



# Blockchain, IoT and Big Data technologies in logistics and supply chain

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The purpose of this thesis is to explore how new technologies can improve supply chains and logistics. Global supply chains involve many parties and they are very complex. Huge amounts of goods are moving every day, but they are not working effectively. Information flow is slow and it involves a lot of expensive paperwork.

If the supplier is on the other side of the globe than the buyer, they probably don't know each other's well, and that creates the problem. There's no trust. Businesses store all their data in their own silos and are very cautious about how to share it. Lack of trust creates huge obstacle and slows down the movement of the goods. In logistics, lots of old-fashioned documents are required.

The main objective was to investigate blockchain, Internet of Things and Big data, and try to find new solutions for suppliers of the goods. These new technologies have the potential to revolutionize supply chains. Especially blockchain. But there are many reasons why this has not happened. I try to find out what are the downsides and question marks that are slowing down the progress.

Sources that I used were latest articles and books, and I also had a chance to interview three global supply chain leaders.

Based on the results IoT and big data are already widely used, and these two technologies can offer new solutions for suppliers. Blockchains are not there yet, but there are already many different solutions available. In fact, most of the goods that are moving across the globe are already using blockchain based platform. And it works. But clearly there are reasons why it is not mainstream yet.

Keywords: Blockchain, Logistics, Supply chain, Internet of Things, Big data

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## 1 Introduction

International logistics and supply chain have developed a lot in the past few decades. The trade is more global and buying goods from other side of the world isn't expensive, thanks to emergence of containers. But there are still many challenges that needs to be solved. The movement of the goods can be considered fast, but the information flow behind it is not.

Lack of trust is probably the biggest obstacle in global trade. In international trade, the seller has many risks to worry about. Is he going to receive money from the buyer after sending the goods, or does he have to pay penalties if the delivery is late? In the meantime, the buyer of the goods might be also concerned about the late delivery, or the quality of the goods. What is the origin of the goods? Other parties such as transport companies, banks and customs are facing similar issues. Information flow is not efficient, transparency is lacking, and there are too many third parties involved. There are a lot of unwanted costs like the paperwork, which is expensive and there is lot of that, especially when the goods are moving across the borders.

Few years ago, the biggest shipping line in the world, Maersk Line analysed their supply chain and found out something interesting. They noticed that shipping one container full of avocados from Kenya to Netherlands had lots of friction during the delivery. The container was involved with over 30 different entities, and more than 100 individuals, and over 200 separate exchanges of information documentation. The majority of these actions was made completely manually, meaning that there were lots of time-consuming paperwork. Maersk estimates, that paperwork costs up to 15% in every shipment. And it is not going to get easier. The population of the globe is rising all the time, meaning more products are needed, and that creates even more pressure to companies to develop their activities.

New technologies such as blockchain has potential to overcome these challenges. In financial sector, the cryptocurrencies are already a big deal, and many people have heard about the Bitcoin which has millions of users worldwide. Technology behind this electric currency is blockchain, and logistics and supply chain are expected to be the second most important target group.

The Internet of Things (IoT) has emerged in recent years, and it is widely being used in logistics and supply chains. And today there are many different solutions to track shipments, and everything can be seen in real time if the shipment is equipped with smart tracking device. Logistics and supply chains are also transforming into more data-driven industry, and many big companies are analysing data in order to make better decisions.

There are several technologies that are used in supply chains, but I selected these three because I believe they have the best potential. In this study I am focusing more on blockchain, because they are not so well known. IoT and big data have already emerged. Logistics is part of supply chain, but because these two are using these technologies in different ways, I decided to include both.

The purpose of this research is to find out what kind of solutions these new technologies can offer to suppliers. Especially in logistics many companies are using different technologies and developing new ways to deliver the goods. But what kind of opportunities there are for the shipper of the goods? What are the benefits, and what kind of risks there are? I try to find answers to these questions, by reading books and latest articles. I also had honour to interview three supply chain leaders who have been in charge of global supply chains. I wanted to know what experts think about these technologies and what they expect from the future.

At the beginning of the research I will explain the basics of different technologies. I will then explain how these features can be utilized in supply chains, and then I will present a number of practical examples. After that I go through the results of the interviews and finally you can see results and conclusion from all of this. My ultimate goal is to find new solutions for the suppliers of the goods, that can be achieved with these new technologies.

## 2 Blockchain, Internet of Things and Big data

In recent years, several different technologies have been developed that are now used in logistics and supply chain. Some of them are more mature and already widely used, but others are just making their way. I chose these three technologies because I personally believe they have the greatest potential. I have some data analysing experience and I've been using IoT devices, and I have also previously studied blockchain operations in the financial world. Generations have evolved, and nowadays people are used to getting everything they need very quickly. Demands are also increasing in supply chains and these different technologies can provide more efficient solutions.

Blockchain has huge potential. Deloitte surveyed ~ 1400 senior executives in several countries, who are working in large global companies. According to Deloitte's 2019 Global Blockchain Survey were, 53% said that blockchain has become critical priority for their organizations. The result has increased 10% from last year. 77 % believes, that they will lose competitive advantage, if they are not adopting blockchain (Deloitte 2019).

The popularity of blockchains continues to grow. The financial sector is the clear leader, and other industries are following them with a bit more cautious approach. The development of

others is a bit slower, but sometimes development can come faster than expected. For example, 3D printing was not widely believed a few years ago, but now it is widely used (Deloitte 2019).

Participants of the survey sees blockchain a connecting platform than can enable many business processes. “The question for executives is no longer - will blockchain work - but, how can we make blockchain work for us?” Companies are no longer so pessimistic about blockchains. They are more concerned how this affects the way they operate? How will it change existing industries and what kind of new markets will emerge? (Deloitte 2019).

## 2.1 Blockchain explained

Blockchain is currently best known for being the technology behind Bitcoin. Cryptocurrencies has been revelation in finance, but logistics and supply chain are believed to have second highest potential.

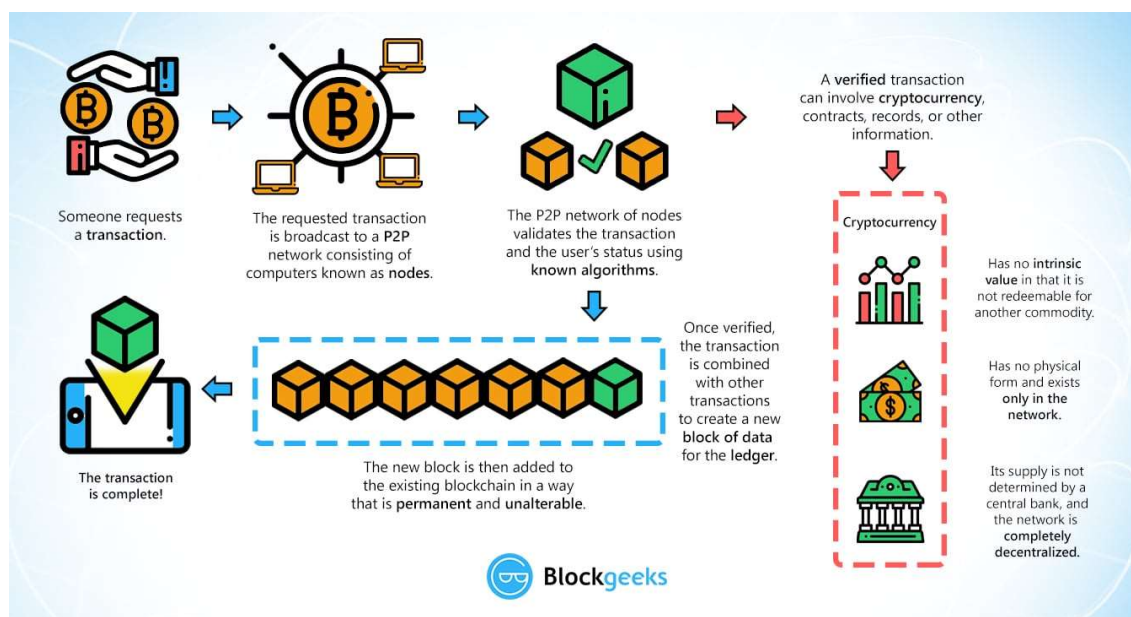
Blockchain was invented in 2008 by a person who uses pseudonym Satoshi Nakamoto. Decentralized technology is managed by peer-to-peer network and it provided platform for Bitcoin cryptocurrency. While Bitcoin was the pioneer in blockchain technology, in 2013 programmer called Vitalik Buterin discovered that there is a need for scripting language, which can be used for creating decentralized applications. Buterin was unable to reach mutual agreement with the community, and decided to start developing new platform called Ethereum, which had new ground breaking feature, smart contracts (Binance 2019).

Blockchain is a new way to share and document data. It's a decentralized digital ledger, where users can share information securely without any need of a third party. Users and their devices are called “nodes”, and they can make transactions with others, like transferring money for example. Every transaction is verified by the consensus, meaning no one can make changes by themselves. After transaction is verified in the network, all information is added to a block. New block is then added to a blockchain, where are multiple copies of the same data are stored in different locations. When each block forms a complicated chain, it is almost impossible to make any changes after that, thus making it very secure for its users (McDaniel & Norberg 2019).

Blockchain offers several benefits to its users. One of the advantages is reduced costs, which is possible because it eliminates the need of third parties. With no central authority, the transactions are significantly faster in blockchain technology. Privacy is enhanced and such transparency has never been possible before, because all transactions are verified. Faster

processes and reduced error rates lead to improved efficiency and better quality, thus allowing making better profits and growing business. (Mougayar 2016, 48)

Picture 1 Blockchain explained



## 2.2 Types of blockchain

There are three main types of blockchain, and each one has their own benefits and downsides.

Public blockchains, like Bitcoin is open for everyone, and the whole ledger is shared between many participants. Transactions happens very fast with blockchain technology. It allows users transfer money from other side of the world in seconds, because there is no third party like bank involved. Transparency is a big feature. In public blockchain users can see transactions what others make, but the information contains only secure data, like date and the amount of money being transferred. Hacking the system is very hard, because you would need unrealistic amount of resources. It's impossible to make changes to one block, because every new block need authentication and the blocks are connected into complicated chain. You would need to make changes to the entire database to gain consensus, which is difficult because the community has hundreds of thousands of users (Hedge trade 2019).



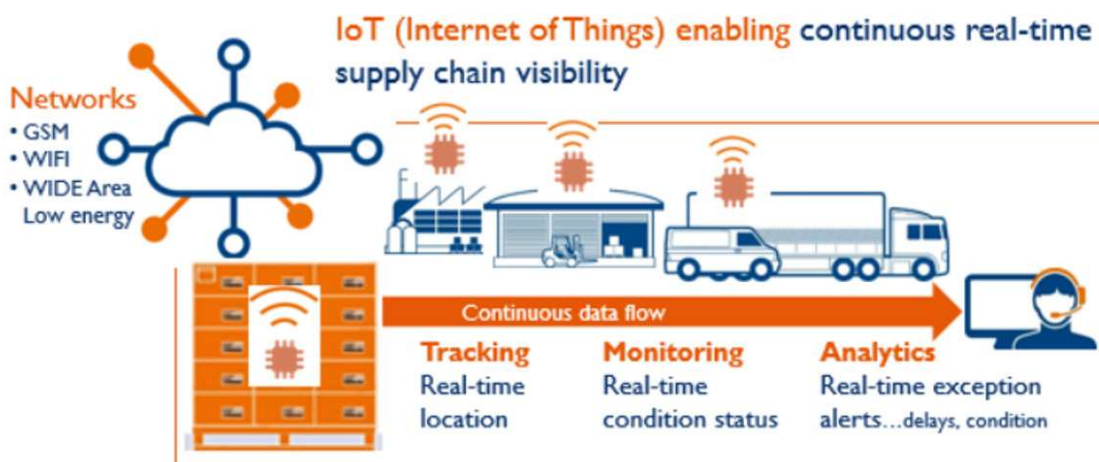
Private blockchain is built for private business, where bigger companies operate in order to improve their activities and grow profits. Transactions are even faster than in public environment. The ownership is more centralized, and the owner of the platform manages environment by determining the rights for each participant. Members of private blockchain cannot join themselves - they need permission to join. Participants know each other, but they can't see details of the transactions. Private blockchain has one key downside and it is lower security than in public blockchain, where every transaction is verified by the community. In private blockchain there are only a few parties - or maybe just one - who can verify transactions, which allows owners abuse transactions (Hedge trade 2019).

Third blockchain type is called consortium, which is also built mainly for enterprises. It's a mixture of public and private blockchains. The system is semi-decentralized, which means that there is dedicated user group who is in control. Transactions are verified by larger group than in private network, but there are far less participants than in public blockchain. Consortium blockchain has basic security features but has more control on network (Hedge trade 2019). Blockchain based platform Hyperledger is one example of consortium blockchain.

### 2.3 IoT - Internet of Things

Internet of Things (IoT) is a system of interrelated computing devices and machines. These smart devices have sensors, processors and communication equipment, and they are capable to collect data, and send it without human interactions. The device can be almost anything from implant which monitors heart rate, to sensor which will alert the owner when the car needs maintenance. The whole concept Internet of Things was invented already in 1970, and IoT was first mentioned in 1999 when Proctor& Gamble had presentation about RFID's. But the real emergence of IoT happened in 2010, and since then billions of devices have been manufactured. (Rouse 2019)

Picture 2 IoT in supply chain



IoT helps managing supply chain easier and it can help companies to grow business. IoT is already involved in every industry, and it has much untapped potential. The ability to get access of real time data at anytime, anywhere is a huge benefit. It can make decision making easier, improve customer experience, and enhance processes. The fact that human intervention is reduced - or removed completely, can lead to significant costs and time savings. Cisco has estimated, that IoT will have an \$11 trillion impact by 2025. (Rouse 2019)

In developed countries dozens of devices like smartphones, computers, televisions and many others are being used every day by one person. There are currently approximately 15 billion IoT - devices in use worldwide. That number is huge, but they only represent less than 1% of every device that has potential to connect with internet. But this is just the beginning, there might be approximately 50 billion IoT- devices in the world by the year 2020. (DHL 2015)

Shipment tracking is essential part of logistics. Management needs constantly real-time information about the movement of the goods, and this is where IoT- devices can offer a lot.

In modern warehouse business every inch of the warehouse space should be used as efficiently as possible. The movement of the goods needs to be fast and, and cost of activities low. Personnel safety is also important aspect of warehouse business. Pallet can be equipped with IoT devices, which will give signals about their location. Information is transmitted to system and the inventory levels can be seen from there. Scanning the pallets helps controlling the stock levels. When the pallet is scanned in the departure area, the information obtained from it can be used to fill the stock levels where it left. Devices can also send alerts, when they are not utilized properly. Forklifts can be also equipped with IoT devices for employee safety purposes. Almost every accident with forklifts happens with pedestrians, and the lack of driver's visibility is usually reason behind the accident. Forklift can be equipped with IoT device, which automatically slows down in intersections, when it senses that there are

pedestrians or other forklifts around. The device can also alert the driver, when he has too much load. (DHL 2015)

Tracking and tracing shipments in freight transportations is nowadays possible because of IoT-devices. The data logger is one example of an IoT device. It is an electronic device which includes processor, memory, and battery. A standard logger can record, for example, temperature data, and the data is obtained when the device is connected to the computer via a cable. However, at this stage the damage had already occurred and nothing could be done to prevent it (Trusted Global 2019).

Modern IoT data loggers have been developed to meet this need. They are capable of transmitting data in real-time through various connections and can also be remotely controlled. The device is capable of transmitting data, by using GSM /GPRS networks. 3G and 4G networks provide positioning information. 4G is a newer network and it is capable of higher speeds than 3G. If no positioning information is received via 3G or 4G, it may be obtained through the GSM network by calculating triangulation. Downsize with triangulation is, that it is not very accurate. But it is still better than nothing (Trusted Global 2019).

Next generation IoT- devices have many functions and sensors. For instance, IoT- device can monitor temperature and humidity. This is very valuable feature for goods that are temperature sensitive, for example medicines and food products. Intelligent devices are also capable to track shock- and light events. Shock sensors may indicate where potentially damaging impact may have occurred, or the light sensor might detect light, if someone is opening the package or container without permission. Thefts from organized crime cause loss of billions of dollars every year around the world. According to global logistics security service provider Freight Watch, 946 cargo theft incidents was reported in USA, and 689 in Europe, in 2012. (DHL 2015).

When positioning is added to data that other sensors keep track, the event has more accurate information, and it may indicate when and where the unwanted event happened. All sensors can be set to send immediate alerts if condition ranges are exceeded, which helps preventing potential damage. The information that IoT - loggers have collected can be viewed and managed through a web-based interface, where the data can be processed to a visual format. Devices can be controlled and managed in real time. They will continue to save data even if the data cannot be sent for any reason, and then send all the stored data the next time the connection is established. For example, a container sailing in the ocean may travel long distances in difficult conditions, and the goods may be damaged during the trip. There might be no network in the middle of the seas, but as soon as the ship arrives at the port and the device is connected, it transmits all stored data. In short, IoT- dataloggers have several benefits. They improve visibility, efficiency, safety and these smart devices decrease the amount of delays,

risk of theft, and fuel costs. Better overview of the whole supply chain can be very profitable. (Trusted Global 2019).

In logistics and supply chain, IoT - devices can enhance fleet management. Optimizing vehicle usage is top priority for many companies and organizations who own large fleet. Managing transportation and cargo movement in large logistic hubs like in harbours can be a huge challenge, especially during rush hours when there is much traffic generated by trucks, trains and ships. Traffic flow needs to be as efficient as possible, and units equipped with IoT- devices that are capable to track positioning, can provide better overview of movement. (DHL 2015)

## 2.4 Big Data

Global research advisory company Gartner Inc. defined big data in year 2001: “Big data is data that contains greater variety arriving in increasing volumes and with ever-higher velocity”. In the beginning there was three Vs in big data. Volume, Velocity and variety.

Volume refers to the incredible amounts of unstructured data which is generated each second from webpages, mobile apps, sensor equipment's etc. Velocity refers to the speed. It's about how fast rapidly rising amount of data can be received and handled. Variety is defined as all kind of types of data we can use. Traditional data is structured, and easier to use. But big data is usually more unstructured or semi-structured data. Latter one, for example audio file needs additional pre-processing before it can be used.

Later two more Vs emerged, value and veracity. Big data is nowadays valuable capital. But even though if someone has large amount of data, it is useless if it doesn't provide any value. Storing data is expensive, but the costs are decreasing all the time. Veracity helps to filter through what is important and what is not (Oracle 2019).

Using IoT- devices will generate a tremendous amount of information that can be analysed and used for business developing purposes. Data is very valuable, and the amount of data is increasing rapidly. Big global companies are investing on it heavily, and others are following. Analysing data helps company's management making better decisions, when they are developing their business activities. In logistics and supply chains, especially location information is an important information for the customer and service provider. By analysing data, management can develop existing processes as well as help creating entire new businesses. (Kazemi 2019).

One example is a possible product recall if tainted product has been detected. For example, if a product is medicine, each item related to a batch has to be tracked immediately. The movement of the goods must be stopped, and the product must be returned to the sender in the best and most effective manner possible. Positioning data can also be used to determine the best possible route for vehicles that are delivering goods. For example, if certain part of the road is not in use, because of traffic jam or accident, IoT devices can collect information and that data can be analysed, in order to find best possible alternative route (Kazemi 2019).

Picture 3 Examples of big data usage in supply chain

Product design					
Supply chain design					
A. Sales, inventory, and operations planning					
• Supplier risk management and incoming goods projection		• Inventory projection and scenario planning		• Forecasting accuracy evaluation and optimization	
B. Sourcing	C. Production	D. Warehousing	E. Transportation	F. Point-of-sale	G. Consumer
<ul style="list-style-type: none"> <li>• Cost modeling to identify cost drivers</li> <li>• Quantification of benefits from spend pooling</li> <li>• Automatic analysis of contract compliance</li> <li>• Aggregate demand/supply balancing</li> </ul>	<ul style="list-style-type: none"> <li>• Scheduling of energy-intensive production</li> <li>• Statistical quality control and tolerance optimization capabilities</li> <li>• Lot sizing and scheduling considering cost, inventories, and capacities</li> </ul>	<ul style="list-style-type: none"> <li>• Picking zone/ warehouse space allocation</li> <li>• Worker to picking zone allocation based on efficiency</li> <li>• Automatic stock relocation in high bay storage areas</li> <li>• Cleansheet cost modeling</li> <li>• Workload optimization</li> </ul>	<ul style="list-style-type: none"> <li>• Real-time routing and ramp allocation at warehouses</li> <li>• Delivery scheduling in line with consumer patterns</li> <li>• Cleansheet cost modeling</li> <li>• Dynamic routing</li> </ul>	<ul style="list-style-type: none"> <li>• Out-of-stock detection and prevention</li> <li>• Shelf space optimization</li> <li>• Channel/store allocation of goods maximizing service</li> <li>• Retail employee scheduling</li> </ul>	<ul style="list-style-type: none"> <li>• Credit rating to define payment terms offered</li> <li>• Return projection to calculate outstanding inventory</li> <li>• Product recommendations based on purchase history</li> <li>• Fraud detection</li> </ul>

Fuel consumption is a huge expenditure in logistics, but it can be measured more effectively with big data. Global courier companies have started to develop their routing activities with real-time data from vehicles, and traffic. For example, UPS has developed its own system for a decade to make their network of over 50 000 routes act more efficiently. The new system can save \$300-400 million annually. Delivering packages efficiently is a challenge, because receivers are not always available. 1-2 failed deliveries a day may not sound like a bad deal, but if they happen to more than one driver, they will cost a lot - especially in the long run. Additional deliveries also lead to higher emissions which should be avoided. Analyzing data can help you estimate when the customer is more likely to be at home. (KPMG 2017).

### 3 Blockchain in logistics and supply chain

Technology wise it is possible to develop supply chains and logistics many ways. For instance, creating new prototypes with 3D printing and developing new products and platforms with customers are few examples what supply chains research and development might be. Big data can be used in advanced demand planning and sales operations. Procurement and sourcing can gain benefits from testing virtual parts and packages, and order processing can be enhanced with robotic automation solutions. In production stage role of machine automation is rising, and humans can gain benefits in products assembly processes, when they use smart glasses. In transportations, goods can be moved with driverless trucks and autonomous vehicles in warehouses. Conditions of the shipment can be measured in real time with smart sensors and drones can be used for “last mile” deliveries. At the end of the supply chain, service providers who are receiving the goods can use 3D printing for spare parts, and smart glasses for fixing equipment. Predictive analysis ensures that the equipment is in good condition. If sensor senses that certain part of the machine is at the end of its lifecycle, it informs it in real time (Capgemini 2018).

#### 3.1 Digital supply chain

The digitalization in supply chains and logistics is developing rapidly. Technology investments are top priority for many businesses worldwide, and investments in transformation were almost 93 billion dollars in 2018. Following technologies are considered as a key initiative in digital supply chain: Internet of Things, Business Intelligence, Advanced Analytics and Artificial Intelligence, Robotics, Robotic Process Automation, Automation, 3D Printing/Additive Manufacturing, Mobility, Blockchain, Augmented Reality and Virtual Reality. (Capgemini 2019).

According to Capgemini’s survey, 53% of the manufacturers has supply chain digitalization as a top priority. Reason for this high percentage is simple - it provides best returns. Procurement and supply chains tops in both categories - average ROI and average payback periods - when comparing to others like, human resources, finance and accounting, research and development, customer service, sales and so on. Businesses are investing in digital supply chains because of increased revenue, cost savings, new business modules and being more customer-centric. (Capgemini 2019).

Picture 4 Examples what blockchain can do in supply chain



### 3.2 Smart contracts

One of the biggest benefits of blockchains is the ability to use smart contracts. Establishing and verifying contracts is very demanding, and sometimes it is not possible to operate with contract, because of lack of resources.

Smart contract is an agreement between two or more different parties which is written in code into blockchain. It's like Excel's IF function: if something happens then something follows. Smart contracts contain all the content of the contract in digital form and the functions are executed automatically. Transactions can be traced and not reversed, which makes them reliable (Innanen, Eerola 2019).

With smart contracts there is no need for third parties, such as banks and lawyers. They have traditionally been necessary, but their downside is that they increase contract costs and delay the process (Innanen 2019).

Larger contracts will most likely continue to need the above-mentioned parties, but a smart contract can be a good solution for smaller contracts. The benefits are in savings of time and money. The amount of paperwork is decreased significantly for example. All approvals and signatures can be executed faster. Other advantage is, that all data is instantly accessible. The delivery of the entire shipment can be traced back to the origin in seconds. And the information is secure. No one can edit them by themselves (Blume Global 2019).

Smart contracts are not all the same. Some may be based entirely on information generated by the code, or they may also include some natural language. However, most contracts are completely digital when their interest lies in automating transactions (Innanen 2019).

In logistics and supply chains smart contracts can provide real-time data of deliveries when IoT devices are also connected to shipments (Innanen 2019). One example is the goods received notification. When shipment is equipped with IoT- a device that is capable of tracking the location, the payment can be made automatically when certain conditions are met. This means that the seller of the goods no longer has to create an invoice or send it to the recipient. Invoice processing is removed from both parties, and the error rates will decrease. It also means less reworking (Blume Global 2019)

### 3.3 Alliances and projects

#### 3.3.1 Smartlog, Kouvola Innovation

Kouvola Innovation Oy leads EU - funded innovative project called Smartlog. It started in 2016, and the aim of the project is to connect several logistics companies into one blockchain based platform. Other participants are from Sweden, Estonia and Latvia, and the aim is to improve the transport flow of cross-border shipments. The project has three stages, working, analysing and developing. Working belongs to Estonia based company called Sensei LCC, and it is responsible of gathering feedback from companies who are responsible of transportations. Tallinn University of Technology is responsible of creating the framework, for how to analyse the data. Kouvola Innovation Oy will provide and develop the actual software for the project (Smartlog 2019).

In Europe, transport companies operating Northern Europe and Baltic regions are facing similar kind of problems that many others have around the world - information flow is not efficient. It doesn't matter if the company is small or big. The one that is investing a lot for its own IT, is operating as inefficiently as the one who doesn't have comparable resources, because they need to inform each other's. It's a teamwork because many cross-borders shipments are handled by several carriers. There are thousands of different software's, which might have good in-house functions, but they fail when they should communicate with others. Basic work is also inefficient, because it includes a lot manual work. When information is not flowing automatically, humans need to operate, and it means more expenses. Humans make



errors - well because we are humans - and the data is not always reliable for many reasons (Smartlog 2019).

It is obvious, that there is a need for a platform that connects many users in a way that they can understand each other's. Transactions needs more structure, and blockchain based platform might be the solution for everyone. Blockchain might improve efficiency similar ways, if every transaction is validated and time stamped. Automatic processes and real-time information have huge potential. Increasing the trust by sharing safe and reliable data between others is the key in futures logistics (Smartlog 2019).

### 3.3.2 BiTA

BiTA was founded in 2017 and it is already the biggest blockchain alliance in the world with over 500 members. The community aims to develop best practises and standards for blockchain in transportation industry. Members of BiTA are logistics and transportation providers, suppliers and technology companies. The most notorious ones are UPS, FedEx, Panalpina, Procter& Gamble and Google (BiTA 2019).

### 3.3.3 Hyperledger

Hyperledger Fabric is a modular blockchain framework, created by Linux Foundation. Members of Fabric can define asset types and consensus protocols, and they can set permissions on who can join the network. The architecture is highly modular, meaning that businesses can plug in different functionalities to suit their particular needs. Unlike other blockchain applications like Bitcoin where users are anonymous, users of Fabric network know each other's in order to gain more trust (Hyperledger Fabric 2019).

Previously businesses had following problems with blockchains - everyone could see all the information in the transactions. But Hyperledger Fabric's has a feature called private channels which makes transactions private. Only those who have been granted access to the specific channel can see details of the transaction. By using the channel companies can't see competitors transaction details if they are now allowed to, like agreed price for example even though they are using the same platform (Hyperledger Fabric 2019).

Fabric is the first technology to support smart contracts, and first that enables use of standard programming language. Smart contracts are called as "chaincodes" in Fabric, and they

enable businesses to make transactions without need of third parties (Hyperledger Fabric 2019).

### 3.3.4 EU Blockchain

The potential of the blockchain in public services is also being carefully studied in the EU, because they want to increase trust in information and processes between every stakeholder.

EU has approximately ~250 000 personnel working in public procurement, and together they spend approximately 14% of GDP (2 trillion euros) for services every year. EU is the main principal in many sectors, such as education, health, transportation, energy and so on. Numbers are huge, and it is no wonder that EU tries to find ways to cut down the expenses. Reducing the costs with just 1% might save 20 000 000 000 euros. EU aims to improve transparency, integrity and data, and it also boost digitalization in procurement (European Commission 2019).

EU Blockchain is a project which is initiated by the EU. The aim of the project is to advocate blockchain innovations and the development of the blockchain ecosystem in the union. The ultimate goal is to make EU as the global leader of blockchain technology (EU Blockchain 2019).

Governments generally play a key role when defining rules in international trade for other business, and with blockchain technologies customs from different countries are in a spotlight. But in addition, EU also has its own processes that can be developed. Most important processes are probably in finance sector, but developing supply chain is also important for EU. One of these is in procurement, where an audit trail could be a potential area for improvement. Traceability is very important factor, and the essence of the audit trail is that it fulfils precision and accuracy and the principles of perfection. Blockchain technology is a perfect match here, and it might also improve the overview of procurement, which could be huge for the officials (EU Blockchain).

The EU is also interested in the potential of smart contracts. The procurement might be more efficient when decision-making between suppliers is much more transparent and more secure. A smart contract can for example speed up the payment process. Automatic payments could be introduced between the EU and the suppliers, and the payment would take place once certain conditions of the contract were met. This would also include valuable information for the reporting and accounting (EU Blockchain). EU clearly sees the potential of blockchain, but wants to see more experiments.

## 4 Case studies in future's logistics and supply chain

### 4.1 TradeLens - created by Maersk and IBM

Maersk is the largest container ship operator in the world, and together with IBM they built supply chain ecosystem called TradeLens. Blockchain based system is open for everyone and the aim is to share efficient, transparent and secure exchange of information between all parties involved. Approximately 10 million events and more than 100,000 documents are being handled in Trade Lens every week (TradeLens 2018), and more than 154 million events has been recorded in the blockchain, and the numbers are growing by one million per day (IBM 2018).

TradeLens objectives are to connect everyone involved in the supply chain to use one platform, which offers secure, reliable and efficient data in real time. Owners of the goods, transport companies, customs and many other parties are allowed to join. System creates trust between participants, which leads to managing logistics and supply chain more effectively. The details of the cargo, location, trade documents and other information can be gained easily, which also makes it easier to predict and prevent unwanted risks which might occur (TradeLens 2018).

IBM and Maersk are part of the advisory board, but the TradeLens itself is not a company. It is just a platform and everyone is free to join, to share secure and reliable data. By joining to TradeLens, users gain several benefits. Ports and terminal for example, gain advantage when they have more information about the cargo which is arriving or leaving. It is easier to associate with other parties, and managing own activities is easier because you have more accurate data available. Ocean carriers doesn't have to invest so much for customer service, because information is easily accessible, and cargo handling errors are reduced. Owners of the goods have better understanding about the status of the cargo, thanks to transparent ecosystem which makes it also easier to predict incoming actions, that are required. For transport companies, this means that planning and optimizing fleet is more effective, and making custom clearances with customs is much easier for freight forwarders. It also means less paperwork for governments and financial services also gain several benefits when information is real-time (TradeLens 2018).

In 2018, already 94 different organisations were involved with TradeLens, or had plans to participate. Over 20 port and terminal operators across the globe, including Hong Kong, Singapore and Rotterdam - are currently involved, and these are one of the biggest in the world. Several freight forwarders, shippers, inland carriers, and customs have joined as well, and the numbers keeps rising (IBM 2018).

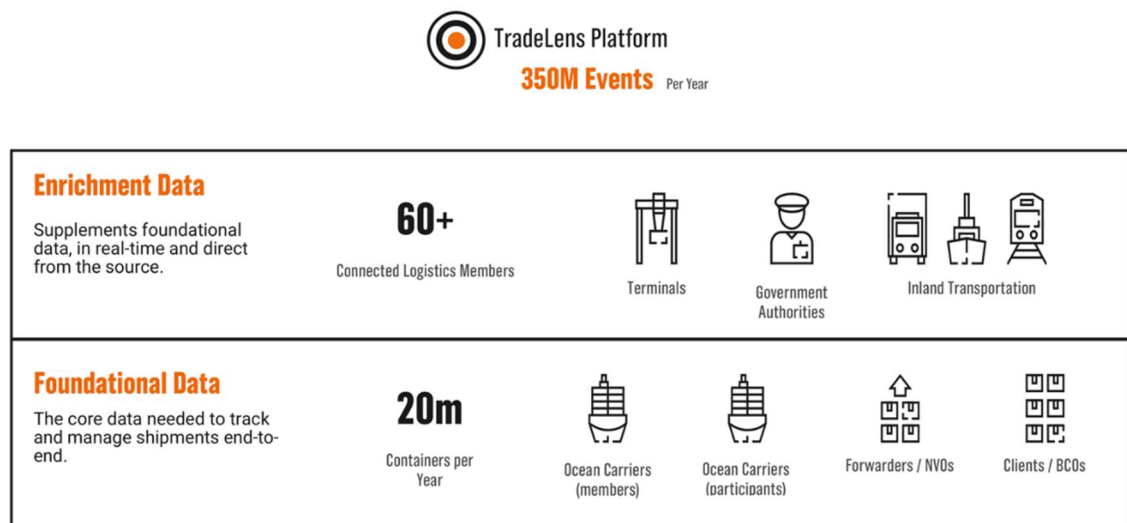
In May 2019, the second and third biggest ship operator's CMA CGM and MSC joined TradeLens, meaning almost half of the world's container movement are connect by the same innovative ecosystem. The platform already has over 100 daily users, and the numbers are expected to grow. CMA CGM and MSC have key roles in TradeLens network, where they validate transactions, host data and work with advisory board. New key players are excited to be part of a new ecosystem, which allows companies to create new kind of business models (Maersk 2019).

Procter and Gamble - one of the biggest cargo consignors in the world gains huge benefits from the platform, because most of their goods are shipped in containers. Managing supply chain is very effective, because shipments can be tracked real-time (Maersk 2019).

TradeLens provides secure platform for its users to share documents. Companies can have different kind of rights and access to data. Owner of the goods might have full access, while transportation company could have limited vision. By giving permission, participants are able to upload, view, edit, and download documents. Documents can be either structured or unstructured. Structured documents contain lots of data and are easily modified, and they offer more options to users, for example process automation. Unstructured documents, like scanned PDF are easy to share between different parties. Every document can be found faster and more easily, because everything is in one place. No one has to check anything from their own database or emails. Every time document is edited, new version is created and the previous one is eliminated (TradeLens 2019).

Example of workflow in TradeLens: Container is stuffed by the shipper, and the final packing is uploaded to ecosystem. Next, the freight forwarder obtains packing list and commercial invoice from the system and creates customs clearance. After the clearance, every document and every version are stored in TradeLens, where blockchain provides that data is stored safely, and every transaction can be tracked and reviewed (TradeLens 2019).

Picture 5 Statistics from TradeLens platform



\*Ocean carriers who are not network members can provide data as requested by their customers.

#### 4.2 IoT in transportation - Case port of Hamburg

Port of Hamburg is Europe's second biggest harbour, and it is located at the city centre area. Almost 10 million containers pass through the harbour every year, and that number is expected to double by 2025. Over 40 000 trucks are moving around the harbour area, where are over 130 bridges and road approximately 140 kilometres. Traffic flow needs to be efficient and the idle time needs to be as low as possible. Increasing the size of the port was not an option, and the authorities of the port had to find another solution. In 2016 authorities installed IoT- devices around the harbour and worked with SAP to build cloud- based platform, where the goal was to connect harbours numerous stakeholders. Nowadays land, rail- and ocean carriers, customs, terminals and warehouses and many other operators at the harbour receive traffic and coordinating information via mobile phones. Vessels and trucks receive information in advance, which bridge is being lowered, and what is the best route. More efficient traffic management also means less pollution. (Forbes 2016)

### 4.3 Cargo X

Bill of lading is one of the most important documents in logistics and Cargo X has created innovative blockchain based platform for carriers, forwarders, and other parties who are involved in the process. Blockchain based Bill of lading has several benefits. For traditional paper version the transit time might be 5-10 days, but with blockchain it happens immediately. It can't be stolen or lost, and data can be stored, and it can provide other information about the cargo as well. European transport companies Mitsui Group and Fracht are one of the biggest partners, and Cargo X is also member of BiTA, Blockchain in Transport Alliance (Cargo X 2019).

## 5 Challenges

Creating blockchain consortiums is a huge challenge for supply chain leaders. Suppliers are competing against each other's and it is a very difficult task to attract different parties into same complex project, where designing and implementing takes a lot of time and resources. Participants need to be engaged and they need to believe that it can deliver good results (Accenture 2018).

Sharing standardized data globally is not an easy task either. Participants need to decide what kind of data is being used, and what is not. Everyone needs to have different rights because not everyone can see all the information, such as competitors' prices. Defining these common rules among the various parties can take a lot of time. Legal and compliance regulations must be taken into account when defining the solution. In order to make sure that the solution works, especially compliance needs to be part of the design (Accenture 2018).

It will take some time before majority of the organizations will implement blockchain solutions, and replace current systems. Almost everyone is expecting to see fully functional ecosystem that works, before they are going to invest anything on it (Accenture 2018).

According to Deloitte's survey, blockchains are now considered to be one of the top priorities for participants, but only 23% have started blockchain development - the number has gone down 11% from the previous year. 43% of respondents believed that blockchains were overhyped. Organizations have many different kinds of obstacles that prevent them from implementing blockchains. These barriers are illustrated in this following figure (Deloitte 2019).

According to Capgemini's survey, 51% of respondents think that lack of talent is a big challenge for companies, when they are developing digital supply chains. It is hard to find talented employees and retaining them. With IoT security and privacy are key concerns. Hackers might cause lots of destruction if they manage to break into the system, and history already has several unfortunate cases. It is also hard to find proper business cases for IoT devices. The project may not receive funding or will not be supported by management. Smart devices generate lots of un-structured data, which is hard to use. Even though there is lots of data, management doesn't know what to do with it. Lack of standards and protocols are also the key concerns as well as connection issues (Capgemini 2018).

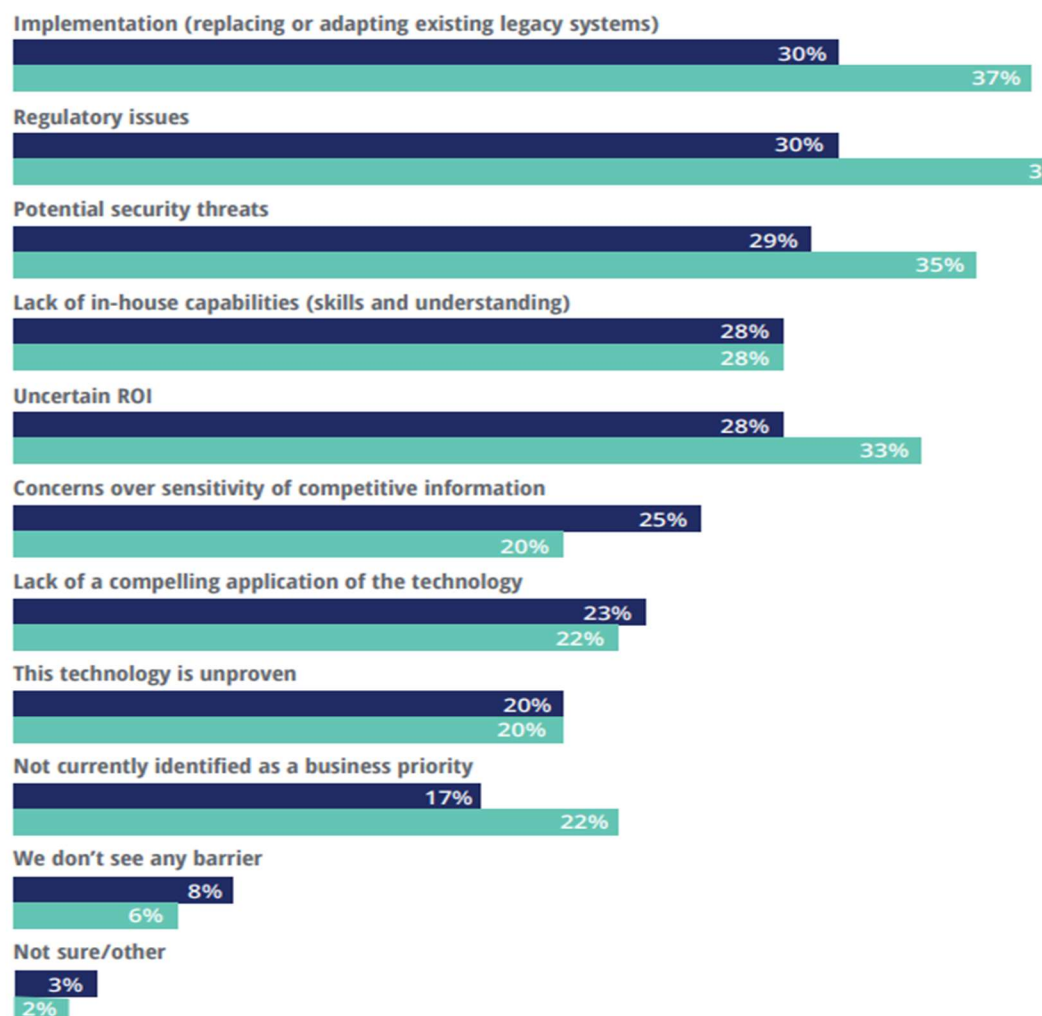
Chart 1 Deloitte's Global Blockchain survey 2019

### Organizational barriers to greater investment in blockchain technology (2019 vs. 2018)

A more even distribution of barriers emerged in 2019 in comparison to 2018

Survey question: What are your organization or project's barriers, if any, to increasing adoption a scale in blockchain technology? (Percentage of respondents who feel the issue is a barrier)

■ 2019 ■ 2018



## 6 Expert interviews

I interviewed three supply chain leaders who had extensive experience in managing various global supply chains. They've been working as vice presidents and directors in companies like Posti, Fiskars, Suunto, Elcoteq etc. All these experts had directed supply chains with various technologies, and you could see that they were excited and interested in these topics. Before the interview I presented these technologies with ~20 PowerPoint slides, and then I asked their opinions about them. I was also interested in how they see the role of a human in supply chain. When technologies like these are emerging, what leaders need to consider when managing supply chain? I also wanted to know what this means in employee level. Are they going to lose their jobs? Finally, I allowed experts to answer freely what other ideas they have for future supply chains.

The whole research is very wide-ranging, and as expected so were the answers. However, many conclusions could be drawn from these. Experts gave comments to all technologies, but most of them were about blockchains. This was certainly influenced by the fact that most of the presentation was related to this technology. I felt that IoT and Big data were well known for these experts, but blockchain is something new and I may need to explain what I have already discovered.

Q: What are your thoughts about these future technologies? Positive or negative

All interviewees liked the potential of these technologies. They were accompanied by positive thoughts as well as negative and neutral thoughts. They all thought that importance of them will only get bigger, and it is a very good idea to study more about them.

Blockchains are believed to solve current problems and it is believed that those companies that are the first to develop them will benefit most and can gain a competitive advantage. They have the potential to completely redefine traditional value chains when different middlemen may disappear. In the future, supply chains will be shorter and faster, and the blockchain can provide the best platform for this.

However, in the case of blockchains, there is still room for improvement in the following areas. Standards need to be agreed and all the negative things about them. A lot of them are created in the financial world, with various scams and money laundering. In addition, there are ambiguities such as who owns the data and what if incorrect information ends up in the block chain? In addition, supply chains are not as agile as the financial world, for example,



with the changes brought by digitalization. It takes some time before we can get rid of document scanning. But if blockchains become more common, experts believe that paperwork will be reduced, and that is only a good thing.

IoT devices were said to have the potential to add value. A device that accompanies a transmission to monitor its conditions can bring several different benefits. Global shipments go through many different parties and there is no precise information about their circumstances, and it is hard to predict anything. But IoT- device can be a good solution for this problem, thanks to the real time information.

Big data was also believed to have a lot of potential, and one of the interviewees thought that it is the most important technology currently. There are already many good data sources, and if it is properly interpreted, it can produce good results. For example, it can produce more accurate forecasts, which is usually very challenging when it comes to a product that is delivered worldwide. But data should be collected from sources other than the company's own sources too. You should be able to follow markets and trends more closely and mix all data together to get the better picture.

Q: Technology is advancing rapidly, but what is the role of the human in supply chain management?

Experts believe that as development progresses, many different aspects of supply chain management need to be addressed. First, it is important that management carefully considers their strategy. Before new technology is introduced, you must think what problem is this going to solve? Is there any problem at all? Technology may solve one problem, but it may cause a new problem.

If there are any processes that can be easily automated, they can be outsourced to robotics. You need to pay attention to value chains and how they can be modified. We should not think too much about old solution but focus more on creating something completely new. Available data must be of good quality and there must be clear rules for its use.

Q: Are employees in risk of losing their jobs because of emergence of new technologies?

All experts agreed that the new technologies will shape industries, and some people might lose their jobs. It has happened before, and it will happen in the future. Easy and simple processes can be replaced by different technologies. But they also bring new opportunities and jobs. Even if a company reduces its human resources in one unit, it frees up capital that it can use elsewhere. In countries with a good level of education, this is not a big problem when people can change the whole industry if needed.

According to experts, batch sizes will become smaller in supply chains. In the future, we need more precise information about where the goods are going, and we need more flexibility in deliveries. Changing the destination point to another while the delivery is ongoing is one example, and other one is how to plan the delivery so that the shipment arrives just in time.

Everyone highlighted that the customer is the most important. There are ways to respond to growing demands and to provide added value to the customer. There are many other technologies, such as RPA, AR, AI, VR, and they are creating new business models. Self-driving cars could allow people to use commuting for something more rewarding. IT projects are expensive and demanding with precise customization. More attention is paid to integration between systems

Q: Other thoughts about the future of supply chains?

According to experts, batch sizes of supply chains will become shorter and smaller in size. In the future, we need more precise information about the status of the goods, and we need more flexibility in deliveries. Changing the destination when the delivery is already going to one place is something that needs improvement. Planning the delivery time is another, because fastest delivery is not always the best solution.

There are many ways to respond to growing demands and to provide added value to the customer. Blockchain, IoT- and Big data are good technologies but there are many other technologies too, such as RPA, AR, AI, VR. All these new technologies are going to create new business models. Self-driving cars could allow people to use commuting for something more rewarding. IT projects are expensive and demanding with precise customization. More attention is paid to integration between systems

It is clear, that experts think that supply chains need to be more efficient. Information must be available faster and the entire supply chain has to be more transparent. The technologies presented have a great deal of potential to solve these problems and challenges, but especially with the blockchain, it is only potential that we are talking about. More testing and experimentation are needed. But it has ground breaking potential and it may not take many years, when we are in a completely different situation. Big data and IoT are already here and businesses don't have to wait for any breakthrough. It has already happened. Everything you need is there, and the company can develop different solutions itself.

But it is good to remember that these technologies must be managed correctly. You must think carefully about what you are doing and why. Sometimes a simple solution may be the

best solution. Keep it simple - is a good rule. Some employees might lose their jobs because of these technologies, but new ones will be created.

## 7 Results

The popularity of blockchains in logistics and supply chains continues to grow. Blockchain has been revelation in the financial world, but logistics and supply chains are following them and growing rapidly. In finance, public blockchain are widely used but in logistics and supply chain private and consortium blockchains are having bigger impact. There are many stakeholders in global cross border shipments and blockchain ecosystems already in use by many businesses. It is surprising to see that most of the goods that move around the world are already moving in a blockchain based ecosystem. And even more surprisingly, big competitors are successfully using that same ecosystem. IoT - and big data are much more widely used than blockchains, which was no surprise. The costs and risks associated with these technologies are lower. But the potential might be slightly lower. Blockchains can revolutionize supply chains completely.

There were numerous examples how businesses have adopted blockchain, and it was impossible to include everything. For example, Walmart is investing a lot for blockchain, and they are already quite far whit tracing the origin of the goods with blockchain. Customers in China can use their mobile phones in grocery stores, and check the origin by scanning the product with mobile phone.

Smart contracts can automate various processes in supply chains and logistics. They can even be used to reach an agreement between different parties without involving lawyers and banks. When easy and repetitive actions such as generating and sending invoice is being automatized, they allow employees to focus more on challenging tasks. The number of errors can be reduced drastically.

Standards are - and will be -in the spotlight when businesses are defining new common rules for blockchains. Currently there are many different frameworks that companies use, but based on the study, Hyperledger Fabric appears to be the most significant. It is being used by many companies and large IT giants like IBM, SAP and Microsoft are already selling their own solutions. Many organizations work together and form alliances. In logistics, BiTa is a quite big organization and it connects several global transport companies like FedEx and UPS. EU - another big community - is also very interested of blockchains, and wants to be in forefront when blockchains are evolving. They have created blockchain community and the plan is to connect global blockchain expertise, and seek what for example smart contracts can do.

There are several successful examples of blockchain in use, and probably the biggest successful example is TradeLens, which is developed by Maersk and IBM. The platform connects together nearly 100 participants around the globe. Shipping lines, warehouses, harbors, carriers, forwarders and many others. Companies and organizations gain huge benefits when they are using the same ecosystem. Information flows much more efficiently, and each party is able to plan more easily their operations. Shipping liners can check the status of the container easily, and the amount of paperwork is reduced. Other stakeholders in the transport chain can see incoming shipments, and can plan resources accordingly. Document management is much easier when all information is immediately available. The platform is safe to use and for that reason largest competitors in the industry are using the same platform. All members of the blockchain have different roles and, for example, competitors cannot see each other's prices.

Even though blockchains have a lot of potential, there are still many reasons why it has not emerged completely. Blockchain based ecosystem requires consortium where are many different parties, and that is challenging because everyone has their own opinion and it requires lots of resources. Defining common rules, such as how and what data is being used takes a lot of time. When designing a solution, regulation issues needs to be taken in to account. Companies want to see more results before they are ready to invest more. Potential security threats and lack of competence are also major issues.

## 8 Conclusions

The purpose of this research was to investigate new technologies such as blockchain, IoT, and Big data and investigate what kind of solutions there are in supply chains and logistics. The scope of the research was wide, but it could have been wider because there are so many other technologies too. Narrowing the amount of technologies was an option, but I decided to include these three, because in a way they are connected, and I am bit familiar with them. The goal was to find new solutions for the supplier of the goods.

As a result, there are many ways to improve supplier's logistics and supply chains. Technologies have different maturity rates. Big data is already mainstream in supply chains, and the use of IoT devices has increased significantly in recent years. Blockchain however hasn't emerged like other, but it is definitely one of the futures technologies, because it holds lots of potential, and might revolutionize industries completely. All experts that I interviewed believe that importance of the three will only get bigger, and it is good to understand how they work and what kind of solutions and benefits they offer. And these interviewee's are no

exception. In global scale investing on IT will continue to grow, because supply chains are becoming more complex and more diverse, and therefore more challenging to manage.

I have experience in using large amount of data in a project, where the company's warehouse functions were developed. Raw, unstructured data was obtained from ERP system, and first I had to find information that was relevant and create structure for it. Then it was combined with information from other sources and finally the efficiency of various processes could be monitored. Eventually, after analyzing the data, it was possible to locate processes that worked efficiently, and which did not - and by whom. As a result, production in the entire warehouse was streamlined, and this was also reflected in transportation. All this was accomplished thanks to the data found in the system. Deliveries were more on time with less missing packages, and finally the customer satisfaction was improved, and costs reduced. In many large warehouses, the right amount of staff in relation to the tasks they perform is one of the most important tasks for management. Management should go even further with data usage and start using more data that can be obtained from outside of organization. Bigger companies should focus more how consumers consumption patterns change.

Monitoring the goods while they are moving across the globe has been a challenge for businesses. IoT devices can be solution for this problem, because these smart devices can offer real time condition 24/7. Theft and pilferages attempts can be tracked and analysed, which helps recognizing high-risk locations, and plan alternative routes in the future. Some products like pharmaceuticals are very temperature sensitive. IoT device can track temperature in real time and send alerts if certain limits are exceeded. Smart devices are not expensive, and they can prevent cargo for damages which is worth millions of euros. In global logistics, the shipper and the receiver of the goods might use delivery term, where both parties are responsible of costs and risks of the transportations. For example, the shipper of the goods might be responsible of the main transportation from port-to-port, and receiver organizes inland transportation from port to destination. But if the goods are damaged, and it is detected at the destination, it is very hard to say when it happened. During the sea freight or ground transportation? IoT device is capable of monitoring G-forces and it might indicate the time and the position, where the impact occurred. If you need to know when the shipment arrives at the destination, it is possible if IoT device is being used with Geofencing.

Blockchain truly has potential to shape industries. Smart contracts alone might be the reason for final breakthrough. Automating processes is something that every business is looking for, if it is easy to implement and manage. In logistic and supply chain, dozens of simple events occur in every delivery, and they work inefficiently. Humans need to do lots of expensive manual work. But smart contracts can support employees and give them more time for focusing something else.

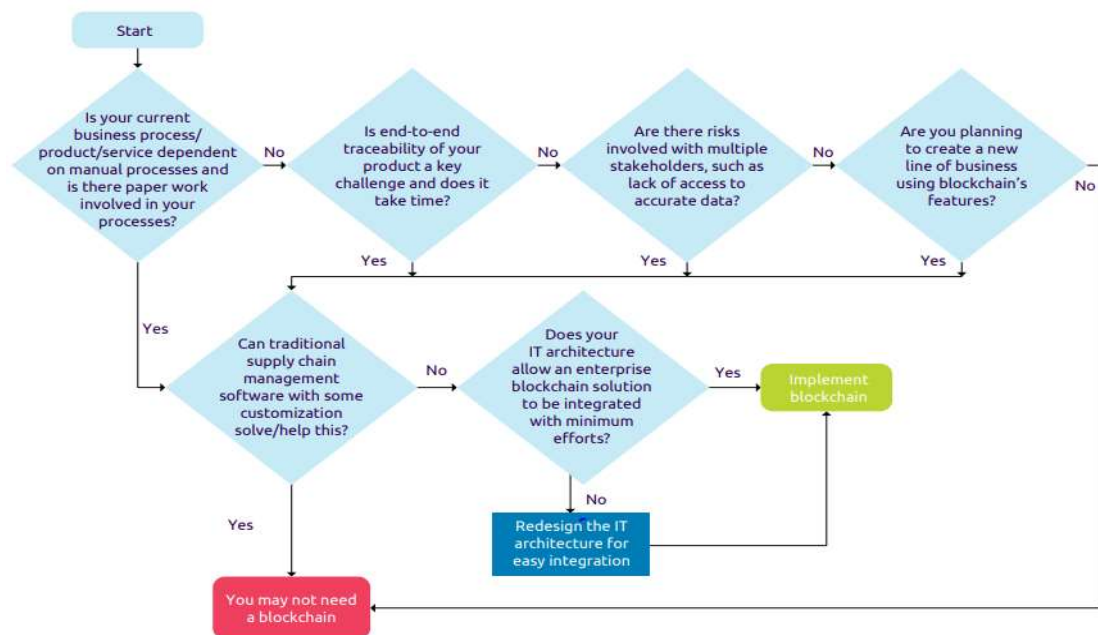
First users of blockchain in supply chain can gain competitive advantage by offering something that competitors can't. For example, with fully transparent supply chain the supplier can prove what is the origin of the goods. This might be a good option for customers who are interested of the conditions, where the goods are manufactured. The supplier can promote corporate social responsibility matters by proving that the manufacturing conditions has been good.

The amount of paperwork can be reduced significantly with blockchain. For example, paper heavy process like letter of credit is possible to execute completely digitally. Several banks have already created blockchain based Letter of credit platform, where the aim is to improve efficiency.

It will take some time for blockchain to emerge on wider scale, but if it happens it might revolutionize supply chain. But first businesses want to see more results, standards need to form, and more competence should be available. Prejudices must change and the hype needs to transform into results. The lack of goods business cases is also one obstacle for blockchain. Management needs to think what kind of solution can blockchain provide. Or is there a problem at all?

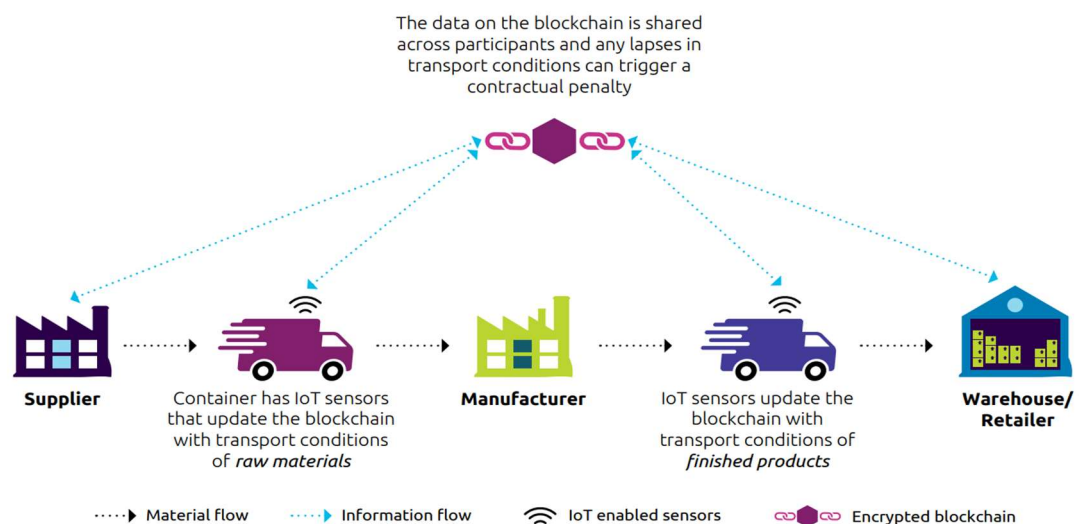
Following diagram demonstrates what the implementation process could be.

Figure 1 Evaluating process whether blockchain implementation is the right choice for your business



Future's supply chain might look something like this, where all these three technologies are working together. The blockchain provides safe and efficient platform to every stakeholder in the supply chain. Carriers, forwarders, shipping lines, port operators, customs, warehouses and even suppliers' competitors are all using the same ecosystem. IoT- devices are monitoring conditions of the shipments in real time, and all data is being analysed in order to improve decision making.

Picture 6 Smart container application in supply chain



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## Appendix 1 - Interview

**Blockchain, IoT ja Big data toimitusketjuissa - Haastattelu 5.11.2019**  
**Yrittäjä (Ex- Suunto, Ex-Fiskars, Ex-Elcoteq)**

**Kysymykset**

1. Minkälaisia ajatuksia esitetyt tulevaisuuden teknologiat herättivät? Positiivisia tai negatiivisia
2. Teknologia kehittyy kovaa vauhtia, mutta mikä on ihmisen rooli toimitusketjun hallinnassa?
3. Uhkaako automaatio ja robotiikka tavallisia työntekijöitä?
4. Muita ajatuksia mitkä liittyvät tulevaisuuden toimitusketjuihin

**Vastaukset**

1.
  - **IOT:** Laitteiden käyttö tulee pitää yksinkertaisena. Haasteet tietoturvassa (esim. RFID)
  - **Internet of Stupid Things:** Pitääkö kaiken todella olla verkossa? Se tuo kompleksi- suutta ja lisää kustannuksia. Jos prosessit saadaan idettyä yksinkertaisina ja nopeina ovat tarpeetkin helpommin toteutettavia
  - **Blockchain:** Lohkoketjulla on paljon potentiaalia ratkaista joitakin nykyisiä ongelmia ja ajatus kuulostaa hyvältä
  - Tarvitaan kuitenkin standardeja ja yhteisiä pelisääntöjä. Puhelinverkoilla oli aiemmin sama tilanne, ennen kuin GSM verkoista tuli standardi. Silloin kotimaassa toiminut puhelin ei enää toiminut, jos sitä yritti käyttää Amerikassa. Datan aitous, integraatiot ja kustannukset ovat avainasemassa. Käyttääkö ko. teknologia yleisesti paljon energiaa: siis korkea energiankulutus?
  - **Big data:** Erittäin hyvä teknologia, josta on paljon apua päätöksenteossa. Datan analysoinnissa on vielä paljon potentiaalia. Jos esim. halutaan kehittää parempia ennusteita, tarvitaan päätöksentekoon laadukasta dataa. Erityisesti kuluttajille suunnatuissa tuotteissa ennustaminen on yrityksen sisällä vaikeaa, koska kuluttajien käytöstä on vaikea ennakoida pidemmälle kuin muutaman kuukauden päähän. Toisaalta toimitusketjut ovat ajallisesti helposti paljon pidempiä. Myyntiennusteet perustuvat useiden eri henkilöiden arvioihin eri vaiheessa ketjua. Ennusteet vääristyvät helposti, kun niihin usein liitetään budjetteja mihin yritetään päästä. Kaikilla ketjun jäsenillä ei ole samaa tietoa uusista tuotteista, tuotteiden lopetuksista, kampanjoista tai kilpailijoiden toimenpiteistä. Ison data määrän hyödyntäminen eri lähteistä, kuten yrityksen omista tiedoista yhdistettynä markkinoiden, ja eri trendien kehitykseen voivat yhdessä muodostaa luotettavan kuvan. Myynnin kannattaa keskittyä lähitulevaisuuden ennustamiseen (esim. 0-3 kk) pidemmän ajan ennuste voidaan tuottaa historiatiedon pohjalta tilastollisesti ja yhdistämällä tähän muuta markkinatietoa
2.
  - Yrityksen pitää miettiä hyvin tarkkaan strategia. Millä markkinoilla halutaan olla, ja mitä siellä tarjotaan
  - On hyvä muistaa, että ihminen saattaa tulkita dataa fiilis- pohjalta
  - Datan laatuun pitää kiinnittää huomiota. Se pitää olla kunnossa, jotta voidaan tehdä oikeita päätöksiä. Sitä pitää seurata tarkkaan
  - Datan suhteen pitää myös tehdä säännöt, miten siten on tarkoitus käyttää

3.

- Valmistukseen liittyen, mikään ei ole niin joustava kuin ihminen. Vaikka jotain työpaikkoja voi hävitä, tulee tilalle uusia. Maat missä on parempi koulutustaso, ovat paremmassa asemassa. Mutta kehittyvissä maissa, missä ei ole helppoa kouluttautua uusiin tehtäviin, on omat haasteensa. Niiden etuina kuitenkin halvempi työvoima.
- Yleisesti voi todeta, että tuotteet pyritään jatkossa tekemään lähellä sitä markkinaa, jossa ne on tarkoitus myydä
- Mikäli kehitys on kovin nopeaa, niin haasteet osaamiselle tulevat olemaan suuremmat

4.

- Integraatioiden ja läpinäkyvyyden merkitys tulee kasvamaan
- Toimitusketjuissa läpimenoaika pitää saada lyhennettyä
- Uudet teknologiat luovat mahdollisuuksia myös pienille- ja keskisuurille yrityksille
- ERP projektit kalliita ja sisältävät paljon riskejä. Yritykset haluavat hyvin tarkkaan räätälöityjä ratkaisuja, jotka ovat kuitenkin haasteellista toteuttaa. Pitää miettiä tasapaino sen välillä haluaako tarkasti omaan toimintaan räätälöidyn järjestelmän, joka on helposti kallis mutta tarpeisiin hyvin sopiva, mutta vaikeasti muuntuva tarpeen mukaan ja on kallis ylläpitää VAI standardiratkaisun, joka tekee sen mitä pitää ilman hienouksia. Se on edullisempi, mutta ei tuo kilpailuetua, mutta toisaalta siihen on helppo integroitua ja ylläpito on edullisempaa

## Appendix 2 - Interview

**Blockchain, IoT ja Big data toimitusketjuissa ja logistiikassa -haastattelu 8.11.2019**  
**Konsultti (Ex-Posti, Ex- Deloitte, Ex- Elcoteq)**

### Kysymykset

1. Minkälaisia ajatuksia esitetyt tulevaisuuden teknologiat herättivät? Positiivisia tai negatiivisia
2. Teknologia kehittyy kovaa vauhtia, mutta mikä on ihmisen rooli toimitusketjun hallinnassa?
3. Uhkaako automaatio ja robotiikka tavallisia työntekijöitä?
4. Muita ajatuksia mitkä liittyvät tulevaisuuden toimitusketjuihin

### Vastaukset

1.

Esitetyt teknologiat ovat hyviä ja mielenkiintoisia. Ne herättävät lukuisia kysymyksiä kuten:

- Pitääkö arvoketjujen olla edelleen sama, vai muuttuvatko ne? Edessä voi olla isoja mullistuksia, missä erilaisten välikäsien merkitys voi muuttua. Tulevaisuuden toimitusketjut ovat lyhyempiä ja kustannustehokkaampia. Huomio kiinnittyy siihen, kuinka monta ylimääräistä peluria saadaan välistä pois
- Uusien teknologioiden avulla voidaan saada nopeasti tietoa, että onko jokin asia tapahtunut vai ei
- Eri toimialoilla on erilainen maturiteetti. Esimerkiksi finanssialalla ollaan paljon pidemmällä digitalisaation suhteen, kun kynää ja paperia ei juurikaan tarvita. Mutta toimitusketjuissa kaikki ei tule käymään niin nopeasti. Esimerkkinä dokumenttien skannaus
- Teknologioiden avulla pystytään vähentämään paperityötä, joka ei ole kustannustehokasta
- Miten uusi teknologia muuttaa vanhaa toimintatapaa. Se voi olla vaikeaa
- Tulevaisuudessa verkkokaupoilla ja liikkeillä voi olla erilaiset toimintatavat. Tuotteilla ei välttämättä ole keskusvarastoa, vaan tuotteet sijaitsevat eri myymälöissä. Kun tuote ostetaan verkkokaupasta, se käy läpi useamman verkosta löytyvän myymälän, ja valikoituu lopulta yhteen
- Miten lohkoketjut muokkaavat tulevaisuutta. Ne ovat mielenkiintoisia, mutta niiden miettiminen käytännön ratkaisuinä on haasteellista

2.

- Työ mihin voidaan määritellä säännöt, voidaan automatisoida
- Katse pitää olla siinä, että miten arvoketjut voivat muuttua. Johtaminen sen mukaan
- Ei jäädä miettimään liikaa miten vanhaa mallia kehitettäisiin, vaan keskitytään uuteen

3.

- Eri teknologioiden avulla on vähennetty työntekijöitä, mutta sen myötä avautuu myös uusia mahdollisuuksia

4.

- Monella toimialalla pyritään nopeampaan ja pienempään eräkokoon. Riittää kuitenkin, että tiedetään että missä ne menevät. Tavoitteena ns. mustan aukon eliminointi.
- Jos tiedetään miten kaikki toimii luotettavasti, määränpää voidaan myös muuttaa. Nykyisin määränpään muuttaminen ei onnistu helposti.
- Mikä on tavarantoimituksen oikea toimitusaika. Voidaan miettiä, että tarvitseeko jonkin lähtöajan mennä perille niin nopeasti kuin mahdollista. Esimerkiksi yritys saattaa haluta toimituksen omalle työmaalleen pikaisesti, mutta tavaroiden asentajat saattavat tulla vasta joskus myöhemmin, jolloin tavarat voivat jäädä turhaan sateeseen.
- Asiakkaan arvonnäyttämisen ja toiminnantehostamisen ovat keskiössä
- Minkälainen säästöpotentiaali on kuskittomilla ajoneuvoilla? Minkälainen vaikutus näillä on muuhun ympäristöön? Jos ajoneuvot liikkuvat itsestään öisin, niin minkälainen vaikutus sillä on esimerkiksi hotelleihin? Mitä uusia mahdollisuuksia saataisiin työmatkoihin, jos kuljettajan ei tarvitse keskittyä ajamiseen?
- Teknologioiden kehityksen myötä tulee uusia bisnesmalleja, ja ne voivat disrputoida vanhoja
- Teknologioiden avulla pystytään lisäämään ajoneuvoihin sensoreita ja seurata niiden tehokkuutta. Myös teiden kuntoa pystytään tarkistamaan tehokkaammin. Sen sijaan että joku henkilö menee tarkastamaan liikennemerkkien kuntoa tai routavaurioita, ne voidaan tehdä niin että tiedot skannataan ajoneuvolla, joka on koko ajan liikkeessä. Myös renkaiden kulumista voidaan seurata laserkeilauksen avulla.

## Appendix 3 - Interview

Blockchain, IoT ja Big data toimitusketjuissa - Haastattelu 7.11.2019  
Fiskars Group VP, QEHS & SC Excellence

### Kysymykset

1. Minkälaisia ajatuksia esitetyt tulevaisuuden teknologiat herättivät? Positiivisia tai negatiivisia
2. Teknologia kehittyy kovaa vauhtia, mutta mikä on ihmisen rooli toimitusketjun hallinnassa?
3. Uhkaako automaatio ja robotiikka tavallisia työntekijöitä?
4. Muita ajatuksia mitkä liittyvät tulevaisuuden toimitusketjuihin

### Vastaukset

1.
  - Uudet teknologiat ovat pelkästään hyvä asia. Ja niitä on esitettyjen esimerkkien lisäksi lukuisia muitakin, n. 10-15 kpl, kuten RPA ja tekoäly.
  - On mielenkiintoista nähdä millä vauhdilla nämä tulevat käyttöön, sekä miten yritykset jaotellaan. Ne yritykset jotka menevät ensin, tulevat varmasti saamaan kilpailuedun
  - Näistä eri teknologioista Big datalla on kuitenkin ehkä se kaikista suurin potentiaali. Data analytiikalla voidaan tehostaa toimintaa, kun tietoa haetaan ja sitä ver-taillaan
  - Teknologioihin liittyvistä negatiivisista vaikutuksista tulisi päästä eroon
  - IoT - laitteilla on kyky tuottaa lisäarvoa
  - Kuka omistaa lohkoketjuihin liittyvän datan, kun mukana saattaa kuitenkin olla kolmansia osapuolia?
  - Miten lohkoketjujen kautta tapahtuvaa toimintaa verotetaan? Se on yksi kysymys-merkki erityisesti finanssimaailmassa
2.
  - Se mikä toistuu ja voidaan tehdä helposti, tulee automatisoida esim. RPA:n avulla. Jos prosessit saadaan koneille ja rutiinityö pois, pystyy ihminen keskittämään enemmän lisäarvon tuottamiseen
3.
  - Kyllä ja ei. Jos robotiikka pystyy korvaamaan vaiheita jotka ovat toistuvia, ja samalla palkat nousevat, niin se johtaa työpaikkojen vähenemiseen. Vaikutukset voivat näkyä ihan toimistotyössäkkin. Mutta vastaavasti yritykset pääsevät fokusoi-maan resurssit lisäarvoihin, jolloin työpaikkoja voi tulla lisää
4.
  - Erilaisia teknologioita on useita ja niissä on paljon mahdollisuuksia
  - IT ratkaisuja varten on tärkeätä löytää oikeanlainen partneri, joka ymmärtää ja osaa viedä asiaa eteenpäin. Kallen vaihtoehto ei ole välttämättä paras
  - Toimitusketjujen mallinnus ja simulointi on myös osa tulevaisuutta. Niiden avulla pystytään kokeilemaan erilaisia skenaarioita, ja etsimään se paras ratkaisu
  - Toimitusten ennakointi esimerkiksi kuriiri lähetyksissä tulee kehittymään
  - Eri teknologioista huolimatta yksinkertaisin ratkaisu voi olla kuitenkin paras. Keep it simple. Esimerkiksi kannettava tietokone voidaan RPA:n avulla ohjelmoida teke-mään toimituksen tilaustietoihin liittyvää työtä. Kustannus on hyvin pieni ja höyty on suuri.