LAB University of Applied Sciences

Blockchain technology in supply chain

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Abstract

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Abstract

Covid-19 has affected almost every area of business, including the supply chain. It has exposed many weaknesses in complex supply chains. Blockchain technology is helping to address some of them.

The purpose of this study is to introduce blockchain technology to supply chain companies to cope with the challenges and successfully emerge from the crisis.

The study uses qualitative method and inductive approach. The case of this thesis is changes in supply chain caused by the pandemic. Interview with Transval is used as primary data. Transval OY and Capgemini reports are analyzed to support the interview, as well as a published interview with IBM.

The conclusion of the study shows that problems such as lack of transparency, monitoring of goods, losses, insecure transactions, and many others can be solved by using blockchain technology.

Keywords

Blockchain, supply chain, Covid-19, Transval, IBM, Capgemini

Contents

1 Introduction

1.1 Research Background

The coronavirus pandemic has taken a serious toll on the world economy. Covid-19 resulted in a lockdown that countries had to impose because of the rapid spread of the virus. People are instructed not to leave their homes except for emergencies.

On the one hand, the number of individual customers has increased dramatically. But the most profitable part of the business - delivery from one commercial enterprise to another - has suffered. (Overstreet 2021.) The demand for some products has dropped and some have increased greatly, such as basic foods and masks (McKinsey 2021). It turned out that companies were not ready for a pandemic. However, the logistics industry has played an important role in this vital situation. Not only masks, food, and medical equipment, but also dumbbells, work-from-home desks, fire pits, and others were in demand (USA today 2021).

Changes in needs, border closures and many other issues that arose during the pandemic have exposed supply chain weaknesses. More companies are now reviewing their supply chains to make them more resilient. Openness and transparency play an important role in business resilience. That's what the innovative blockchain technology will help achieve. How exactly blockchain technology can help companies in these difficult times will be showed in this thesis.

1.2 Thesis Objectives, Research Questions and Limitations

The purpose of this study is **to show how blockchain technology can help logistics companies**. Blockchain technology appeared not so long ago and not everyone is yet familiar with this innovation. This thesis will be useful for companies that are thinking of introducing blockchain technology into the supply chain and for companies that have faced difficulties in their supply chains.

To drive a research paper, project, or thesis, a suitable research question is needed, which provides a clear focus and purpose (McCombes 2019). The main research question of this thesis is:

- **How blockchain technology help solve some of the supply chain weaknesses that emerged during Covid-19?**

To achieve the answer to the main question, the following sub-questions are composed:

- How has Covid-19 influenced global logistics?

- What weaknesses emerged during the pandemic in the supply chain?

- How is blockchain technology used in the supply chain?

Covid-19 is a new phenomenon in the world that has not yet been well studied. So far, there is little information on this situation. It is not possible to describe the full impact of the pandemic on our world, as the process is ongoing, and changes are still occurring. Blockchain in logistics appeared not so long ago, so there is also a lack of information here.

Qualitative data identifiers, unlike straightforward quantitative data, can be subjective, making qualitative data analysis a difficult process with many options and structures. As a result, different researchers can interpret the same interview in various ways.

When looking for a company to research, a restriction in the form of access appeared. Yes, not all companies have an interest in providing data for the study. Therefore, it was impossible to conduct an analysis based on data from several companies. There was a time constraint, so it was not possible to conduct a more accurate interview with the Transval.

1.3 Theoretical Framework

This thesis is based on blockchain theory which will lay a strong base and provide a clearer picture of the subject. The first part of the theory is about blockchain technology. The nature of this technology, and its use in the supply chain will be explained. Also in this chapter will be basic information to understand what the supply chain is all about. The second part of the theory explains Covid-19 impact on logistics.

1.4 Research Methodology and Data Collection

Specific strategies for gathering and interpreting data are known as research methods. In Figure 1 you can see what methods are used in this thesis research.

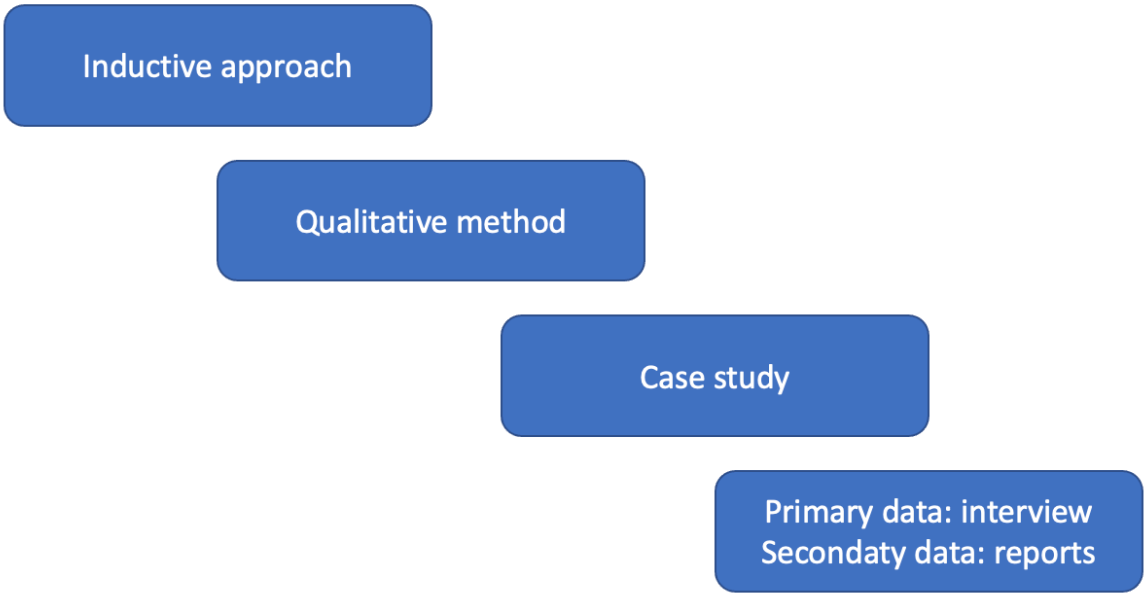

Figure 1. Research methodology and data collection

Induction is a method of thinking in which a kind of general picture is drawn based on single facts. Knowledge of the individual units leads to the conclusion that all objects in each series have the same characteristics. In this situation, the logic moves from empirical investigation to theoretical results. (Eriksson & Kovalainen 2016, 23.) The inductive inference is deduced not strictly according to logic but based on intuition and certain concepts. As a result, the final outcome is only probabilistic and requires verification. Therefore, inductive approach is the most suitable for this thesis research.

Observing, listening, and interpreting are more important to qualitative researchers. As a result, the researcher is deeply involved in both the study process and the analysis of the findings. Because of these factors, qualitative research is considered more subjective, implying that the results are dependent on the researcher. Quantitative business research, on the other hand, can be described as business research that meets research objectives through empirical evaluations using numerical measurement and analytical methods. (Zikmund et al. 2010, 134-135.)

Due to there are qualitative data in this thesis as for research methodology, the qualitative method was selected. In this thesis, the case study approach is used. Firstly, the case is defined and solved in the case study. This approach is used to gain an in-depth understanding of a complicated subject in its real-life context. (Eriksson & Kovalainen 2016, 131-133.) The case of this thesis is changes in supply chain caused by the pandemic.

Primary data is original data that is collected by researchers directly from main sources through interviews, questionnaires, surveys, observations, and others (O'Gorman & MacIntosh 2014, 77). Interview with Transval Oy is used as primary data in this thesis.

Secondary data is information ever collected for any purpose unrelated to the current task such as company reports, computer-based databases, archival records, and others (O'Gorman & MacIntosh 2014, 79). Reports of Transval Oy, report of research company Capgemini, and published interview with IBM will be analyzed in the thesis research.

1.5 Thesis Structure

The study begins with an introduction, which includes the foundation of the study (Figure 2). This chapter includes background information, the main objective, and research questions, as well as limitations. This is followed by information about the theoretical framework and methodology. At the very end, the structure of this research is presented. The purpose of this chapter is to construct a mind map regarding the main concept of the thesis, as well as to assist the reader in gaining an overview of the investigated issue and obtaining general information about it.

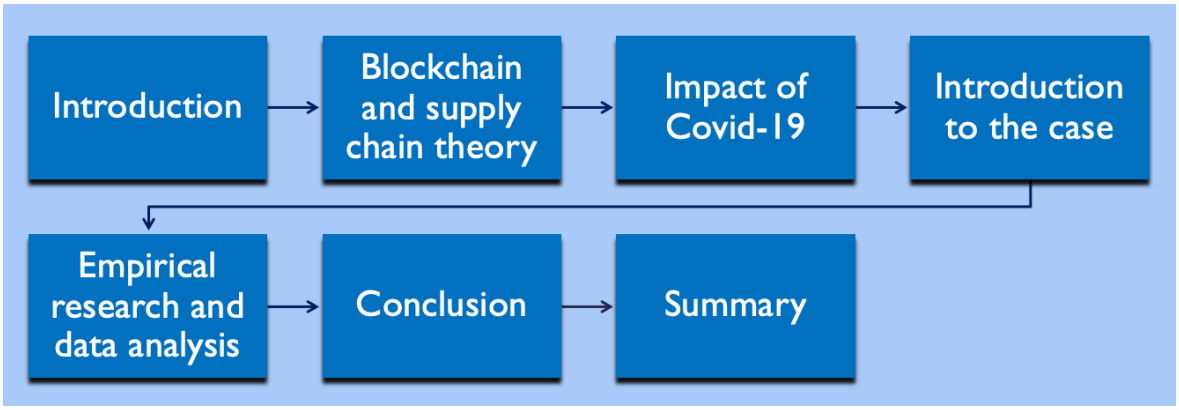

Figure 2. Thesis structure

The second chapter is based on the theory of blockchain and supply chain. To do the research, it is necessary to be well-versed in the topic and to understand what it is all about. It explains the purpose of technology, and its use in supply chains.

The third chapter discusses the implications of Covid-19 for the logistics industry. The major problem that blockchain technology may be utilized to tackle will be explained in this chapter.

The reader is introduced to the case in the fourth chapter. The reader will acquire crucial facts about the involving companies before examining the data given in part five.

Empirical research and data analysis are discussed in the fifth chapter. The information gathered through interview with the Transval OY and their published reports, report of Capgemini, and published interview with IBM company, which are familiar with blockchain technology, will be analyzed in this thesis.

At the sixth chapter, the conclusions are made. It is in this chapter that the answers to the research questions are finally formulated. As well as the validity and reliability and suggestions on Further Research.

The final chapter is the summary. This chapter includes a brief overview of the research, which gives an overview of the thesis without reading it.

2 Blockchain and supply chain

2.1 Blockchain technology

Blockchain technology appeared not so long ago. Blockchain was introduced as the technology behind Bitcoin, the first cryptocurrency. While there is some debate among experts about the future of cryptocurrencies, there is no debate about the bright future of blockchain technology.

2.1.1 Definition of blockchain

Blockchain is the latest technology, the interest in which has grown along with the popularity of cryptocurrencies. Today it is widely discussed not only in the world of logistics. Blockchain is already being used to store and process personal data and identification, in marketing and computer games.

Blockchain contains all records of transactions. Blockchain is also called distributed ledger technology because the entire chain of transactions and the current list of owners are stored on their computers by multiple independent users. Even if one or more computers fail, the information is not lost. (Hirsh & Alman 2020, 15)

In other words, Blockchain is a distributed database that contains information about all transactions made by participants in the system. The information is stored as a chain of blocks. Each block contains a certain number of transactions. In addition to paying for services, blockchain can be used to exchange or track data, as well as to enter contracts and other arrangements. (Conway 2021.)

With blockchain, each transaction is recorded and added to the distributed database chain as a new fragment that is manually assigned a unique multi-digit numeric cipher. This fragment stores data about the date, time, participants, transaction amount, and information about the whole network.

It can be thought of as a ledger that each participant in the event has and is constantly updated. Any event can be entered into this ledger - from financial transactions with cryptocurrencies Bitcoin, Etherum, and others, to the results of a presidential election or identification data.

The peculiarity of the blockchain is that the pages (blocks) of this book are stored simultaneously by all users of the network, are constantly updated, and refer to old pages. And if

someone tries to cheat the system by tearing or pasting some page into the book, the system will immediately refer to tens of thousands of other versions of this book and will find a discrepancy in the structure of the blocks.

The basic blockchain system is an ever-growing sequence of blocks that are shared among participants via peer-to-peer networks, which most people use to download and distribute torrents.

For example, two people argue over 10 euros to see who can eat a pizza faster. The bet can be resolved in three ways:

- trust each other (unreliable, as one of the participants could break the deal)
- sign a contract (takes time and money)
- both participants of a dispute give 10 euros to a third party, who determines the winner and gives him the "prize fund" (the most unreliable option, as the third party can take the money for itself).

Blockchain offers a transparent and reliable variation of the third method. The role of the third party is played by a program that will accept contributions from participants and send the money to the winner of the bet. Both participants have access to all these transactions.

Any transaction is written to a block, several copies of which are stored on several computers. Together they form a blockchain, which provides increased transparency and security. Each block contains links to its "neighbors": the previous block and the next, so any unauthorized changes in one block disrupt the entire chain. In addition, blockchain is a decentralized system, as all its participants have the same level of access.

2.1.2 Blockchain use

The introduction of blockchain increases the speed of exchange, reduces time costs, and improves the quality, reliability, and availability of services. At the same time, it increases transparency and reliability and reduces risks.

The main application of blockchain is in the crypto industry. But beyond that, blockchain projects are used in banking, financial services, payment services, public sector, transportation, logistics, IoT, healthcare, intellectual property management, energy, and so on. (Kenton 2021.)

Blockchain makes all processes in the banking industry safer, more reliable, and transparent. Money transfers, securities transaction settlements, letters of credit, KYC compliance-

all these operations now take place with the implementation of this technology. Blockchain could reduce costs of banks. Technology can optimize infrastructure and drastically reduce costs. Many banks, despite their inherent conservatism, would be dangerous to underestimate the potential of this technology. Its widespread adoption could lead to the elimination of some participants in the global financial system. (Kenton 2021.)

Each node in the blockchain system holds a copy of the entire database and checks against each other. This makes the system viable even in the event of successful hacker attacks on its single nodes. Although blockchain-based applications offer anonymity, the technology can be used to attach real identities to cryptographic identities in the database. (Kenton 2021.)

2.2 Blockchain in supply chain management

Depending on the product, the supply chain usually consists of dozens or even hundreds of steps and stretches thousands of kilometers around the world. Dozens of specialists handle tons of paperwork, and logistics processes sometimes drag on for weeks or months.

Supply chains have become increasingly complex and there is less and less transparency in communication between supply chain participants, so customers and clients do not fully understand the value of the product. Moreover, when irregularities are suspected on one side of the supply chain, they are not easy to detect. That is why many experts have high hopes for blockchain in logistics.

2.2.1 Definition of supply chain management

Supply Chain Management (SCM) as defined by the Council of Supply Chain Management Professionals (CSCMP):

Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies. Supply Chain Management is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model. It includes all the logistics management activities noted above, as well as manufacturing operations, and it drives coordination of

processes and activities with and across marketing, sales, product design, finance, and information technology. (CSCMP 2013.)

At its most fundamental level, supply chain management (SCM) is the management of the flow of goods, data, and finance associated with a product or service, from the purchase of raw materials to the delivery of the product to the destination.

Although many people equate the supply chain with logistics, logistics is just one component of the supply chain. Modern digitally managed SCM systems include material handling and software for all parties involved in creating products or services, fulfilling orders, and tracking information, such as suppliers, manufacturers, wholesalers, transportation and logistics service providers, and retailers.

Supply chain operations encompass aspects such as purchasing, product lifecycle management, supply chain planning (including inventory planning and maintenance of enterprise assets and production lines), logistics (including transportation and fleet management), and order management. SCM can also extend to activities related to global trade, such as global supplier management and multinational manufacturing processes.

2.2.2 The role of blockchain in supply chain

Emel Aktas et al. (2021, 40-43) identify a few categories of supply chain management. The first one is customer service. Effective communication is very important for customer service. Blockchain reduces problem processing time for customer service teams. The customer service team has access to all data. In the same way, authorized network users such as the anchor customer, his bank, and distributors have access to the information. This lowers the requirement for administrative tasks to discover or comprehend product status and projected arrival time as it moves through the supply chain. (Aktas et al. 2021, 40.)

The second one is budget versus results. Growing gasoline and trucking costs, rising, or falling demand, contemporary technology, new laws, rising labor expenses, and rising commodity prices all contribute to unpredictability and put pressure on competing for supply chains. By automating error-free procedures, blockchain reduces costs. It improves transaction transparency and predictability while also accelerating the transportation of physical commodities. It keeps an immutable record of provenance, that is, all the acts, movements, and status of things at a specific location or time. Companies utilize this information to com-

bat crime and track output. It also exposes strategy flaws, promotes sustainability and corporate social responsibility, and chances for process re-engineering. (Aktas et al. 2021, 40–41.)

The next one is risk management. It is beneficial for supply chain actors to increase their resistance to product movement disruptions. The better protected they are against external risks such as economic and political crises, the more resilient they are to internal risks such as market shifts, advanced technology, new or improved products, loan availability, and global sourcing operations. Blockchain eliminates extraneous connections in the chain, middlemen, and centralized services that add friction (costs and delays) to the chain, and aids in compliance with customs and regulations. (Aktas et al. 2021, 42.)

Relationship administration is the fourth category. By aligning and adhering to performance measurement criteria, suppliers and partners can optimize and improve the flow of products through the supply chain. Standards that are mutually agreed upon and assure consistent output will build amicable relationships between suppliers and partners. All participants in the supply chain blockchain network can observe two-way metadata about product actions as they flow through the supply chain. Concerned about achieving the deadline, the anchor buyer will have anonymous access to performance metadata. This means that they will be aware of the status and location of the goods as it moves through the supply chain, and suppliers will reveal their sources. Lower-level suppliers can manage their schedules to meet increased demand by allowing them to see new orders. (Aktas et al. 2021, 42.)

The final category is human resource. The efficient use of technology reduces the number of personnel required while increasing the level of sophistication and abilities required to offer it. Workers of the company will have more time to put their abilities to use and will be able to work more efficiently. Human resources will benefit significantly in the long run because of blockchain and related technologies such as artificial intelligence. (Aktas et al. 2021, 42-43.)

2.2.3 Implementing blockchain in the supply chain

Lack of transparency due to conflicting or even non-existent data, a significant amount of manual (paper) work, lack of interoperability, and insufficient information on product lifespan or travel history are the biggest challenges in the supply chain. Michael Lierow et al. used a beef supply chain example to paint a way to incorporate blockchain technology into the supply chain (Figure 3).

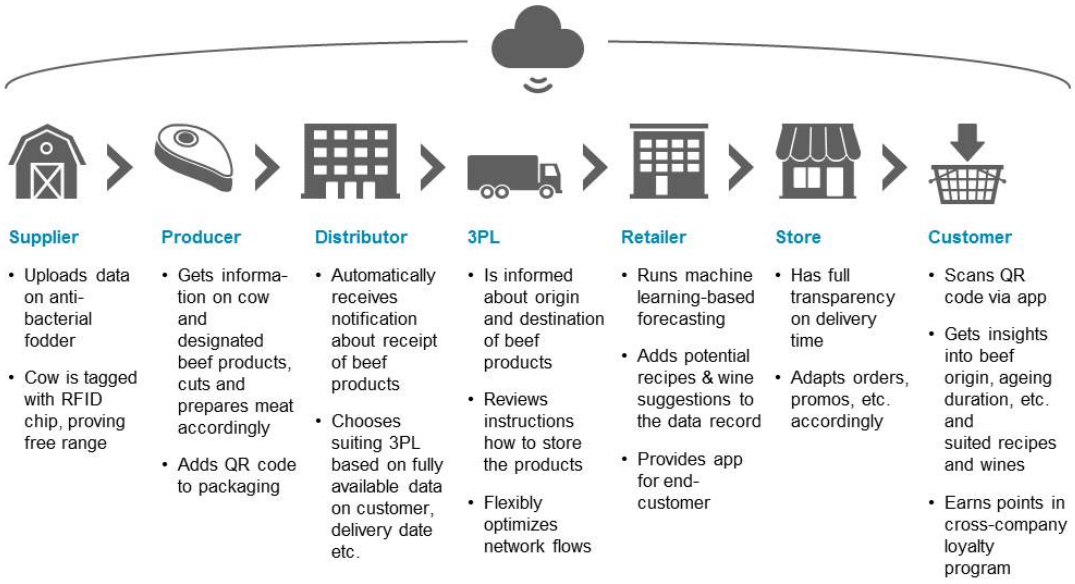

Figure 3. End-To-End Blockchain-Enabled Supply Chain

Each participant in the process can find out the information he or she needs at any time. This technology ensures honest and opens mutual relations.

However, to implement the technology, it is worth following a three-step strategy (Figure 4). To begin, a company-internal blockchain should be established to allow the business time to become acquainted with the technology while ensuring data availability and consistency. The blockchain should then be extended to surrounding stakeholders, such as third-party logistics and direct suppliers, to facilitate data interchange. Finally, connect all supply chain participants, including end-users, to the blockchain. (Lierow et al.)

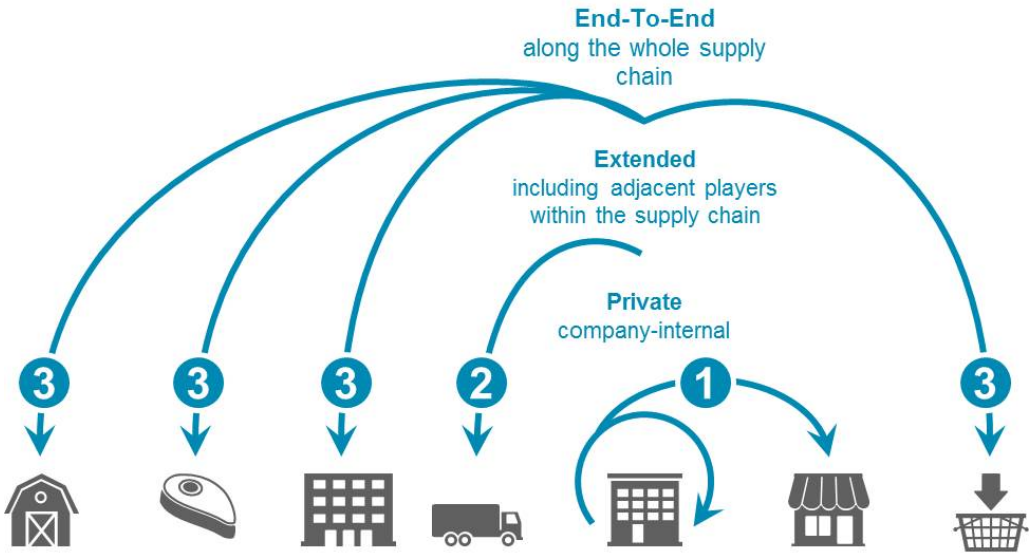

Figure 4. Three-step Blockchain Integration into The Supply Chain

3 Impact of Covid-19 on logistics

3.1 Definition of Covid-19

Coronaviruses are a family of viruses found in both humans and animals. Coronaviruses usually cause mild inflammatory processes in the respiratory tract. COVID-19 or Coronavirus disease is an infectious disease caused by the SARS-CoV-2 virus. Symptoms of COVID-19 are nonspecific and can vary in severity. The disease can progress without signs of illness, but it can also cause severe pneumonia, and in the worst case for people at risk, the disease can be fatal. In most cases, coronaviruses are transmitted through airborne droplets (coughing, sneezing) and direct contact. Less commonly, the virus can spread through contaminated surfaces. People over the age of 60 with a weakened immune system and/or chronic illnesses are at the highest risk of contracting coronavirus or influenza. Any concomitant illness increases the risk of disease. Children infected with coronavirus usually have few or no symptoms. (WHO.)

On December 31, 2019, the World Health Organization (WHO) received a case of unknown microbial etiology that occurred in Wuhan City, Hubei Province, China. WHO later announced that a new type of coronavirus had been detected in samples taken from these patients. Since then, the outbreak has taken on alarming proportions and spread rapidly around the world. WHO first declared a public health emergency of international concern on January 30, 2020, and then officially declared a pandemic on March 11, 2020. Clinical studies are ongoing to learn more about the virus, its origin, how it affects the human body, and its treatment.

Vaccines generally need years of study and testing before they can be used in the clinic, but in 2020, scientists set out on a race to develop safe and effective coronavirus vaccines in record time. At the end of October 2021, 105 vaccines are being tested in human clinical trials, with 41 having reached the final phases of testing. More than 75 preclinical vaccinations are now being tested in animals. (Zimmer C. et al. 2021.)

3.2 Supply chain management during Covid-19

The COVID-19 pandemic has changed not only the lives of many people but also the global and local markets. Worldwide, there has been a significant reduction in production capacity due to the closure of borders between countries and the imposition of self-isolation. The coronavirus pandemic has disrupted the usual links between producers and consumers and has made major changes in the business of logistics companies.

The spread of the coronavirus dealt a serious blow to global logistics and the supply chain for raw materials and finished products. The crisis caused an imbalance in cargo flows due to changes in demand, suspension of production, and imposed restrictions. The main players in the sector had to rethink their core business processes and make important management decisions.

The impact of the coronavirus on supplies was felt from the very beginning of the crisis. Losses and changes in one way or another affected all business sectors, and their scale depended on the area of activity and complexity of the supply chain. Companies selling medical supplies, food, and basic needs had the fastest to react to the changes.

The logistics industry in recent years has been characterized by complex supply chains with heterogeneous groups of remote suppliers. The model is based on complete interconnectivity between the participants, technology, and transportation that promote global flows.

Supply chains operate on economies of scale. Containers from hundreds of cargo owners were loaded onto one ship and carried from Southeast Asia to Europe, which allowed for acceptable shipping costs. However, with the ban on the transportation of any goods other than life-support items, the cargo flow was significantly reduced, the transport was not filled, and the cost of transportation increased dozens of times. The closure of borders and breaking of chains disrupted the former mode of operation. Usual delivery times have increased. (Twinn 2020.) This is due to stricter control at the border - the introduction of mandatory inspections by the border guard, customs, and medical services.

The coronavirus pandemic has exposed several problems in one way, or another related to the disruption of supply chains. One of the first problems was the difficulty of switching to an online mode. Employees in warehouses and production facilities were provided with personal protective equipment, and specialists working in the office were moved to remote work. The transition to online mode was not easy for all companies: the task was complicated by the need to restructure business processes in the shortest possible time to avoid loss of profits, increased costs, and failures in the delivery of orders. There could have been no hiccups if the appropriate IT infrastructure was available. Companies using cloud IT solutions had an advantage in this case because clouds are originally designed for remote access. (Rheude 2020.)

In the same way, there were problems in the management of the warehouse. Many people underestimate the importance of modern warehouse management. In an emergency, it is important to receive timely and up-to-date information on available inventory from suppliers, so that there is an opportunity to meet consumer demand. (Rheude 2020.) Modern Vendor-managed inventory and advanced warehouse automation systems can easily solve this

problem, but before the pandemic, many companies did not even think about implementing such solutions.

Problems with logistics optimization emerged. Before the crisis, logistics was perceived as a cost center, so companies sought to optimize costs by delegating storage, transportation, and delivery functions to contractors offering the lowest rates in the service market. The situation today demonstrates that this approach cannot cope with the increased loads. Only long-term relationships and relationship management with contractors based on performance indicators, plus modern information technology can easily scale logistics in times of unpredictable ups and downs. (Rheude 2020.)

A strong dependence on importers and suppliers has emerged. The dependence of certain industries on major importers is a problem that sometimes completely halts a company's activities during a crisis. The closure of borders, a ban on exports and increased customs clearance time creates problems with deliveries. Problems with local suppliers are easier to solve. Quickly switching to work with a new supplier allows supplier portals, which have a wide functionality that allows not only to collect and store data about partners but also to digitize orders, optimize logistics and automate document flow. (Rheude 2020.)

3.3 Response to the crisis

With the onset of the crisis, states had to respond. States depended on each other. To provide everyone with the things they needed, states had to act. Governments have largely responded to this problem by identifying ports, shipping, and freight as essential services, and therefore exempting them from blockade measures. Although many airports around the world are blocked for pass-through flights, most are still available for cargo shipments, which can be critical to responding to COVID-19. To eliminate supply chain bottlenecks and facilitate customs clearance, third-party logistics companies and governments must work more closely together. (Twinn 2020.)

Companies themselves have also taken several steps. First, new security protocols were introduced. This has involved the introduction of a mask regime, distance requirements, and disinfection of the work area. Of course, this measure did not completely save the epidemic, but reduced the number of infected and increased the level of protection of employees. (Twinn 2020.)

Secondly, changes in transport were necessary. Maritime carriers played an important role in the immediate response to the coronavirus outbreak, providing food, medicine, and other essential commodities in a time of shortages. Despite the complexity of the situation, most

ports around the world remained open for cargo traffic, though still inaccessible to passengers. (Twinn 2020.)

Nevertheless, there are still few alternatives to maritime transport, and other transport industries are also subject to similar effects of the pandemic. Transportation of commercial goods by air has traditionally been less common due to high costs. With fewer flights and fewer passengers. Airlines have resorted to retrofitting planes to accommodate commercial cargo in the cabin, not just in the luggage compartment. (Twinn 2020.)

Other transportation industries are feeling much more confident in the crisis. In the current conditions a promising opportunity opened for cargo transportation from China to Europe by rail, given the significantly increased delivery time by sea transport and the rising cost of air freight, many companies may opt for the rail network, which is much less affected by the restrictive measures. Many companies have begun to switch from trucking to rail. (Twinn 2020.)

The third change has been the adaptation of the services offered to the current demand and security protocols. Given the situation, demand has changed, and companies have had to adapt. Some major players have played critical roles in the delivery of medical supplies. In February, for example, UPS supplied free air transport to Wuhan for two million masks and safety gear. Because demand for critical supplies is high, warehouses and retailers are focused on grocery deliveries, while companies in the last-mile category are offering no-contact delivery solutions. (Twinn 2020.)

4 Case study introduction

Case study research consists of a detailed analysis of an individual case. This type of research focuses on a bounded scenario or system, which is an entity having a purpose and working pieces. (Bryman & Bell 2011.) The case of this research is changes in supply chain caused by the pandemic. Such companies as Transval OY, IBM and Capgemini were taken to analyze the case.

4.1 Transval OY

Transval is 100% owned by the Posti Group. Posti is a prominent distribution and logistics company in Finland, Sweden, and the Baltic countries. They provide a range of postal, logistical, freight, and e-commerce services. They have the most comprehensive service network in Finland, visiting over three million households and companies each working day. (Posti a.) Posti reached a deal to acquire in-house logistics firm Suomen Transval Group Oy in September 2018. In January 2019, Posti finalized the acquisition of its in-house logistics firm. The purchase was a step forward in the logistics services expansion plan of Posti, and Posti has emerged as a major player in logistics outsourcing solutions in Finland. (Posti b.)

Transval OY is the market leader in outsourcing logistics in Finland. The company was founded in 1994. Transval employs over 5000 workers. More than 500 corporate clients in Finland and the Baltic nations have entrusted them with all or part of their output at their facilities, which include warehouses, terminals, factories, industrial plants, and stores. Transval owns 350,000 square meters of safe, certified, carbon-neutral storage space. Their services include responsible and safe supply chain solutions ranging from transportation to warehousing, as well as in-house logistics solutions and logistics professional human resources services. Their subsidiary KV Turva provides remote monitoring, loss management, and security vendor services to the retail industry. (Transval OY 2020a.)

The company has several shared values that guide them. These values consist of reliability, respect, progressiveness, responsibility, caring for people and society, and the environment. They are already 100% carbon neutral. Transval together with Posti, planning to push their emissions to zero by 2030. (Transval OY 2020a.)

4.2 IBM

IBM (International Business Machines) was founded on June 16, 1911, by Charles Flint. The company makes and sells computer hardware and software and provides hosting and

consulting services in IT fields ranging from mainframe computers to nanotechnology. IBM is also a research company that holds most of the patents created by American businesses. IBM (Big Blue) is one of the top 30 largest employers in the world. IBM is headquartered in Armonk, New York, USA. The company operates in five segments: cognitive solutions, global business services, technology services and cloud platforms, systems, and global finance. (IBM.)

IBM has a long history of global technology innovation. For 26 years, IBM has been the world leader in U.S. patents, six IBM employees are Nobel Prize winners, and IBM engineers have developed countless unique products and services. One of the technologies the company uses is blockchain. IBM is deploying blockchain technology with customers to transform global commerce, product security tracking, and supply chain management. The corporation has a presence in almost every country in the world. Its largest offices are in the United States and India. Together, the two countries alone employ more than 200,000 people. (IBM.)

4.3 Capgemini

Capgemini is one of the world's largest management and information technology consulting companies. It was founded by Serge Kampf in 1967 as a business management and data processing company. The company is headquartered in Paris, France. The company acquired its name by merging two organizations - CAP UK and Gemini Computer Systems. (Capgemini 2021.)

Capgemini employs over 290,000 team members in nearly 50 countries, including 100,000 of them based in India. Clients benefit from the company's assistance in building their businesses through the use of technology and digital solutions that are tailored to their specific needs, allowing them to attain competitiveness and creativity. (Capgemini 2021.)

5 Empirical research and data analysis

5.1 Design and formulation of the empirical research

The research, as stated in the introduction chapter, is carried out using the qualitative method. Qualitative method was applied through interview with the office manager from the case company, reports of Transval Oy, report of research company Capgemini, and published interview with IBM. The goal of the thesis is **to show how blockchain technology can help logistics companies.**

Due to the pandemic situation, the interview with the Transval OY office manager was conducted via email. The goal was to gain a better understanding of the case company's issues throughout the pandemic and how it has handled it so far. Appendix 1 contains the interview questions. The interview was conducted in English and consists of three main questions. It was found out in advance that the company does not use blockchain technology.

Reports of Transval were reviewed to determine the situation. The IT failure reports attracted attention. A report by research company Capgemini was used for the analysis. They surveyed 1000 companies from the consumer products, retail, discrete manufacturing, and life sciences sectors. The third main source of data was a published interview with IBM, which in 2017 announced a project that aims to explore the use of blockchain technology to control the food supply and improve food safety.

During the data collection for the empirical part, notes were taken and analyzed immediately. Then, when all the data were collected, was a data reduction process. This was done because qualitative studies usually produce a large amount of data, but not all of it is meaningful. Therefore, it was necessary to identify and focus on what was meaningful. The next step was to identify meaningful patterns and themes. To be analyzable, qualitative data must first be classified into the significant patterns and/or themes that you saw. Content analysis is used to carry out this process. This method of coding involves going through all the material and categorizing words, phrases, and chunks of text that connect to your research issues of interest (either using words or symbols). After the data has been coded, it can be sorted and examined by code to look for patterns. Next, the data has been collected, organized, and compressed into an image, which facilitated the conclusion. The final step was the formation and verification of conclusions.

5.2 Data analysis

5.2.1 Interview and reports of Transval OY

The interview with Transval presents 3 questions based on the research questions (Appendix 1). The first question was related to changes in logistics during the pandemic. The company highlights such change as the increase of e-commerce business. Transval expands its retail offering by acquiring KV Turva in 2020. The purchase of KV Turva, according to the firm, would strengthen their portfolio of services in the field of in-store expenditure control and remote monitoring (Transval OY 2020). E-commerce and retail digitization will open new potential for growth in retail store services.

On June 8, 2021, TietoEVRY's data center, which is an IT disruption of Transval, affected warehousing services (Transval OY 2021). A few days later, the work got back on track, but losses were incurred. The company announced that for those companies who have delays in data transfer and so on, they will work closely with the customer to bring services back to normal (Pyykkö 2021).

A weakness that has come to light in the company is the difficulty in notifying all employees of changes in instructions from management. The company highlights the rapid change of information and the inability to communicate on time and centrally. The main changes in the company were recommendations to protect and regulate the number of people in one room. Employees also have to do a lot of paperwork. However, it has become more difficult to organize the process because of restrictions.

5.2.2 Reports of Capgemini

Research company Capgemini published a report entitled "Fast for-ward: Rethinking supply chain resilience for post-COVID-19 world". The company surveyed 1,000 organizations during the study. According to this report, 80% of the companies report that they face serious problems in all aspects of their business. 72% of the companies surveyed had difficulties with end-to-end monitoring of the supply chain (Figure 5). Companies also experienced difficulties in supply planning, warehousing and distribution, difficulties in reconfiguring production lines, difficulties related to product delays in ports or border crossing, difficulties in supply planning due to lack of information about affected suppliers, and many others.

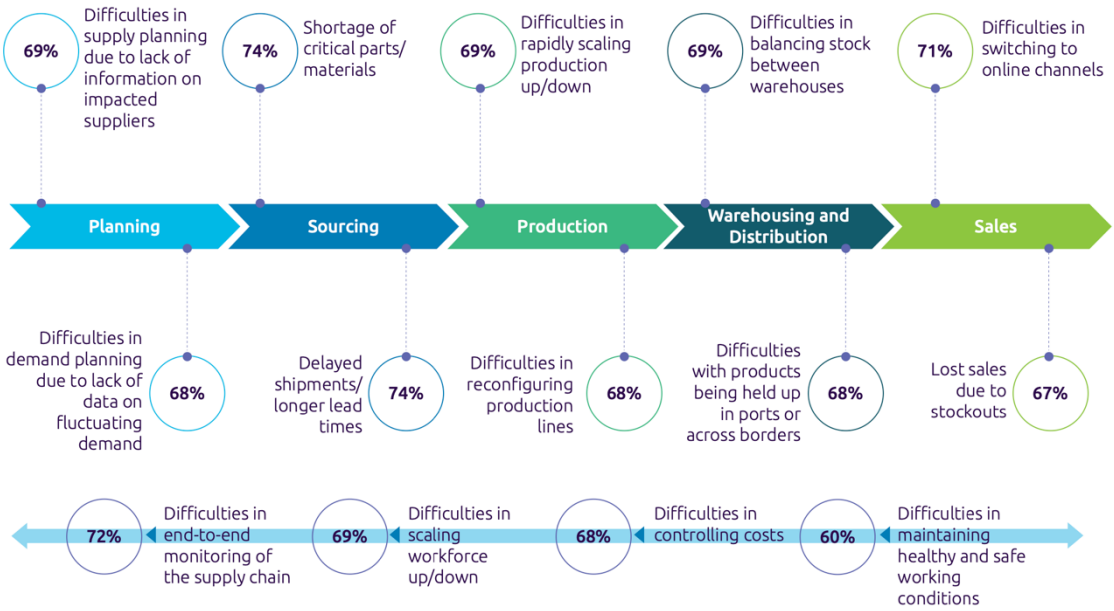

Figure 5. Percentage of organizations that faced significant challenges in each area

Companies understand that in this situation it is necessary to act. Thus, more than half of the companies surveyed believe that supply chain resilience is of paramount importance (Figure 6). This implies the ability of the supply chain to respond and adapt to changes in the environment so that its performance is within certain defined tolerance ranges or to return to baseline parameters within a given transition period.

Figure 6. Impact of the COVID-19 crisis on supply chain resilience

The Covid-19 crisis has impacted supply chain logistics systems around the world. If you measure the impact of Covid on supply chain companies around the world, just over half believe their companies need to change (Figure 7). The logistics industry in recent years has been characterized by the creation of complex supply chains with heterogeneous groups of remote suppliers. The model is based on complete interconnectivity between the

participants, technology, and transportation that promotes global flows. However, with a ban on the transportation of any goods other than life-support items, the flow of goods was significantly reduced, transportation was not full, and the cost of transportation increased dozens of times. Such organization of the supply chain is not possible now: the closure of borders and breaking of chains disrupts the former mode of operation.

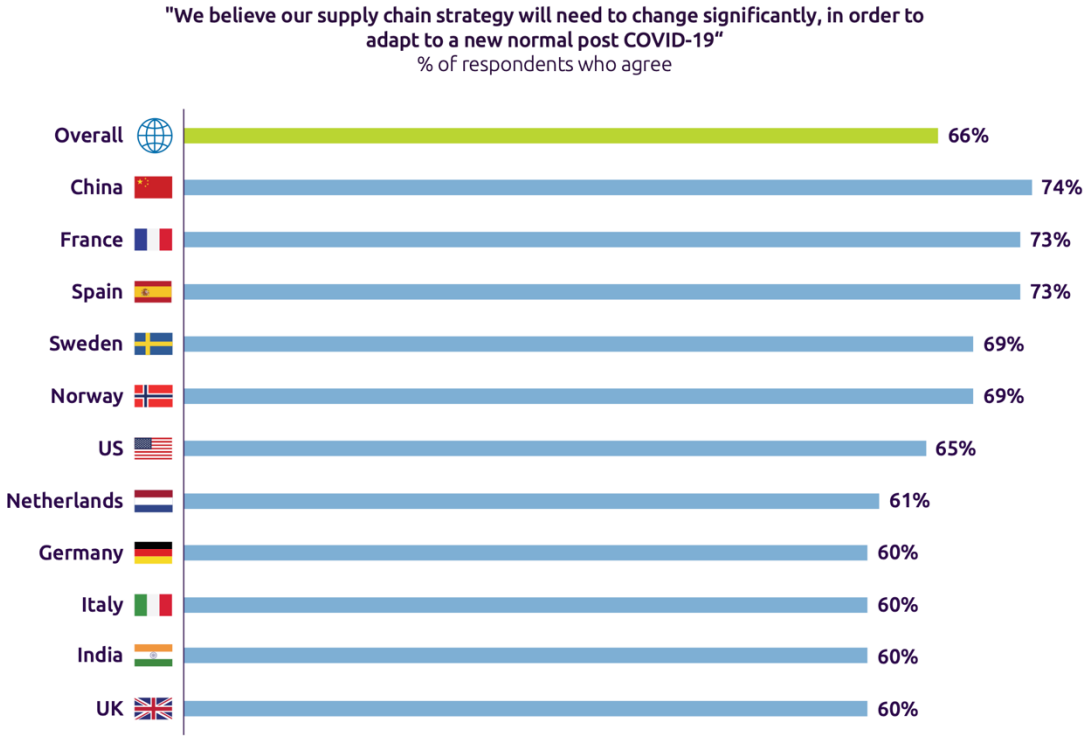

Figure 7. Percentage of organizations that see the need for a significant shift in them

5.2.3 IBM experience

Every year people die because of contaminated food. Problems affecting food safety, such as contamination, the spread of disease and waste, are exacerbated by the lack of access to and traceability of information. It can take weeks to determine the exact location of contamination. IBM has experience using blockchain to track food shipments. SVR technologies published an interview with IBM where they shared their experience.

The company has been working on a project with the Walmart chain of stores since October 2016. By implementing a distributed registry-based system, the retailer has reduced the time it takes to monitor mango shipments from seven days to 2.2 seconds.

In the interview, the company highlights 4 key components of the blockchain ecosystem. They are node application, shared ledger, consensus algorithm, virtual machine.

Each computer in the blockchain ecosystem must install and run a node application. The shared ledger can be managed and viewed through a node application that runs on every computer in the network. It represents a data structure that is distributed across all nodes in the blockchain network. The consensus algorithm is the part of the node application that provides the rules of how the blockchain network arrives at a single general ledger representation. The virtual machine understands a wide range of instructions, manages the state of digital contracts, and enforces contract terms.

IBM highlights the benefits of blockchain as secure online transactions, which comes at the expense of careful tracking of all transaction records. Blockchain also eliminates the double-spending problem because each block or unit can only be transferred once.

The company warns the challenge to overcome for market-wide adoption include getting the data onto the network. It needs to determine what information needs to get onto the blockchain, in what formats, for what types of food, and so on. The company is still working on this challenge and is moving toward improvements.

6 Conclusion

6.1 Answers for Research Questions

To answer the main research question, the sub-questions will be answered first. In this way, there will be a basis for answering the main question. All conclusions are made on the data of theoretical and empirical parts of the study. For a more accurate answer, a table 1 was created to collect the key findings for each sub-question.

Question	Key points
How has Covid-19 influenced global logistics?	• Supply disruption • Imbalance in cargo flows • Suspension of production • Change of demand • Disruption of producer and consumer connections • Introduction of restrictions • Switching to E-commerce • Introduction of IT • Increase of delivery time
What weaknesses emerged during the pandemic in supply chain?	• Increased paperwork • Reducing the number of employees • The problem of end-to-end monitoring • Supply planning • Warehouse management • Dependency on suppliers • Difficulty in notifying all employees of frequent changes
How is blockchain technology used in the supply chain?	• Customer service • Increases transparency, honesty, and openness in the relationship • Speeds up shipping • Safer online transactions • Identifies inefficiencies • Elimination of extraneous links in the supply chain = reduced costs • Supply chain optimization

Table 1. Key points for the research sub-questions

- How has Covid-19 influenced global logistics?

Covid-19 has affected logistics both negatively and positively. On the one hand, border closures disrupted shipments, resulting in large losses and increased delivery times and

costs. Due to the restrictions imposed, not all products could be exported from the supplying countries. This disrupted the usual producer-consumer relationship. With the onset of the pandemic, demand also changed, so some companies halted production, and some made high profits. The main positive change in the logistics sector has been stronger adoption of information technology and increased e-commerce. Companies began to review and improve their supply chains.

- What weaknesses emerged during the pandemic in the supply chain?

A big challenge for supply chain companies was the problem of end-to-end monitoring. This manifested as difficulty in tracking the location and condition of inventory, forecasting customer demand, and accurately tracking the share of transportation capacity. In cases of geopolitical unrest, a lack of end-to-end visibility into global supply chains can put companies at increased risk of disruption. Companies without transparent supply chains can suffer huge financial losses because they do not have enough information to identify and respond to disruptions.

Restrictions during the pandemic have had an impact internally and externally. Companies had to reduce the number of workers in one room. The amount of paperwork increased, and the number of employees decreased. Changes were happening weekly, and notifying employees became more difficult. If we talk about changes from the outside, Covid showed companies how dependent they were on each other. So, companies started to change their chains.

- How is blockchain technology used in the supply chain?

Blockchain technology is mostly used to monitor supply chain processes and for secure online transactions. In addition, the technology helps with customer service by making it easier to access all product information. The technology is valued for increasing transparency, honesty, and openness in the relationships of all supply chain participants. It also allows for faster transportation of goods, identification of weaknesses in the chain, and reduction of unnecessary steps.

- How does blockchain technology help solve some of the supply chain weaknesses that emerged during Covid-19?

Thanks to blockchain technology, the amount of paperwork is dramatically reduced. All data is in the cloud and there is no need for a huge amount of paperwork. The technology reduces unnecessary interactions that lead to duplicate documents.

The technology offers security and transparency in all steps. Companies can track changes and record everything - what was changed, why, who made the change, and when. Because all items in the chain have the same version of the registry, there is no disagreement about transactions in the chain, and the transaction process becomes more efficient. Once products are shipped and digital smart contracts are signed, the data is reflected in the public ledger. The data is stored along with information about who created it and when, and this information is extremely difficult to fake. Companies that have access to this ledger can track items and see who currently has the items.

Blockchain can be combined with the Internet of Things and mobile technology to develop real-time delivery monitoring systems. Tracking no longer needs to be done manually - instead, it can be done with digital sensors that track goods through the entire supply chain from start to finish. Using blockchain and the Internet of Things, logistics companies can reduce delivery times, make the logistics process transparent, and closely track deliverables.

Organizations can maintain accurate and up-to-date inventories using small sensors attached to products or objects. These smart inventories can provide a wealth of useful data about items, their past locations, onsite storage times, and more.

6.2 Validity and Reliability

When the same study is conducted under the same conditions, but on a different group of participants, the same results should be obtained. Validity is the extent to which the research method and its results meet the objectives of the study. High validity is characterized by a properly chosen research method that correctly identifies, measures, and interprets the object under study. (O´Brien & Orn 2018.)

It cannot be said with certainty that this study is reliable and valid. This study is qualitative and does not lead different groups of individuals to the same data. All the research questions were answered, and the purpose was accomplished. For this purpose, theoretical and empirical knowledge obtained during the study was used. The author of the study processed, analyzed, and published data collected from reports, articles, books, and interviews.

6.3 Suggestions for Further Research

This study focuses on a specific logistics company. As further research, we can look at how the technology is used in other areas such as medicine, aviation, charity, voting, and more. It is also possible to do a more in-depth study of the effects of coronavirus on logistics. Since this study was conducted a year and a half after the onset of the disease, not all the impact could be assessed.

7 Summary

The pandemic revealed the vulnerability of existing supply chains, with the result that strength turned into weakness. Supply chains were optimized for just-in-time deliveries. Stocks were exactly what was needed to meet current needs. But in a pandemic, the whole well-adjusted mechanism failed - it turned out that although stocks are expensive, it is not bad to have them for emergencies. This forces a rethinking of the approach to supply chain management.

New technologies offer promising opportunities for comprehensive supply chain improvements. The use of blockchain technology can help increase transparency and improve supply chain tracking mechanisms, as well as reduce administrative costs. This study presented the challenges faced by companies that do not use the technology. It also presents the experience of a company that has long implemented blockchain technology in the supply chain, which can be used as an example of the introduction of the technology.

Blockchain has the potential to transform supply chains and change the way we make, sell, buy and consume products. Increasing transparency, traceability, and security in supply chains could be a breakthrough in becoming a safer and much more trustworthy economy, by promoting trust and integrity and by preventing questionable practices.

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Appendix 1. Interview with Transval OY

How has Covid-19 influenced your company?

* Yes, Covid-19 has impacted our company and our customers. We can see that Covid-19 has increase e-commerce business and that of course impact logistics.

What weaknesses emerged during the pandemic?

* Information from authority guidance change very fast. This created need to change guidance to personnel weekly basis and challenge is how to reach all the personnel with new information.

Have you changed the way you work because of the COVID-19 pandemic?

* Yes, changed and we still have guidelines of the protection and regulation how many people in the same room. Hygiene guidelines have also been emphasized during a pandemic and this probably continue after pandemic.