from the local companies was crucial for answering the RQ2 (see Sub-Chapter 1.2) with a more detailed investigation. Also, there were few questions included in the regional survey to investigate RQ1 in detail which has been presented as a result (see section 4.2.2). In this Sub-Chapter, the response from the local survey has been analyzed and presented because of the help of figures.

The response rate from the local survey was surprisingly greater in number as compared to the response rate from the first survey. Out of 575 contacted companies 53 responses were received which was about 9 percent of the overall rate and a good amount of data for finding the results. In the second survey, it was seen that almost both regions answered in identical amounts. However, if the relative terms are taken into the consideration, South Karelia region's response rate was about 50.94 % which was a bit better than the Kymenlaakso region whose response

rate was 49.05 %. It was estimated from the interpretation that the achievement of higher response rate from these regions could be mainly due to the interest factor on the pandemic as the research in these regions was only focused from the perspective of RQ2 (see Sub-Chapter 1.3) and was relatively fewer questions comparing to the first survey.

4.2.1 Result of the survey from local companies regarding RQ2

This section analyzes the results of the survey from local companies which is mainly concerned with the impact of coronavirus on logistics activities and operations. This section will present results in a detail and will mainly be focused on the perspective of RQ2 (see Sub-Chapter 1.3)

Changes in freight transportation cost after COVID-19

Regarding the changes in the freight transportation cost of the companies after the COVID-19 pandemic, it was asked to the respondents that, whether the freight transportation cost increases for their companies or not after the pandemic effect. It seems from the result (Figure 23) that, it will not have much effect, but a minor increase in the freight transportation cost can come into play after the COVID-19 pandemic.

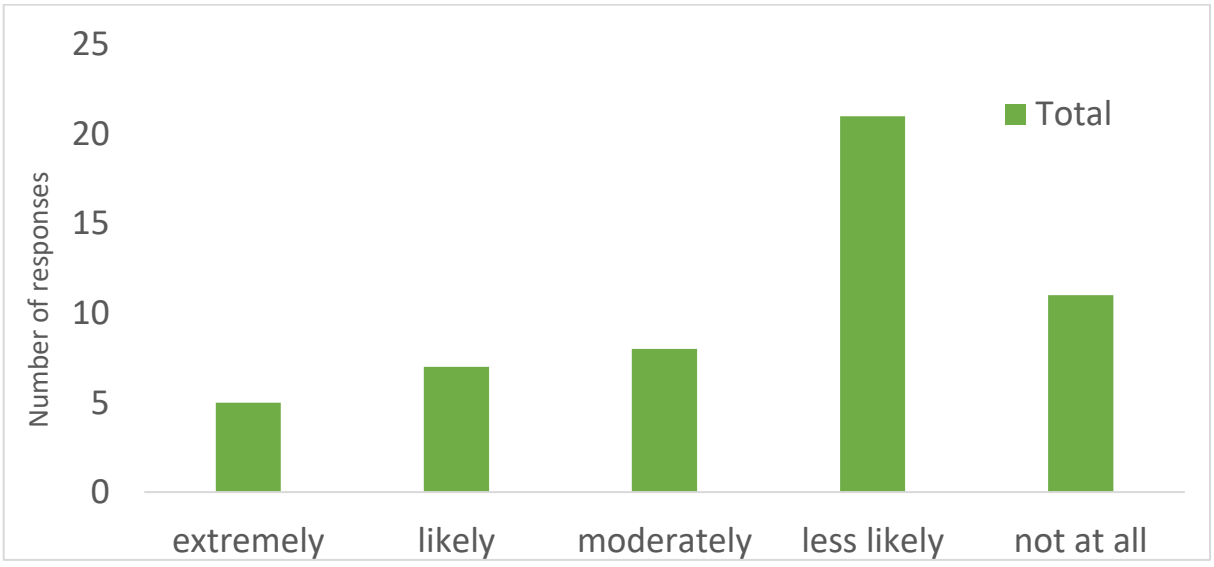

Figure 23. Responses of the survey 2020 from regional companies for changes in the freight transportation cost after COVID-19 (n=53).

Furthermore, the respondents result in Figure 23 shows that there is likely a slight possibility of increment in freight transportation cost as only very few companies think that the cost is going to increase extremely, likely, and moderately. However, these frequencies are less compared to the companies who think that there is very little or not at all impact of COVID-19 in their freight transportation cost.

Further analysis of freight transportation cost based on revenue size of the companies (both survey data included)

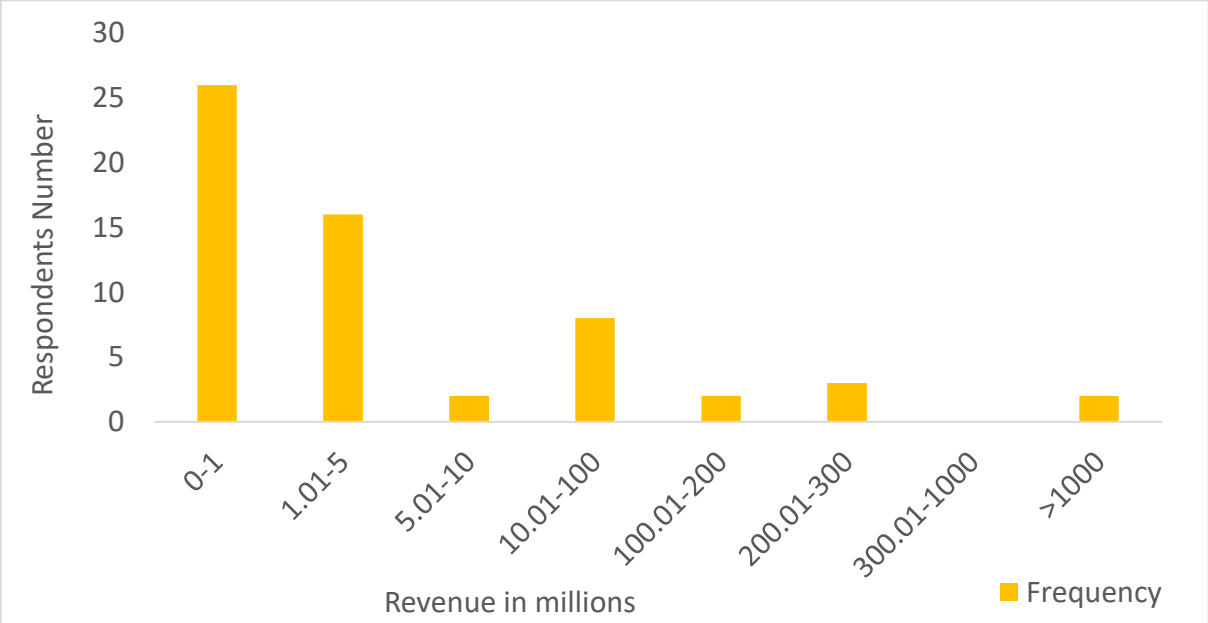

Figure 24. Responses of the companies from survey 1 and 2 based on revenue.

Similarly, based on the revenue generated by the companies and accounting both surveys together and further processing the data for analyzing it additionally, it was found that most of the companies responding “extremely” were small or medium-sized companies with a revenue of fewer than 20 Million Euros. It seems the larger sized companies do not have much impact on their freight transportation cost due to the COVID-19. However, some minor changes in transportation are likely expected overall. Figure 24 illustrates this with the help of a bar-chart.

Meeting customer´s requirement during COVID-19

Figure 25 shows the respondent´s response to the question asked to them regarding whether their companies were able to meet the customer's requirement or not during the COVID-19 pandemic. After analyzing the result of meeting customer´s requirement during the COVID-19 pandemic situation, the result was interesting from the respondent companies as most of the companies were extremely able to meet their customer's requirement whereas only a few companies were less likely or not able to meet the customer's requirement during the pandemic situation of COVID-19.

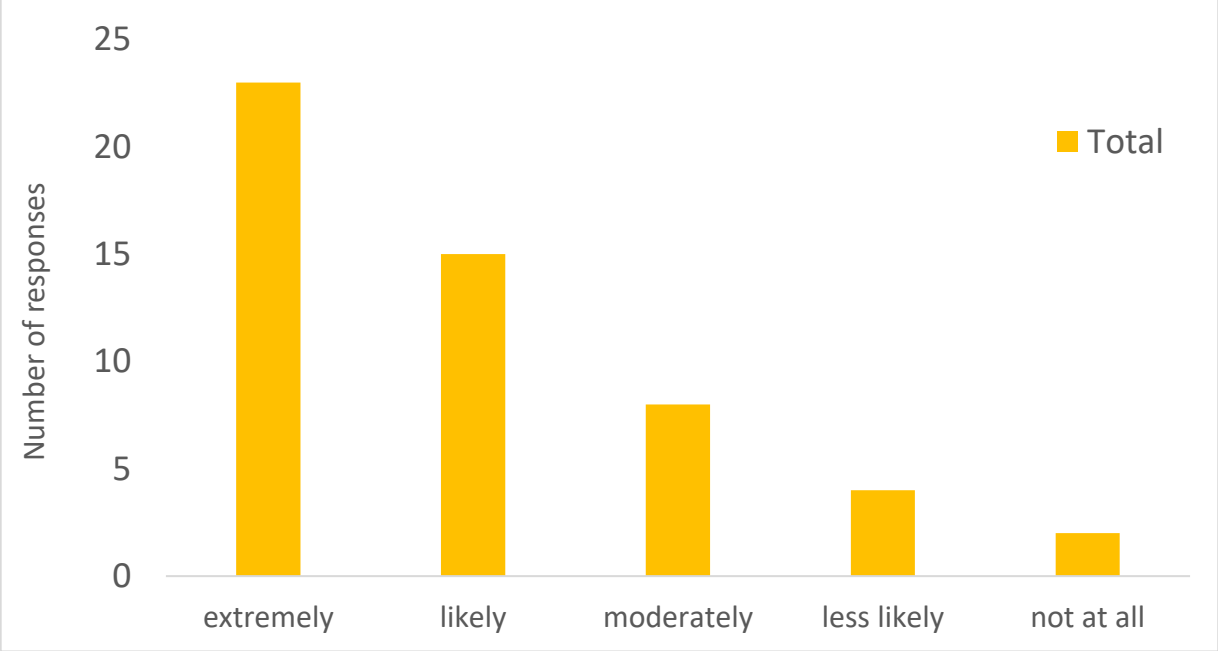

Figure 25. Responses of the survey for meeting customer´s requirements during COVID-19 (n=53).

In a nutshell, it can be said that it was not difficult for the companies to meet the customer's requirement even in the pandemic situation of COVID-19.

Further analysis of the companies based on revenue size concerning meeting the customer requirements (data included from survey 1 and 2)

Also, on further analyzing these data based on revenue magnitude, it can be said that the company, which was not able to meet the customer requirements at all or less likely being able to meet the customer requirements were mainly small size companies having a revenue less than 10 million EUR. The illustration of the respondent's companies based on the revenue magnitude is shown below in Figure 26.

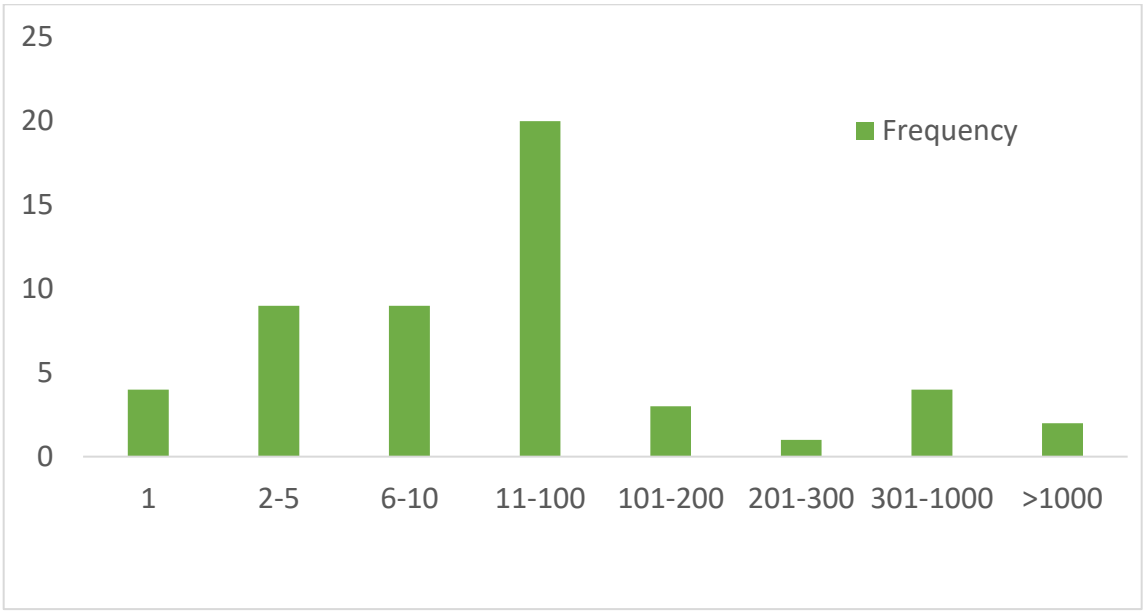

Figure 26. Respondent´s response was based on the revenue size of their companies regarding meeting customer requirements (included both surveys 1 and 2).

Russian market and operation (logistics activities after COVID-19 and long-term supply chain dependencies with Russia after COVID-19)

The responses from the survey regarding the logistics activities in Russia after COVID-19 (Figure 27, left) shows that the continuity of the logistics activities with Russia can change amid COVID-19 since ten respondents answered that they are not likely to continue the logistics activities after COVID-19. On the other hand, thirteen respondents said they are extremely convinced to continue after the COVID-19 and there is no impact for them in their logistics

activities by the pandemic (COVID-19), while nine respondents were also sure and likely to continue their logistics activities with Russia. Only five respondents moderately agreed to continue, which is a kind of fifty-fifty chance, while four respondents replied less likely to continue, which means they intended to minimize the logistics activities with Russia. Furthermore, seven respondents out of 48 did not want to answer the question regarding the continuity of the logistics activities in Russia after the COVID-19 pandemic effect.

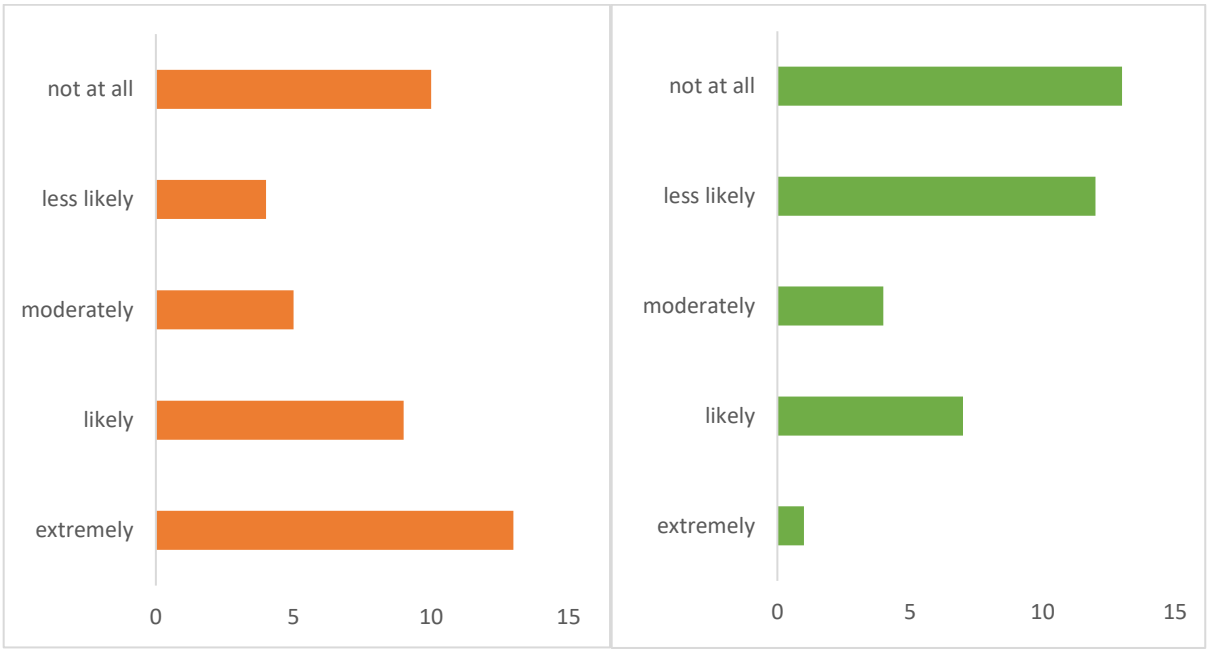

Figure 27. Answers for logistics activities (left, n = 48) and long-term supply chain (right, n = 48) dependencies with Russia after COVID-19.

The result forms the survey regarding the long term supply chain dependencies in Figure 27 (right) says that thirteen out of 48 responses thinks that there will be no impact at all, while twelve thinks that it is less likely that it will have any effect on long term supply chain dependencies to Russia. This means more people believe that the changes in the long-term dependencies with Russia for the supply chain will not affect after the COVID-19 or it will have a minimum impact on their dependencies. There was also some respondent, who thinks that it will have an impact someway to the long-term supply chain dependencies meaning that companies might have to seek other suppliers or manufacturers to depend on for the supply

chain dependencies in the future after the COVID-19 pandemic effect. Moreover, eleven respondents did not answer the question regarding the long-term supply chain dependencies with Russia as it can be expected that these companies do not have any operations in the Russian market.

The outcome of the result was that after the COVID-19 pandemic affects the logistics activities with Russia will variate to some extent meaning that the COVID-19 will hit the Russian market. On the other hand, there will not be a considerable difference in the long-term supply chain dependencies to Russia, only the least possible change will be noticed after the COVID-19 pandemic effect.

Chinese market and operation (logistics activities after COVID-19 and long-term supply chain dependencies with China after COVID-19)

In context to China the response regarding the logistics activities after the COVID-19 is quite curious as twenty respondents (Figure 28, left) which is unexpectedly double to that of Russia (see Figure 27, left) responded that logistics activities will not continue at all, while two of total respondents (n = 46) said it is less likely to continue. Two answers were received convincing that the activities could operate moderately, while eight thinks that is likely to continue and three are extremely sure to continue their logistics activities with China after the COVID-19 pandemic effect (Figure 28, left). Thirty-five out of 46 respondents preferred to choose from the given label, while eleven preferred not to answer the question.

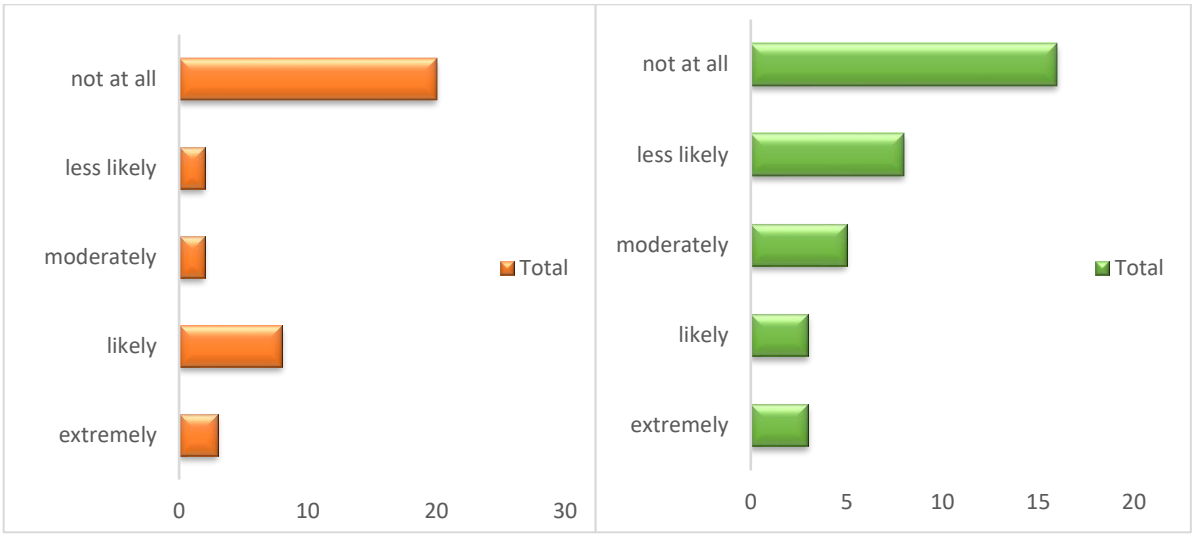

Figure 28. Answers for the logistics activities (Left, n = 46) and long-term supply chain (right, n = 46) dependencies on China.

Figure 28 (right) shows the results obtained for the question that was asked concerning any changes in long term supply chain dependencies with China due to the COVID-19. It can be seen from the result (Figure 28, right) that sixteen respondents replied that the long-term supply chain dependencies will not change at all, while eight thinks it is less likely to change the dependencies to China. Five of the total respondents think the changes will be moderate, while three think it is likely to change and three thinks with extreme certainty that it will change the consequences concerning the dependencies of the long-term supply chain to China. It is important to note that eleven respondents choose not to answer the question asked.

In a nutshell, the results suggest that the impact of COVID-19 will not change the significance of the logistics activities in China, while the supply chain on the other hand will also not face any big fluctuations except minimal alterations.

4.2.2 Result of the survey from local companies regarding RQ1

This section explores the results concerning research question 1 (RQ1), which mainly focuses on the inventory situations, prior mode of freight transportation in the context to China, and Russia.

Size of the inventory in the coming five years

Concerning the size of the inventory in the coming five years, twenty-three respondents think there will be no change in the size, while eleven answers were received who estimates that size will grow moderately and three thinks it will grow significantly (Figure 29). Eight respondents answered that size will diminish moderately, and one respondent said significantly (Figure 29).

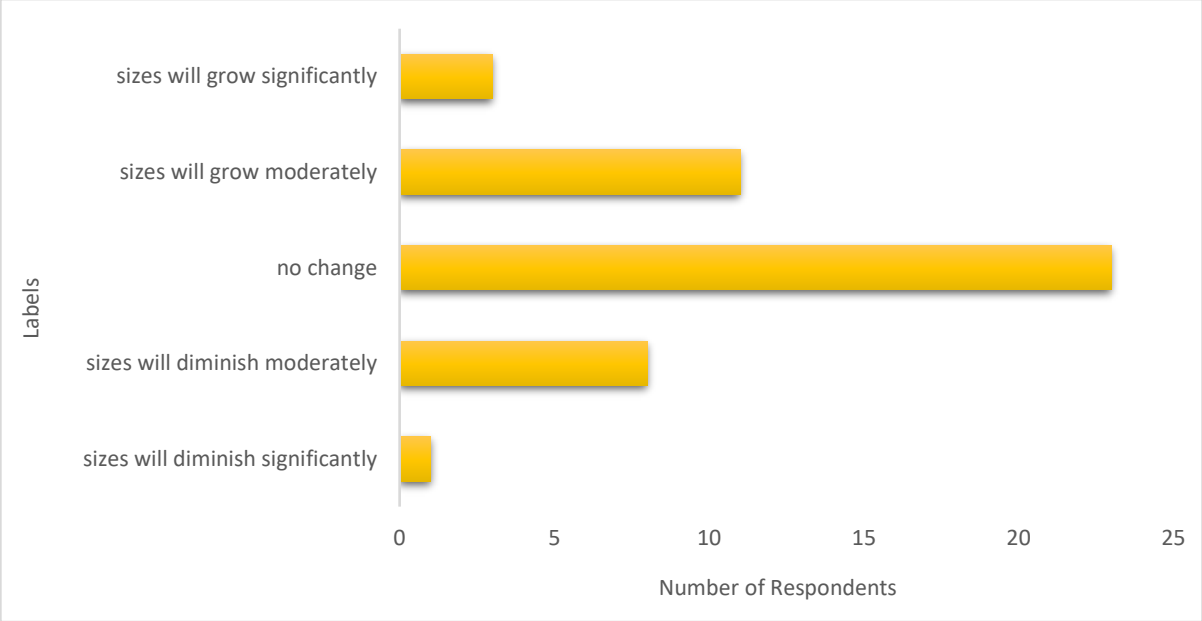

Figure 29. Survey answers for inventory size in the coming five years (n = 53).

The result in Figure 29 shows the inventory size in the coming five years seems to have no change in a general, but some respondents see that it could change over the period in five years. So, the situation includes a variation relating to the size of the inventory in the coming five years.

Primary mode of transportation for the year 2019, 2024 & 2029 with China and Russia

When it comes to the mode selection for the freight transportation, according to the results from the survey, in the case of Russia (n = 48) road is the most used mode of the transport for the logistics activities in 2019 and will for the forthcoming year 2024 and 2029 (Figure 30, left), while rail mode seems to be in increasing phase in the coming years connecting to Russia in a coming decade. Also, it is important to note that there is a slight possibility that companies may also prefer the sea mode for freight transportation to Russia in the future whereas the air mode is not a genuine option for the companies when it comes to freight transportation concerning with Russia (see Figure 30, left).

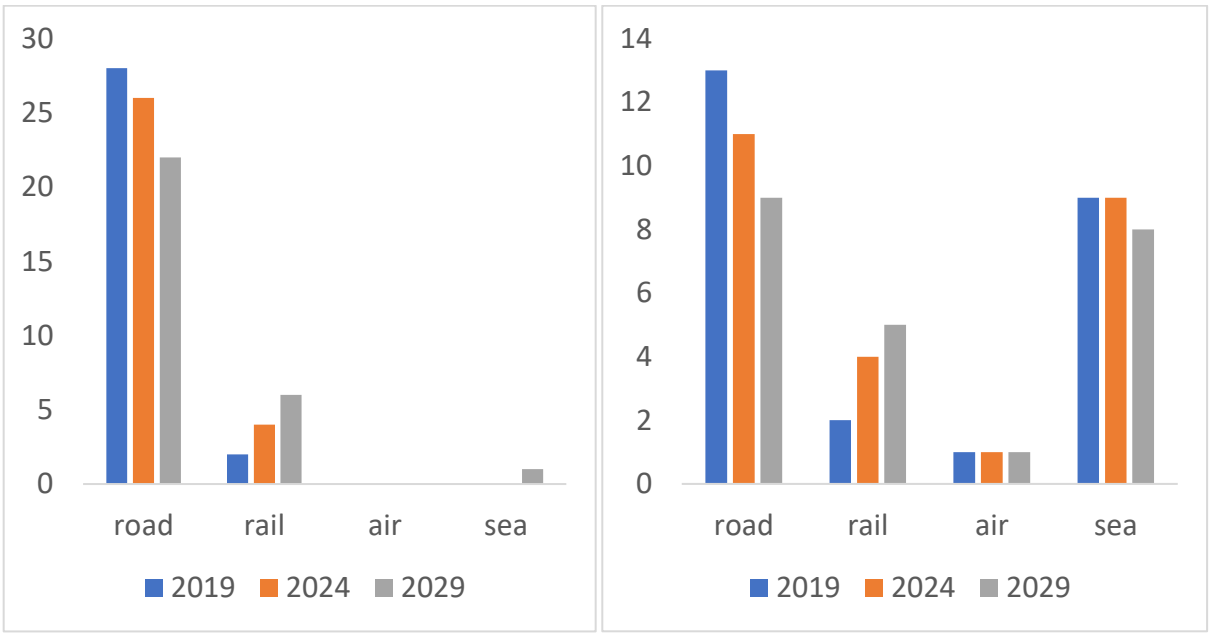

Figure 30. The primary mode of transportation for the year 2019, 2024 & 2029 for the logistics activities with Russia (left, n=48) and China (right, n=46).

In the case of China (n = 46), the results (see Figure 30, right) from the respondents show that all the modes of transportation are in use and will be according to the need. Although all modes are seen active in Figure 30 (right), road and sea modes are widely used modes of transportation in which road is the dominant mode as the primary mode of transportation to China for 2019. It is also important to note that the popularity of the road mode seems to decrease (see Figure 30,

right) when it comes to moving into the future from 2019 to 2029. It might be because of the increasing trend of rail mode from 2019 to 2029, which can be seen in Figure 30 (right) as the rail mode is getting popular in the future. The aerial mode looks to be less preferable and seems to be steady over the decade being a less popular mode for freight transportation to China. The sea mode is also showing a slight variation in the future and is a decline in terms of usability for the freight transportation purpose.

To sum up the result it can be said that, when it comes to connecting with Russia mostly road mode is leading, but the railway is also rising and getting a slight recognition. On the other hand, when it comes to connectivity with China, some variations can be noticed based on the survey results (Figure 30, right). Moreover, railway mode is getting more popularity in connecting to China and is in increasing trend throughout the decade with growing potentiality whereas road and sea modes seem to lose their preferences in the future.

4.2.3 Result from analysis of open-end question from the second survey

After analyzing the data (see Figure 31) from the second survey for the open-end question it was found that the impact of the COVID-19 on the logistics activities for the regional companies was not so high. As most of the companies (around 31%) did not have any effect of it on their logistics activities while about 35 percent of the companies replied that they have a minor or small effect. This shows that companies have no or very less impact of COVID-19 as they were able to manage the logistics activities efficiently even during COVID-19. However, some respondents (about 4%) think that everything cannot be said just after the first wave and they have wait to see the real impact until the second wave if it comes otherwise activities were not much affected by the wave of COVID-19.

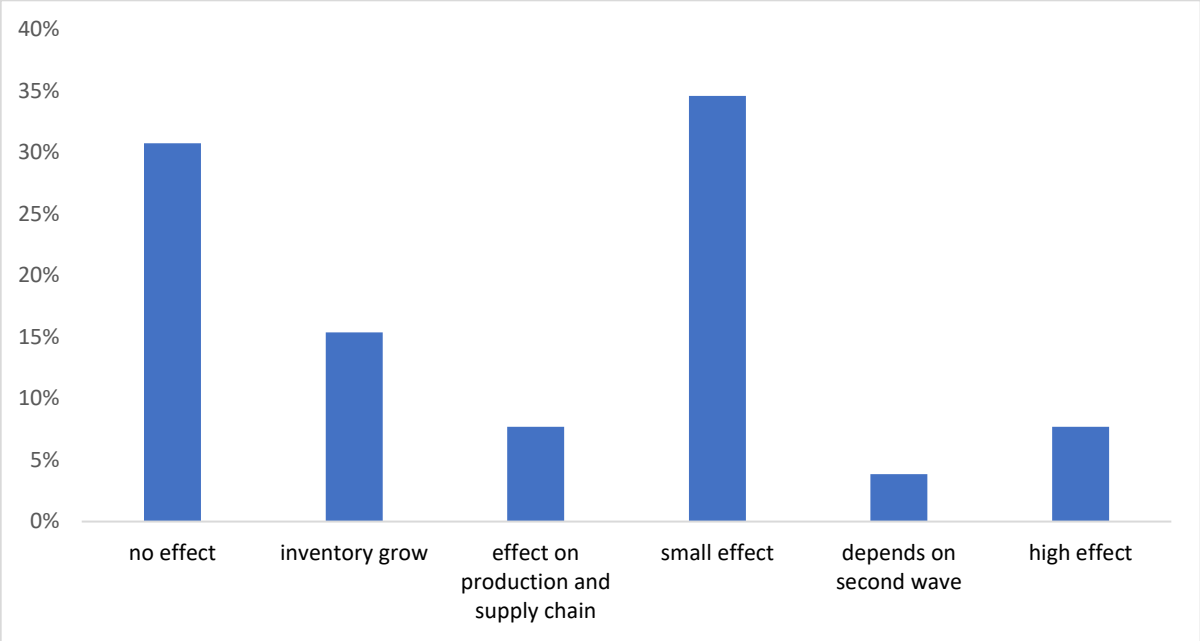

Figure 31. The survey response rate for an open-end question from the second survey (n=26)

Figure 31 also shows that the first wave of COVID-19 has a high impact on some companies (about 8% of the total respondents). The analysis also indicated that the buffer inventories for longer lead-time components will be increased as 15% of the respondents thinks that their inventories will increase due to the COVID-19 pandemic effect. Also, from Figure 31 the impact of COVID-19 is on the production and supply chain side as about 8% of respondents think their supply chain has been interrupted and the production line for them has been declined. The analysis also showed that the market is less active amid COVID-19 and more impact depends on the second wave if it happens other than that everything will be as same as before in the coming year 2021 as the respondents' analysis indicated this.

5 DISCUSSION

The response rate for the second survey was found much higher than what was found from the first survey. A more specific email was used to send the second survey so that the survey can reach directly to the authorities concerned to the department of logistics and supply chain of the companies. Moreover, companies from these regions were small startups and medium-sized in comparison to the companies from the first survey. Earlier research has found that e.g. startups are easy to reach and highly motivated concerning the research and development to stay competitive (Scheer, 2001). Therefore, the reason behind receiving a higher response rate from the second survey than the first survey could mainly due to the factors like use of more specific email addresses directed to the related authorities, short numbers of questions with more closed-end questions, a sample containing more small-sized startups, and the survey was mainly focused to the current issues like COVID-19. Hence, these factors would help to get more responses.

Concerning the transport mode, both surveys (first and second) suggests that the rail mode will gain popularity in the future than any other modes of transportation (see Figure 15, Figure 16, and Figure 30). This is very important to note that, the popularity of the rail modes for trading in the eastern markets indicated the tendency of growing businesses as the rail mode would be easier and faster in comparison to ships whereas would be cheaper than that of air mode. The calculations of Schramm & Zhang (2018) also show that the Eurasian rail freight is about 80 % cheaper than the use of airways for freight transportation and convenient over the conventional sea freight in context to the transit time. Though rail mode seems to take a longer time than road means in a shorter distance of transportation, it is important to note that trains can carry larger container loads comparatively at cheaper transport costs than that of trucks and other transport mediums through road mode.

The railways are suitable for long distances such as China and are also superior as compared to that of a truck in terms of speed, the capacity of carriage, and cost. Also, rails are very efficient when there is a too-long transit time for ships. However, it depends on the demand of the companies and their preferences. But the future scope of the rail mode cannot be denied and is

reliable to take into consideration. Despite the results from each survey shows, rail mode tends to get popular in the future, the semitrailer from road mode is still the preferable medium and means of transport for the North European companies as a result of the first survey suggests. Besides, Water (2009) suggests that rail terminals have facilities to link with road transports and another intermodal possibility is rail delivering to sea transports at major ports. Therefore, the vitality of the rail mode cannot be suppressed over any other mode as it seems to grow in the coming decade with more smooth growth than any other mode.

It can also be noted from the results of the Holopainen (2015) from the literature, that these semitrailers are the most used medium when it comes to the freight transportation from North European companies regarding the eastern markets. Results from the works of Hilmola (2019) also supported the fact that semitrailers are the most preferable and used transport unit for logistics activities from Northern Europe. However, it was found from the result that the most preferable transport unit for Northern European companies is a container in the case of China on the other hand it can be semitrailer or container in the case of Russia.

The findings from this research concerning the size of inventory from the first survey were crucial to answer a part of RQ1 (see Sub-Chapter 1.3), where inventory situation was also included with other logistics factors. The finding from the first survey tells that the size of the inventory in the North European companies will not going to change sooner in the future. However, the finding from the second survey indicates that a noticeable change in the size can be seen in the coming five years meaning that the size of the inventory may increase. Furthermore, analysis of free comments from the second survey resulted that, the size of the inventory will grow, and buffer inventories for longer Leadtime components will be increased. Some respondents in the free comments also indicated that COVID-19 did not have much effect as their business was mainly in the Baltic States or Finland. So only slight changes in their inventory management. This finding indicates that there will be some changes in the size of the inventories in the coming years (see Figure 29). Hilmola (2020) in his research showed how pivotal inventory management is from the perspective of economic development and value creation for the stakeholders. Therefore, holding inventories becomes utterly important for the companies, which could be the reason that the finding of the surveys indicates the stabilize in

the size of the inventory in the coming five years. In nutshell, the results suggest that the first wave of the COVID-19 has affected the market and resulted in less active markets. Regarding the warehousing activities, it seems that companies with smaller warehouses or warehouses with a lesser number of employees are going to stay in the markets. The results from those multinational companies indicate at least for a decade the warehousing activities are steady and primarily bounded by the smaller sizes.

Sustainability is one of the major concerns of which social equity, economic viability, and environmental protection are the three pillars of it on which its base stands (Campos et al., 2015). Businesses cannot be sustainable until they can harmonize all three indicators of it. Most importantly, the environmental aspects must be addressed for achieving other factors of suitability. The government, the authentic organizations, people, and all related stakeholders must come together to maintain harmony in those factors and keep the continuum of sustainability (UNO, 2020). Thus, environmental regulations strategies become important for limiting the carbon emissions and sulfur emissions especially coming from the transport sectors as the carbon emissions from the transport acquire 28.2 percent of total carbon dioxide emissions (EPA, 2020). However, Findings from Lähdeaho & Hilmola (2020), suggests that companies are not ready to welcome environmental regulations required in their logistics activities.

The result from the survey suggested that the newly implemented sulfur regulation from IMO going to affect transport costs to some extent meaning that it tends to increase some shipping cost for freight transportation of logistics activities. Also, the results from this thesis suggest that the implementation of the sulfur regulations at the beginning of January 2020 on marine transports is likely to increase the cost of the shipping (see Figure 19) and the company feels unhappy about it. Mostly the companies from Finland replied that these implementations upset them because of resulting in the higher transportation cost during the logistics activities. The result of free comments analysis from the first survey (see Result section 4.1.4) shows that the sulfur regulation implementation from IMO has a huge impact on the company which indicates the environmental regulations increase the higher transport cost increasing the container´s cost and overall transportation during the logistics activities. These findings are similar to the finding of Hilmola (2019) as he indicated in his results that the strict environmental legislation will

increase the freight transportation cost, which will have more impact on Finnish companies as they are well hurt by the strict legislation on the sulfur emission.

Found in the literature, Li et al. (2015) suggested that the carbon caps will increase the overall cost of the companies of which freight transportation costs play a vital role in it. On the other hand, the results from the first survey (see Figure 17) also shows that the implementation of limiting carbon dioxide emission on transportation modes will increase the cost of freight transportation. Overall, it can be said that the implementation of these environmental acts in the future will also keep hurting the companies as their cost of freight transportation also increases with that. So mostly companies from Northern Europe are unhappy with this as it seems they are unprepared for the changes in the regulations of the environment. However, these steps are highly significant from the standpoint of sustainability. These strict regulations are effective and environmentally advantageous and even more effective in the long term. (Korhonen et al., 2018 and the International Maritime Organization. 2020). Research question one (RQ1, see Sub-Chapter 1.3) was mainly concerned with the investigation of four aspects (transport mode, warehousing activities, inventory management, and environmental regulations) in the logistics activities in North European companies. All the above interpretations explain the answers regarding the RQ1 (see Sub-Chapter 1.3).

WHO (2020), declared COVID-19 as one of the worst pandemic occurred in many years, which does not have any cure till now (2020) hence, it was very crucial to study such pandemic´s effect in logistics activities and operation in North European companies, which has been tried to achieve through this thesis work. In literature, it was found from the works of Handfield et al. (2020), the COVID-19 impact will create disruptions for the future flow of the supply chain and ultimately trade.

The major difference between this research work and the previous research works in the same domain especially the works of Holopainen (2015) and Sutela & Hilmola (2010) is that those research didn´t encounter the disastrous pandemics named COVID-19. This research work densely investigates the impact of the COVID-19 pandemic in the logistics activities and operation through the RQ2 (see Sub-Chapter 1.3). The results in this research from the survey

of North European companies also suggests that the COVID-19 is going to hit the foreign activities in the markets regarding China and Russia.

However, the results from questions asked to the respondents from the COVID-19 impact´s perspective, was surprisingly diverse from the expectations as it shows that the companies did not have much trouble in meeting the customer´s requirements even amid COVID-19 (see Figure 20), but small variations concerning costs of the logistics variables like transportations activities has fluctuated. Interpretation of the results suggests that companies' logistics activities aren´t affected too much from the first wave of COVID-19 besides, some supply chain disruptions were faced by the companies. The analyzed results also indicate the continuity of logistics activates with China and Russia will continue in the future after COVID-19

The results from the second survey also show interesting and surprising facts, as the local companies were also able to meet the customers´ needs with higher rates even during the core of COVID-19 with only limited exceptions. The companies that do not have an impact of COVID-19 are the companies having operations mostly in the Baltic States or either they operate only in Finland. From the result, it was seen on further analysis that those companies, which were not able to meet or less likely to meet the customer requirements were the small size companies having revenues less than 10 million EUR (see Figure 26). It could be also because the impact of the COVID-19 has hit them very hard such that transportation costs them substantially higher. Moreover, the results show that it is less likely that there will be a minor increment in the transportation cost after the COVID-19 pandemic effect for the majority of the companies exceptions to the companies, which are small or medium-sized with a revenue of less than 20 million EUR (see Figure 26).

The Russian market is going to hit by COVID-19 for some companies and over dependencies with Russia can change as an aftereffect of COVID-19 (see Figure 18). However, the results from the Chinese market and operation, shows that (see Figure 19) the post effect of COVID-19 will not change the importance of Chinese logistics activities and supply chain dependencies with China at least for a decade and will continue despite the interruptions of COVID-19. This is a surprising finding from the survey that companies show less interest in pulling back their

heads, when it comes to logistics activates in China and supply chain dependencies on it. This means that China is going to be a more interesting market even in the future for the companies. Moreover, companies are likely expecting the popularity of railways concerning the logistics activities in China (see Figure 30, right). Also, it is true in the case of Russia that the railways are expected to increase with a slight exception of the seaways (see Figure 30, left).

Over time, the uncertainties like epidemics, pandemics, natural calamities, etc. have always been waving around the globe. The impacts of SARS at the beginning of the century were one of the impactful epidemics which affected the economy of Southeast Asia (including China) much and took many lives altering the economic scenarios for those emerging economies (Brahambhatt and Dutta et al., 2008). Similarly, the waves of coronavirus (COVID-19)-pandemics in 2020 is another hit of such uncertainties throughout the world. Businesses, supply chains, logistics activities, and various other aspects are highly affected by this newly emerged pandemic in 2020, taking many lives and shattering the economic outlook of the world. However, the forthcoming year 2021 is supposed to be more stabilized and mobile concerning the trade, supply chains, logistics activities as well as overall economic outlook as the results from literature shows. (International Monetary Fund, 2020b). Moreover, the results from both surveys (see result 4.1.2 & result 4.2.1) also suggest that trade, supply chain operations, and logistics activates will back to normal conditions and is likely to grow in the forthcoming year 2021.

Due to the complication going on through the world caused by the COVID-19 pandemic, the demand for health equipment, necessary tools, food, and groceries is increasing day by day. The global supply has become more complex and busier with the limited numbers of resources to meet the customers' requirements. It can be estimated from the results that the companies that operate or have a business relationship with China have faced a huge problem starting from the beginning of 2020 and so with Russia as the days passed. The global supply chain has become more challenged by the current situation and demand. The health equipment companies, pharmaceutical companies, and other required suppliers are additional in need of logistics services. Despite the initial complications, as time advanced companies managed to fulfill the customers' needs regarding Chinese as well as Russian markets. These explanations from the findings help to answer research question two (RQ2, see Sub-Section 1.3) of this thesis.

In the era of digitalization and the realm of situations like COVID-19, technologies like blockchain, artificial intelligence, the internet of things, etc. can be an essential part of the entire ecosystem of the supply chain (Hugos, 2018). The results from the literature show that digital technologies like AI, Blockchains, and IoT seem to grow continuously at some handsome pace, making things possible even during difficult situations and different emergency scenarios. Therefore, the application of these modern cutting-edge technologies can help to enhance the betterment of the supply chain and ecosystem of the business world improving the trades between the different players.

The results (see Figure 21) from the survey of large multinational companies show that these companies are gaining only some interest in emerging technologies like blockchain and AI to be used in their logistics system. However, looking at the gaining popularity and effective worthiness of these advance technologies, it is likely expected that the companies from Northern Europe will use AI, blockchain, IoT, and machine learning algorithms to automate the required steps for buying and selling of the products and thereby enhancing the productivity for meeting the customer´s requirements and stay competitive in the market. Recent studies from Tsiulin et al. (2020) suggests that the use of blockchain can simplify the complexity in the network of the supply chain by fragmenting the processes into easier and smarter ways which may include smart contract and transparency of documents and transactions thus, increasing the agility, innovation, and efficiency to create through the decentralized digital environment. Moreover, the results of the analysis of the free comments from the first survey also suggest that the future trend technology like blockchain could ease and improve a lot of admirative processes and documents needed in the supply chains. This summary tries to answer the research question three RQ3 (see Sub-Chapter 1.3).

6 CONCLUSION

The main purpose of this thesis was to investigate the current situation of the logistics activities in the companies of North European states like Finland, Estonia, Sweden, and Norway. The investigation was done with the help of the research questions (see Sub-Chapter 1.3), which was mainly focused on three major perspectives. At first, the current situation of logistics activities (like warehousing, inventory management, sustainability). Secondly, the exploration was mainly concerned with the impacts of COVID-19 in the companies of those selected regions from Northern Europe, and lastly, the third part was to investigate from the perspective of the impact that modern cutting-edge technology has on those companies in their ecosystem of supply chain and logistics.

The results were created by analyzing the survey data based on the responses from the first and second surveys. After this data was processed for extracting the information required for answering all the research questions regarding this thesis (see Sub-Chapter 1.3). Both literature reviews and results from the survey analysis indicate that in North Europe, a semi-trailer is the most significant transportation unit and often important than the container itself (Hilmola, 2019). Moreover, the road mode is the dominant mode for a shorter distance of freight transportation, while sea modes are the most prominent and preferable when it comes to freight transportation regarding longer distances. European Commission (2020) have also found in their report about 90% of external freight trade of the EU is through the sea. In addition, railways connections are growing as well to form a connection to longer distances like in context to Chinese logistics activities, the result (see Figure 17) was very impressive looking at its growth trend for the coming decade. These findings support the claim made by Water (2009); and Sutela and Hilmola (2010). The new railways' connections to China are going to be an interesting aspect throughout the decade and have the possibilities for potential railways growth, which can be effective to the North European companies concerning their logistics activities in China.

On the other hand, Russian connections are primarily dominated by road and are no longer going to be altered in the decade. Sutela & Hilmola (2010) claimed that sea transport is the main mode from North Europe to China and vice-versa. However, the survey results from this research

show the potentiality of the railways in the coming decade concerning the logistics activities from China to North Europe and vice-versa.

The cost of freight transportation is going to increase, and it seems to be increasing throughout a decade which is mainly affected by the newly implemented sulfur cap regulation by IMO in early 2020. Statista (2020c) claimed in their results that companies are hurt by this newly implemented environmental regulation by IMO. However, the survey results of this research show, mostly the companies who were hurt due to the implementations of the environmental regulation like a sulfur cap, are small-sized companies. These companies are hurt due to an increase in their transportation cost by those new environmental regulations. International Maritime Organization (2020) predicts the same that these regulations will likely increase the cost of container transportation in the forthcoming time. Hilmola et al. (2020) claimed that Inventories´ efficiency has been falling or dropping in the Baltic States and mostly declining development concerning small-sized and medium-sized companies' levels and are lower in SMEs than that of large companies. However, in the long-term companies´ inventory is not going to change even the large, small-sized companies, but there is a high possibility that it will keep on growing as some respondents direct towards this situation. It is expected that in the future the companies with fewer employees in their warehouses will impact the market more and they will withstand for a longer period. Sustainability issues are huge challenges for companies and have a high impact on their logistics activities.

Handfield et al (2020), The Economist (2020), International Monetary Fund (2020) claimed that the COVID-19 pandemic is going to hit the global economy and will create a disruption around the supply chain and logistics activities. Issues related to transportation restrictions and supply chain disruptions are expected to increase further (Institute of Supply Chain, 2020). The COVID-19 pandemic is a serious threat to the companies as it is imposing high human cost and resulting in delay deliveries, delay procuring in the goods, and unexpected transit halts (Entrepreneur India, 2020). These claims are true as the results also show that the impact of the COVID-19 pandemic is high for the companies to have their operation in Chinese or Russian markets and dependencies over them as it hurdles around the environment of the trade operations with these countries. However, it was found from the literature that despite the negative impact

of COVID-19 on economic progress in the global market Latvian railways provided continuous fright transportation including long trains from Asia to Europe (The Baltic Times, 2020). The results from this research also show that despite waves of the COVID-19, from the Chinese market perspective, the companies were able to manage the effect of COVID-19 pandemics and handled the situation to meet the customer requirements as delivering the products to their customers based on the deadlines are always in higher prioritization for the companies.

The rise of China in the global market as a superpower has grabbed the attention of companies worldwide for potential business (Tian, 2016). The companies have no intention of changing their supply chain operations and logistics activities regarding the Chinese market and the supply chain dependencies on China will not be affected by future concerns and will continue to depend on it despite the waves of COVID-19 blown on them. There will be some changes in supply chain operation in the context of Russia since the foreign market operation in Russia was hit by COVID-19 for logistics activities. Therefore, in general, it can be said that the impact of COVID-19 was manageable by the companies and on the other hand, the supply chain operation and logistics activities of the companies in the Russian market were under huge pressure due to the impact of COVID-19.

Due to the COVID-19, companies are going to face some changes in transportation costs, and it tends to rise in the future. The smaller-sized companies are badly hurt by the increase in the cost and the profitability for these companies could be a greater challenge as not much financial supports are available in their favor as results from this research shows. In a nutshell, the challenges of pandemics, epidemics, and other factors can hit the momentum of supply chain and logistics activities at any point in time. Therefore, based on the study, it can be concluded that preparing for all possible uncertainties will help to keep the business healthy and profitable. The first wave of the coronavirus in 2020 made the supply chain and logistics activities static for a while which impacted to hold the inventories for a while and resulted in the expected growth of the inventory size for the future. Furthermore, it is likely expected that the second could affect negatively as well but more on production and supply chain but the impact of the second wave still needs to be tested in more detail.

Cutting-edge technologies are the realm of the supply chain system to drive companies for better business results and helping them stay competitive with competitors (Hugos, 2018). Adoption of new trends of technologies is very crucial to take an advantage of it for better planning in the supply chain system. (Merkaš et al., 2020). Technologies have always been a major part of collecting, processing, and handling the data within the ecosystem of the business environment so that companies can make reliable and valuable decisions faster (Merkaš et al., 2020 and Bricher et al. 2020). Modern cutting-edge technologies like blockchain, artificial intelligence, the internet of things, and machine learning algorithms are the most prominent technologies that companies should look for developing a wide range of information and creating integrated dynamic solutions for logistics activities. (Taniguchi et al., 2020). Different companies around the world are already using AI in their businesses to stay competitive and effective (Harvard Business Review, 2020). These results from the literature hint regarding the impact these technologies will have on the business in the coming years. Therefore, it becomes of utmost importance for the companies to integrate these modern cutting-edge technologies into their business or industrial ecosystem.

Also, the survey results show that companies are likely to adopt the integration of modern technology based on AI, blockchain, machine learning, and IoT as these technologies can have a huge impact on the entire ecosystem of supply chain management. Alongside this, the technology of blockchain can have a huge impact on the transparency of documents and transactions forming a decentralized digital system with an efficient consortium of transportation and supply chain and ease the entire administration processes and documents with improved efficiency, agility, and innovation (Struttmann, 2018). However, the interest rate is few in this research so it will be too early to indicate that companies are ready to face the useful aspects of these technologies soon near in the future.

This research was an investigation of the logistics activities through the method of survey and literature review. The findings from this thesis, investigating the current state of the North European companies can be a valuable addition to the previous works and ongoing research in LUT Kouvola for theory development in the same sector. The research also contributes for understanding the initial impacts from the first wave of the COVID-19 in North European

companies. Moreover, the research shows robust characteristics to understand the impacts of the newly born pandemic of 2020 (COVID-19) in the different aspects of the supply chain and logistics of local companies from South Karelia and Kymenlaakso regions of Finland. The finding on the impact of COVID-19 from local companies with the help of the second survey can be considered more reliable compared to that of the first survey from multinational companies since the respondents´ response of those local companies was higher (see Table 5) than the companies considered for the first survey.

Furthermore, the thesis contributes to exploring the current state and core problems in logistics activities (of the companies based in Finland) encountered during the entire timeline of COVID-19. These findings from the second survey of local companies can keep alarming them and help to prepare for a healthier future in upcoming years from such uncertainties and risks. In addition, it suggests that the greatest scope for increasing companies exports of the products under study may lie in the additional development of trade between Russia and China in the future. Moreover, a proper planning and adopting new trends of technologies like blockchain, artificial intelligence, internet of things, machine learning, and better strategic changes to prepare for the future encounters of the pandemic, epidemics, and other risks can help to keep the momentum of logistics and supply chain operations in North European companies.

The research has its limitations due to the lesser response from a considerable sample size (9 out of 885 & also see Table 5) for the survey as the response rate in this survey mainly concerning the large companies (first survey) was much lower than it was initially expected. Therefore, the reliability of the data could be an issue to conclude strongly anything based on it. However, the respondents in the first survey were from higher management levels in big multinational companies with a significant level of working experience in the field of logistics and supply chain, therefore, the results from the first survey draw some possibilities for the future development paths. Concerning the second survey, the limitations come when considering the in-depth cost calculations regarding transportation which is not taken into the consideration under this study because of the unavailability of the financial data from the companies.

Moreover, still, it will be too early to comment on how it impacted the various aspects of the supply chain and logistics activities of North European companies. Also, the data from the response regarding the interest of using the cutting edge technologies like AI, blockchain, IoT was least to put a poised argument on the future integration of these technologies in the ecosystem of the supply chain for those companies for effective businesses with regarding eastern markets of China and Russia. Furthermore, the actual detailed calculations in numbers regarding the change in the cost of transportation due to factors like environmental regulations, COVID-19, adoption of technologies, etc. have not been taken into the consideration under this study.

For future studies, further research on aftereffects of COVID-19 pandemic in North, East, and West European companies would be an interesting topic to explore and will be of great help in the planning of the supply chain management and logistics activities. Also, the application of advanced technologies like augmented reality in managing the warehousing activities of North European states can help in a better understanding of impact in terms of enhancements and productivity of warehousing activities. Studies can also be made on more technological trends of the future which can be effective solutions for structuring the realm of supply chain and logistics activities in North European companies regarding the markets of global giants like China and Russia. Furthermore, an emerging market like India could offer interesting opportunities for investigating different variables of logistics activities of European companies in the Indian market. These possibilities can be considered into consideration by the reader as a recommendation of the author for further exploration in the same domain by the interested researchers in the forthcoming years.

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APPENDICES

Appendix 1 Sample of invitation letters

1.1 Sample letter for invitation to the first survey

Kutsu osallistumaan kyselytutkimukseen: Pohjois-Euroopan yritysten logistiikan tila

Hyvä vastaanottaja,

Kutsumme teidät osallistumaan LUT Kouvolan kyselytutkimukseen, jonka tavoitteena on selvittää Pohjois-Euroopan yritysten logistiikan tämänhetkistä tilaa ja potentiaalisia haasteita Kiinan ja Venäjän itämarkkinoiden suhteen. Logistiikkatoiminnan kehitys on muuttumassa epävarmemmaksi nykyisten muutosten, kuten COVID-19 -pandemian ja ympäristösopimuksista tulevien säännösten puitteissa. Uuden teknologian roolista on tullut merkittävämpi tämän epävarmuuden hallinnassa. Tutkimuksen tarkoituksena on selvittää mainittujen suuntausten vaikutusta Pohjois-Euroopan yritysten logistiikassa. Tämä tutkimus toimii myös aineistona LUT Kouvolassa suoritettavalle diplomityölle, kuten myös yhteistyölle ja -tutkimukselle kolmen eri yliopiston välillä logistiikan aihealueella (Taltech, HiG ja Xamk).

Kyselyyn vastaaminen kestää noin 10 minuuttia. Osallistuminen tähän tutkimukseen on täysin vapaaehtoista. Voitte jättää tyhjäksi kysymykset, joihin ette halua vastata.

Vastauksenne ovat täysin luottamuksellisia ja kerättyä aineistoa käsitellään yhtenä kokonaisuutena (tai pienempinä ryhminä, esim. maakohtaisesti).

Pyydämme teitä lähettämään vastauksenne viimeistään..... Arvostamme aikaanne ja panostanne tämän tutkimuksen onnistumisen mahdollistamisessa!

Linkki kyselyyn: .....

(continues)

Inbjudan att delta i en undersökning: Logistiksituationen för nordeuropeiska företag

Kära mottagare,

Vi inbjuder dig att delta i forskning av LUT Kouvola att undersöka nuvarande verksamhet och potentiella utmaningar i logistiken för nordeuropeiska företag när det gäller den östra marknaden i Kina och Ryssland. Utvecklingen av logistikverksamheten blir allt mer osäker bland nuvarande trender som COVID-19 pandemi och reglering av miljömässig hållbarhet. Den nya teknikens roll har blivit viktigare för att hantera denna osäkerhet. Denna forskning är avsedd att undersöka effekterna av de nämnda trenderna i logistikverksamheten för nordeuropeiska företag. Forskningen kommer också att fungera som viktigt källmaterial för en masteruppsats som genomförts i LUT Kouvola och i forskningssamarbete inom tre stödjande universitet inom logistikområdet, nämligen Taltech, HiG och Xamk.

Frågeformuläret kommer att kräva cirka 10 minuter att fylla i. Deltagningen i av detta forskningsprojekt är helt frivilligt. Du kan lämna frågor som du inte vill svara som blank. Dina svar kommer att vara konfidentiella och de insamlade uppgifterna kommer att behandlas som en helhet (eller t.ex. genom undergrupper på landsnivå).

Vänligen skicka in dina svar senast den……. Vi uppskattar mycket värdefull tid och bidrag för att göra denna forskning framgångsrik!

Länk till frågeformuläret:……

(continues)

Invitation to participate in a survey: Logistics Situation of North European Companies

Dear recipient,

We invite you to take a part to the research of LUT Kouvola investigating the current activities and potential challenges in the logistics of Northern European Companies regarding the eastern market of China and Russia. The development of logistics activities is becoming more uncertain amid current trends like the COVID-19 pandemic and regulation on environmental sustainability. The role of new technology has become more important in managing this uncertainty. This research is meant to explore the impact of the mentioned trends in the logistics activities of North European companies. The research will also act as source material for a master´s thesis carried out in LUT Kouvola, and in research collaboration within three supporting universities within the field of logistics, namely Taltech, HiG, and Xamk.

The questionnaire will require approximately 10 minutes to complete. Your participation in this research project is completely voluntary. You may leave any questions you wish not to answer as blank. Your responses will remain confidential and the gathered data will be processed as a whole (or e.g. through country-level sub-groups).

Please submit your answers by the …….. We highly appreciate your valuable time and contribution to making this research successful!

Link to the questionnaire: ……

1.2 Sample letter for invitation to the second survey

Kutsu osallistumaan kyselytutkimukseen: Pohjois-Euroopan yritysten logistiikan tila

Hyvä vastaanottaja,

Kutsumme teidät osallistumaan LUT Kouvolan kyselytutkimukseen, jonka tavoitteena on selvittää Pohjois-Euroopan yritysten logistiikan tämänhetkistä tilaa COVID-19 -pandemian keskellä. Tämä tutkimus toimii myös aineistona LUT Kouvolassa suoritettavalle diplomityölle.

Kyselyyn vastaaminen kestää noin 5 minuuttia. Osallistuminen tähän tutkimukseen on täysin vapaaehtoista. Voitte jättää tyhjäksi kysymykset, joihin ette halua vastata. Vastauksenne ovat täysin luottamuksellisia ja kerättyä aineistoa käsitellään yhtenä kokonaisuutena (tai pienempinä ryhminä, esim. maakohtaisesti).

Pyydämme teitä lähettämään vastauksenne viimeistään……. Arvostamme aikaanne ja panostanne tämän tutkimuksen onnistumisen mahdollistamisessa!

Linkki kyselyyn: .....

(continues)

Kära mottagare,

Vi inbjuder dig att delta i forskning av LUT Kouvola att undersöka nuvarande verksamhet och potentiella utmaningar i logistiken för nordeuropeiska företag när det gäller COVID-19-pandemin. Forskningen kommer också att fungera som viktigt källmaterial för en masteruppsats som genomförts i LUT Kouvola.

Frågeformuläret kommer att kräva cirka 5 minuter att fylla i. Deltagningen i av detta forskningsprojekt är helt frivilligt. Du kan lämna frågor som du inte vill svara som blank. Dina svar kommer att vara konfidentiella och de insamlade uppgifterna kommer att behandlas som en helhet (eller t.ex. genom undergrupper på landsnivå).

Vänligen skicka in dina svar senast den ……Vi uppskattar mycket värdefull tid och bidrag för att göra denna forskning framgångsrik!

Länk till frågeformuläret:……

(continues)

Dear recipient,

We invite you to take a part to the research of LUT Kouvola investigating the current activities and potential challenges in the logistics activities of North European companies in regard to the COVID-19 pandemic. The research will also act as source material for a master´s thesis carried out in LUT Kouvola.

The questionnaire will require approximately 5 minutes to complete. Your participation in this research project is completely voluntary. You may leave any questions you wish not to answer as blank. Your responses will remain confidential and the gathered data will be processed as a whole (or e.g. through country-level sub-groups).

Please submit your answers by the ……. We highly appreciate your valuable time and contribution to making this research successful!

Link to the questionnaire……...

(continues)

Appendix 2 First Survey Questionnaire

Survey Research on Logistics Situation of North European Companies

The development of logistics activities is becoming more uncertain amid current trends like COVID-19 pandemic and regulation on environmental sustainability. The role of future technology has become more important in handling this uncertainty. We ask you to spend 10 minutes of your valuable time to answer this survey.

In the following survey, if you do not want to answer a question or questions, please do select "I do not want to answer". This is the selection also in a case where the question area is not applicable or of concern to your company (e.g. your company does not have activities in certain countries).

1. What is your position in the company?

- ◯ director
- ◯ manager
- ◯ administration
- ◯ other

2. How many years you have worked in the company?

- ◯ 1 - 2 years
- ◯ 2 - 4 years
- ◯ 4 - 8 years
- ◯ 8 years or above

3. Which is your company´s most important transportation unit?

- ◯ 20-foot container
- ◯ 40- or 45-foot container
- ◯ semi-trailer
- ◯ something else

Next

Survey Research on Logistics Situation of North European Companies

4. Please estimate how much your company spent in the year 2019 and is planning to spend in the years 2024 and 2029 on transportation of goods (excluding warehousing):

	1-2 % from sales	2-4 % from sales	4-6 % from sales	6-8 % from sales	8 % or above from sales	I do not want to answer
2019	◯	◯	◯	◯	◯	◯
2024	◯	◯	◯	◯	◯	◯
2029	◯	◯	◯	◯	◯	◯

5. Please estimate the annual cargo volume between your company and China (TEU = Twenty-Foot Equivalent Units):

	0-100 TEU	101-5000 TEU	5001-10 000 TEU	10 001-50 000 TEU	more than 50 000 TEU	I do not want to answer
2019	◯	◯	◯	◯	◯	◯
2024	◯	◯	◯	◯	◯	◯
2029	◯	◯	◯	◯	◯	◯

6. Please estimate the annual cargo volume between your company and Russia (TEU = Twenty-Foot Equivalent Units):

	0-100 TEU	101-5000 TEU	5001-10 000 TEU	10 001-50 000 TEU	more than 50 000 TEU	I do not want to answer
2019	◯	◯	◯	◯	◯	◯
2024	◯	◯	◯	◯	◯	◯
2029	◯	◯	◯	◯	◯	◯

7. Please estimate the average number of employees in your warehousing/distribution centers:

	0-10	11-30	31-50	51-100	Above 100	I do not want to answer
2019	◯	◯	◯	◯	◯	◯
2024	◯	◯	◯	◯	◯	◯
2029	◯	◯	◯	◯	◯	◯

Previous Next

LUT University

Survey Research on Logistics Situation of North European Companies

8. What is the primary mode of transportation used in the year 2019 and will be used in year 2024 & 2029 for the logistics activities of your company in China?

	rail	road	sea	air	I do not want to answer
2019	○	○	○	○	○
2024	○	○	○	○	○
2029	○	○	○	○	○

9. What is the primary mode of transportation used in the year 2019 and will be used in year 2024 & 2029 for the logistics activities of your company in Russia?

	rail	road	sea	air	I do not want to answer
2019	○	○	○	○	○
2024	○	○	○	○	○
2029	○	○	○	○	○

10. Will the inventory sizes change in your industry during the coming five years?

- ○ sizes will diminish significantly
- ○ sizes will diminish moderately
- ○ no change
- ○ sizes will grow moderately
- ○ sizes will grow significantly
- ○ I do not want to answer

Previous Next

LUT University

Survey Research on Logistics Situation of North European Companies

Corona-virus impact on logistics

11. How likely the freight transportation cost of your company will increase after COVID-19 pandemic?

- ◯ not at all
- ◯ less likely
- ◯ moderately
- ◯ likely
- ◯ extremely
- ◯ I do not want to answer

12. How likely is your company able to meet the customer requirements during the COVID-19 pandemic?

- ◯ not at all
- ◯ less likely
- ◯ moderately
- ◯ likely
- ◯ extremely
- ◯ I do not want to answer

13. How likely your company´s logistics activities are going to be continuing in Russia after the COVID-19 pandemic effect?

- ◯ not at all
- ◯ less likely
- ◯ moderately
- ◯ likely
- ◯ extremely
- ◯ I do not want to answer

14. How likely long-term supply chain dependencies to Russia will change due to the pandemic situation like COVID-19?

- ◯ not at all
- ◯ less likely
- ◯ moderately
- ◯ likely
- ◯ extremely
- ◯ I do not want to answer

15. How likely your company´s logistics activities are going to be continuing in China after the COVID-19 pandemic effect?

- ◯ not at all
- ◯ less likely
- ◯ moderately
- ◯ likely
- ◯ extremely
- ◯ I do not want to answer

16. How likely long-term supply chain dependencies to China will change due to the pandemic situation like COVID-19?

- ◯ not at all
- ◯ less likely
- ◯ moderately
- ◯ likely
- ◯ extremely
- ◯ I do not want to answer

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Survey Research on Logistics Situation of North European Companies

Environmental regulation and its impact in logistics

17. How much the agreement to limit carbon dioxide emissions (Paris Agreement 2016 on climate change) will affect the transportation costs of your company?

- ◯ not at all
- ◯ a little
- ◯ moderately
- ◯ much
- ◯ extremely
- ◯ I do not want to answer

18. On January 1, 2020, the International Maritime Organization (IMO) imposed new emissions standards (the maximum sulfur content of marine fuels is reduced to 0.5% down from 3.5% globally). How much 2020 sulfur directive on marine fuels will affect the transportation costs for your company?

- ◯ not at all
- ◯ a little
- ◯ moderately
- ◯ much
- ◯ extremely
- ◯ I do not want to answer

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Survey Research on Logistics Situation of North European Companies

Impact of modern technology in logistics activities

19. How interested are you in using machine learning analytics in any of your logistics activities?

- ◯ not at all
- ◯ a little
- ◯ moderately
- ◯ much
- ◯ extremely
- ◯ I do not want to answer

20. How interested are you in using blockchain technology for transaction activities?

- ◯ not at all
- ◯ a little
- ◯ moderately
- ◯ much
- ◯ extremely
- ◯ I do not want to answer

21. How interested are you in using Electric Vehicles for the future logistics activities of your company?

- ◯ not at all
- ◯ a little
- ◯ moderately
- ◯ much
- ◯ extremely
- ◯ I do not want to answer

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Survey Research on Logistics Situation of North European Companies

22. What will be the effect of COVID-19, environmental regulations, and new technology in logistics activities for your company in the nearest future?

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Survey Research on Logistics Situation of North European Companies

More information for reporting results and contacting us

23. The desired outcome of this research is to understand logistics activities in North European countries regarding Eastern Market of China and Russia and make a future scenario on how the logistics will look like for North Europe amid COVID-19, environmental regulation changes, and other challenges. Please indicate, if your company would like to receive a research report from the survey:

- ◯ yes
- ◯ no

24. Please mention the e-mail address where the report can be sent:

email

25. Please fill the form if you are interested to participate in an interview via online video call related to the logistics activities of Northern Europe:

first name

last name

email

country

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Appendix 3 Second Survey Questionnaire

Covid-19 Impacts on Logistics and Supply Chains

1. How likely the freight transportation cost of your company will increase after COVID-19 pandemic?

- ◯ not at all
- ◯ less likely
- ◯ moderately
- ◯ likely
- ◯ extremely
- ◯ I do not want to answer

2. How likely is your company able to meet the customer requirements during the COVID-19 pandemic?

- ◯ not at all
- ◯ less likely
- ◯ moderately
- ◯ likely
- ◯ extremely
- ◯ I do not want to answer

3. Will the inventory sizes change in your industry during the coming five years?

- ◯ sizes will diminish significantly
- ◯ sizes will diminish moderately
- ◯ no change
- ◯ sizes will grow moderately
- ◯ sizes will grow significantly
- ◯ I do not want to answer

4. What is the primary mode of transportation used in the year 2019 and will be used in year 2024 & 2029 for the logistics activities of your company in China?

	rail	road	sea	air	I do not want to answer
2019	○	○	○	○	○
2024	○	○	○	○	○
2029	○	○	○	○	○

5. What is the primary mode of transportation used in the year 2019 and will be used in year 2024 & 2029 for the logistics activities of your company in Russia?

	rail	road	sea	air	I do not want to answer
2019	○	○	○	○	○
2024	○	○	○	○	○
2029	○	○	○	○	○

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Covid-19 Impacts on Logistics and Supply Chains

6. How likely your company´s logistics activities are going to be continuing in Russia after the COVID-19 pandemic effect?

- ○ not at all
- ○ less likely
- ○ moderately
- ○ likely
- ○ extremely
- ○ I do not want to answer

7. How likely long-term supply chain dependencies to Russia will change due to the pandemic situation like COVID-19?

- ○ not at all
- ○ less likely
- ○ moderately
- ○ likely
- ○ extremely
- ○ I do not want to answer

8. How likely your company´s logistics activities are going to be continuing in China after the COVID-19 pandemic effect?

- ○ not at all
- ○ less likely
- ○ moderately
- ○ likely
- ○ extremely
- ○ I do not want to answer

9. How likely long-term supply chain dependencies to China will change due to the pandemic situation like COVID-19?

- ○ not at all
- ○ less likely
- ○ moderately
- ○ likely
- ○ extremely
- ○ I do not want to answer

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Covid-19 Impacts on Logistics and Supply Chains

10. What will be the effect of COVID-19 in logistics activities for your company in the nearest future?

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Covid-19 Impacts on Logistics and Supply Chains

11. The desired outcome of this research is to understand logistics activities in North European countries regarding Eastern Market of China and Russia and make a future scenario on how the logistics will look like for North Europe amid COVID-19. Please indicate, if your company would like to receive a research report from the survey:

- ○ yes
- ○ no

12. Please mention the e-mail address where the report can be sent:

email

13. Please fill the form if you are interested to participate in an interview via online video call related to the logistics activities of Northern Europe:

first name

last name

email

country

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