LAPPEENRANTA-LAHTI UNIVERSITY OF TECHNOLOGY LUT

LUT School of Business and Management

Strategic Finance and Business Analytics

Master's Thesis

Jasmin Majander

DEVELOPMENT OF FACTORING BY USING BLOCKCHAINS

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ABSTRACT

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Development of factoring by using blockchains

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106 pages, 12 figures, 10 tables and 4 appendices

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Keywords: Factoring, Blockchain, Development, Consortium, Smart contract, Marketplace, Platform economy

The thesis's objective was to describe ways on how to develop traditional factoring through private and consortium blockchains in Finnish factoring companies located in Finland. The research was carried out using a qualitative research method with an explorative outlook on the topic. The research was executed as an inductive case study. The research was constructed using a semi-structured interview method with a predetermined interview question set based on the topic's title. Four professionals were interviewed from the finance and IT fields. Data-based content analysis and thematic design were used as the methods of data analysis. The systematic academic literature and use case review results were analyzed by using thematic design. According to the research results, consortiums and smart contracts are good solutions to develop traditional factoring. Consortiums could be executed as larger-scale solutions as large invoice financing marketplaces or as smaller-scale solutions between banks and their customers. The invoice marketplace could be executed through blockchain technology or by using more simple technologies. Smart contracts could be used to automate factoring agreements by using tokens to represent invoices' value, but more research is needed on the contracts' technical execution. Blockchain solutions are still partly underdeveloped and do not yet meet all the requirements of traditional factoring. Blockchain has some issues that need to be taken into consideration. Especially, security and privacy issues and capacity and block size limitations still need to be solved. It still needs to be examined whether suitable solutions for factoring companies' needs to connect Distributed Ledger Technology systems to legacy systems to make payouts directly to customers' bank accounts from smart contracts. Factoring companies need to examine Distributed Ledger Technology to understand its capabilities and consider the correct technology to integrate into their factoring solutions.

TIIVISTELMÄ

Lappeenrannan-Lahden teknillinen yliopisto LUT
School of Business and Management
Strategic Finance and Business Analytics

Jasmin Majander

Factoringin kehittäminen lohkoketjujen avulla

Pro gradu -tutkielma

2020

106 sivua, 12 kuvaajaa, 10 taulukkoa ja 4 liitettä

Tarkastajat: Professori Mikael Collan
Tutkijatohtori Jyrki Savolainen

Hakusanat: Factoring, Lohkoketju, Kehitys, Konsortio, Älysopimus, Markkinapaikka, Alustatalous

Tutkielman tavoitteena oli kuvata tapoja kehittää perinteistä myyntisaatavarahoitusta suljettujen ja konsortio-lohkoketjujen avulla suomalaisissa myyntisaatavarahoitusta tarjoavissa yrityksissä, jotka sijaitsevat Suomessa. Tutkiva tutkimus toteutettiin käyttäen laadullista tutkimusmetodia. Tutkimus toteutettiin induktiivisena tapaustutkimuksena. Tutkimus toteutettiin puolistrukturoidulla haastattelumetodilla, jossa haastattelun otsikko jaettiin yksityiskohtaisiksi kysymyksiksi. Neljää ammattilaista haastateltiin rahoitus- ja tietojenkäsittelyn alalta. Tutkimuksen aineisto käsiteltiin aineistolähtöisen sisällönanalyysin ja teemoittelun keinoin. Teemoittelua hyödynnettiin lisäksi systemaattisen kirjallisuus- ja käyttötapauskatsauksen analysoinnissa. Tutkimuksen tuloksista käy ilmi, että konsortioilla ja älysopimuksilla on hyvä lähteä kehittämään perinteistä myyntisaatavarahoitusta. Konsortiot voitaisiin toteuttaa suuremman mittakaavan laskujenrahoitusmarkkinapaikkoina tai pienemmän mittakaavan ratkaisuina pankkien ja heidän asiakkaidensa välillä. Markkinapaikka voitaisiin toteuttaa lohkoketjuteknologian avulla tai käyttäen yksinkertaisempaa teknologiaa. Älysopimuksia voisi hyödyntää myyntisaatavarahoitussopimuksien automatisoinnissa käyttäen poletteja kuvaamaan laskujen arvoa. Enemmän tutkimusta tarvitaan kuitenkin vielä sopimusten tekniseen toteuttamiseen liittyen. Lohkoketjusovelluksia tarvitsee kehittää eivätkä ne vielä täysin vastaa perinteisen myyntisaatavarahoituksen vaatimuksia. Lohkoketjuihin liittyy ongelmia, jotka tulee ottaa huomioon. Erityisesti, turvallisuuteen ja yksityisyyteen liittyvät haasteet sekä kapasiteettiin ja lohkojen kokoon liittyvät rajoitukset tulee ratkaista. Lisää tutkimusta tarvitaan siitä, onko olemassa sopivia ratkaisuja, joilla hajautetulla tilikirjateknologialla toteutetut järjestelmät voisi yhdistää legacy-järjestelmiin, jotta älysopimuksilta voisi tehdä maksuja asiakkaiden pankkitileille. Factoring-yritysten tulee tutkia hajautettua tilikirjateknologiaa ymmärtääkseen sen mahdollisuudet ja harkitakseen onko se sopiva teknologia integroitavaksi heidän factoring ratkaisuihinsa.

ACKNOWLEDGEMENTS

What a journey it has been. All the anticipation has built up to this moment that I finally get to write the final words for this thesis. I would not be here without the support of my friends and fellow students. With you, my time in LUT has been immemorial. I will always remember the good times we had in Lappeenranta. I finally move on to a new chapter in my life, richer in many experiences and skills.

I want to thank my supervisor Mikael Collan for guiding and supporting me through this project. I also want to show my appreciation to the professionals interviewed for this thesis for the valuable insights you provided. I want to thank my family for providing enormous support during my studies and this thesis. Special thanks to my mother, Joonas, Melisa, and Jannika for always being there whenever I needed extra support.

In Vantaa 6th of December 2020

Jasmin Majander

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1 INTRODUCTION

1.1 Background of the thesis

There has been a lot of discussion about the endless possibilities of blockchain technology in the financial sector during the past few years. In 2008, a pseudonym named Satoshi Nakamoto published a whitepaper called “Bitcoin: A Peer to Peer Electronic Cash System”, that presented the idea of a peer-to-peer network of electronic cash known as Bitcoin. People quickly started glorifying it as the future of the money market. After the Bitcoin network was launched back in 2009, a large audience became aware of blockchain technology. Blockchain offered a solution to trust issues in the electronic transaction field as it is a transparent, decentralized ledger that functions with timestamps. The network is open-sourced, and as new information is added to the blockchain, it cannot be later removed or changed. The system works through a peer-to-peer validation network and does not require third parties to authenticate the transactions. With blockchain technology, transaction costs can be significantly reduced. (Marr, 2018)

In 2013, Vitalik Buterin, the initial contributor to the Bitcoin codebase, was dissatisfied with the Bitcoin codebase’s programming limitations and started to look for a better solution. He ended up inventing the second public blockchain known as Ethereum, which was launched in 2015. Ethereum can be widely used to process loans and contracts such as smart contracts and serve as a virtual currency. (Marr, 2018) After these technologies were introduced, corporations and investors became interested as they saw the huge potential in blockchain technology. Nowadays, blockchain is widely implemented in many sectors, for example, supply chains, insurances, and healthcare.

Blockchain technology has gained ground in the factoring business during the past few years as it is seen as a promising solution to many risks and issues in factoring. Factoring is a form of short-term financing in which a company receives financing against its sales receivables from a financial institution. It is typically used by growing

companies and industries with long payment terms and seasonal fluctuations to increase their working capital. In factoring, blockchains enable automation of many manual tasks, which speeds up and adds security to the transactions. Blockchain platforms like Ethereum, Hyperledger, NEO and R3CORDA make it possible to transfer factoring contracts from old systems to automated smart contracts. The initial enthusiasm about implementing blockchain technology to everything has gradually waned to a more realistic thought on where it actually would make sense to implement its usage.

This thesis examines from a realistic perspective on how traditional factoring could be developed by using blockchains without forgetting the risks and challenges related to factoring and blockchain. There have not been corresponding studies in the research field that focus on this exact topic of traditional factoring. Several studies have focused on blockchain usage in supply chains and supply chain finance, but there are not too many studies to be found regarding traditional factoring. This thesis brings more knowledge of the development of traditional factoring by using blockchains and gives new insight and ideas for corporations and financial institutions to develop their factoring processes by using blockchain technology. This topic is important from an economical perspective because blockchain technology can revolutionize how some financial products are being developed and managed.

1.2 Research focus, objectives, and limitations

This chapter takes a closer look at the research focus, its objectives and presents the limitations to the study. This research provides important development propositions for financial institutions and smaller companies that offer factoring services. The research aims to provide results that could be implemented as they are presented in this research. Figure 1 presents the main topics, the objective, the perspective, and the focus of this thesis.

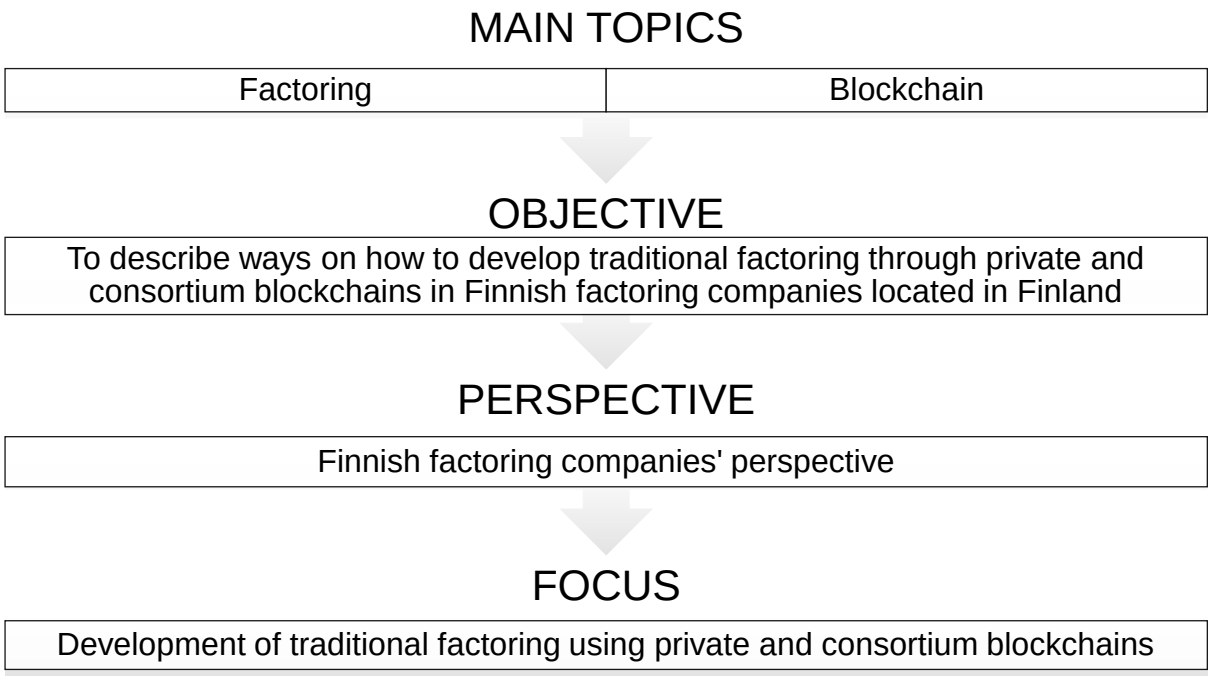


Figure 1 Main research topics, objective, perspective, and focus

This thesis intersects six disciplines: corporate finance, software engineering, data analytics, financial accounting, risk management, and contract law, as presented in figure 2.

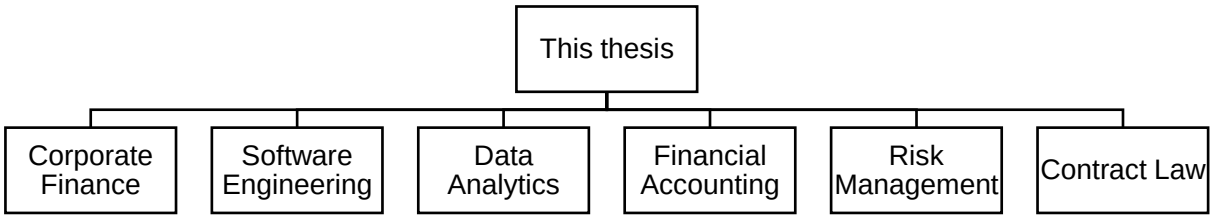


Figure 2 Positioning of the thesis

Corporate finance is a division of finance. It includes corporations' investment decisions, structuring of capital, and sources of funding. Corporate finance is divided into equity finance and debt finance. This thesis examines factoring and supply chain finance, which are part of debt financing. Factoring is further divided into non-recourse and recourse factoring, as presented in figure 3. Non-recourse factoring includes the purchase of receivables, and recourse factoring, in turn, includes invoice credit and

invoice factoring. This thesis focuses on studying the purchase of receivables and invoice credit.

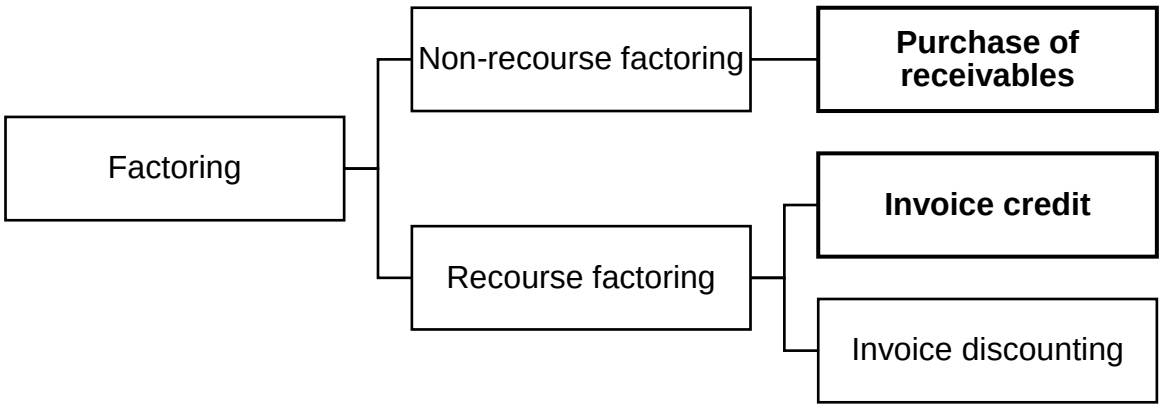


Figure 3 Focus areas of this thesis within factoring emphasized in bold

Traditional factoring includes the purchase of receivables and invoice credits. In these products factoring companies handle the customers' accounts concerning factored invoices. The traditional factoring products were chosen as the focus, as they are typically time-consuming and complex. As this research is done from the Finnish factoring companies' perspective, it is more interesting to examine the traditional factoring products as factoring companies have more control over the invoices and the accounts. In invoice discounting, factoring companies only provide credit towards the invoices but do not handle the accounts. As invoice discounting differs as a product from the traditional products, it is excluded from this thesis.

In addition to factoring, corporate finance includes supply chain finance as an instrument to finance invoices. Supply chain finance differs from factoring through its processes, stakeholders, and purpose. This research chooses to process further use case examples and literature concerning supply chain finance because there are so many studies conducted of supply chain finance development and blockchain in supply chain finance. As there are more studies concerning supply chain finance, it is possible to find good examples of development and use cases. This study also utilizes use cases from invoice discounting as there have been good use cases and research

on that form of finance as well. The processes of invoice discounting and supply chain finance are close to traditional factoring products, so the blockchain use cases of those financing forms can most likely be utilized also in traditional factoring with small modifications.

Software engineering is a division of computer science. It includes the development and production of computer programs and computer software. Database management systems (DBMS) are software systems designed to manage data. Distributed database management systems (DDBMS) are used to manage data in distributed databases and transparentize the distribution for the database users. (Rouse, 2019) Distributed databases are further divided into distributed ledgers also called as distributed ledger technology (DLT), which exist across multiple computing devices. Blockchain is a form of DLT that utilizes cryptography to protect itself from malicious attacks. Blockchain is further divided into four types: public, private, consortium, and a hybrid of public and private blockchain, as presented in figure 4. (Rahkola, 2019, p. 17) This thesis focuses on studying private and consortium blockchains.

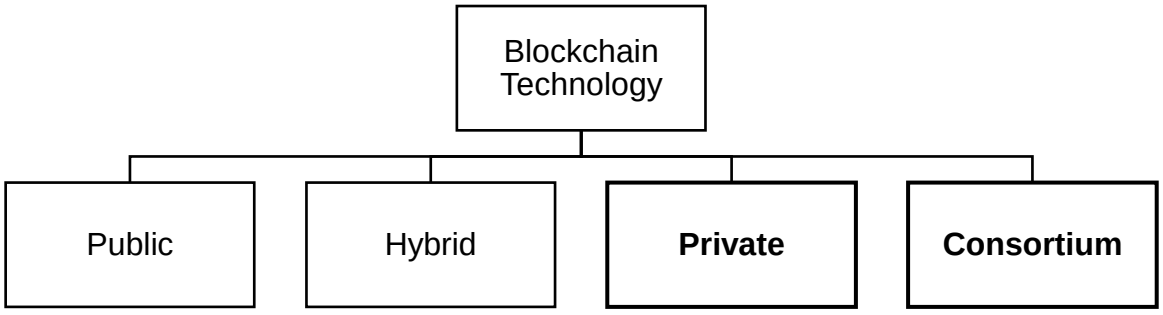


Figure 4 Focus areas of this thesis within blockchain technology emphasized in bold

The financial industry is a very competitive business area where financial institutions have come together to form consortiums and develop products and solutions for bigger customer bases. The factoring market in Finland has a few bigger players who own a big share of the factoring business, and they are most likely not willing to decrease their share. The factoring companies in the Finnish market will most likely start using blockchain technology by developing their own blockchain solutions or forming a

consortium. As the public and hybrid blockchain solutions do not seem likely alternatives for factoring companies at this point, they are excluded from the study.

Data analytics is an important part of factoring companies' credit processes and risk management, which is the reason why it is also considered in this thesis. In addition to data analytics, financial accounting is handled in this thesis as it is related to factoring products as many accounting processes are running behind every transaction and contract.

Risk management is a crucial part of any finance product, transaction, and contract. As this thesis examines factoring, which is a form of finance that includes many risks, there needs to be an understanding of the risks regarding it before any development decisions can be made. An analysis of risks related to the factoring products and processes provides the reader of this study an opportunity to gain insight on the risks before diving into research results. Understanding of the risks also provides the reader an opportunity to understand better why factoring companies end up in certain solutions. More detailed factoring processes are left out of this study as this thesis examines factoring at a more general level and does not focus on a particular company's processes. Companies' detailed processes are typically quite complex and highly confidential. Companies' processes differ from each other, so it is the most sensible solution to inspect factoring from a very general level. Though, it would be an interesting topic to research some factoring company's detailed processes, but that needs to be left to another study.

Contract law is considered in this thesis as factoring products are always based on contracts between the factoring company, its customer, and possible third parties. In every factoring development process, contracts need to be considered as all the changes typically also affect the contracts' contents.

The research is based on qualitative interviews, which were conducted by interviewing professionals working in Finnish companies in Finland. The thesis is limited to examining the factoring market in Finland and its operators, as a capture of many markets would have been too wide of a topic due to differences in finance sectors, processes, and legislation. No analysis of any specific factoring company nor a competitor analysis was made because it is too difficult to find quality data for those kinds of analysis and would require a separate research. A short capture of the factoring market in Finland and its operators is made in order to provide an overview of the present situation in the Finnish market. Technical details are left out of this study as this study is built from businesses' viewpoints. Going too much into technical details would direct the focus of this research away from the business solutions and development ideas. It would also make this research too heavy for the reader.

The research gap for this thesis arises from the fact that only a few studies are written on this topic. There is research where blockchain solutions are studied for supply chain finance and invoice discounting but not specifically for invoice factoring. This may be because factoring is quite a niche market, and there are so many other financing solutions that factoring does not appear to be the most interesting option. The blockchain solutions are rather new in the factoring business, as development of functioning, secure blockchain solutions requires a lot of technical understanding and skills. Many banks have concerns regarding blockchain security and risks, but hopefully, this research opens eyes to the opportunities and how the risks related to the blockchain can be tackled.

This thesis has been conducted as a qualitative research with an explorative outlook on the topic. The research approach was selected to be inductive and research strategy as a case study. This study has been executed by examination literature, previous research, and interviews from professionals of the topic. The data itself consists of scientific articles, news articles, books, previous research, and interviews. This study is constructed using a semi-structured interview method where there was a predetermined interview question set based on the topic's title. Data-based content analysis and thematic design were used as the methods of the data analysis. A more

detailed description of the empirical study and the analysis methods, methodology, and data collection is presented in chapter 4. “Empirical study of development of factoring by using blockchains”.

1.3 Research questions

The objective as well as the main research question of this thesis is:

How could factoring be developed by using private and consortium blockchains?

This main question is quite complex, and to be able to answer to this question, additional research questions need to be answered first. There are two questions within a total of five sub-questions presented below, with a more detailed description of why the research questions were chosen. All the research questions are discussed in chapter 5. “Discussion and conclusions”, where the final conclusions and answers to the research questions are presented.

RQ1. What has been previously written about the use of blockchains in connection with invoice finance?

To be able to answer the main research question, it is necessary to examine what has been previously written about the use of blockchains in connection with invoice finance to build an overview of the current research situation concerning this topic, what kind of methods have been used to study this topic and to understand what kind of data is available of this topic. This research question is answered in chapter 3.1 “Review of academic literature”. The data used to answer this question is gathered from scientific publications, research papers, and articles. The method used to provide an answer to this question is a systematic literature review.

SRQ1.1 What kinds of previous blockchain use cases are there in invoice finance?

To gain insight into how private and consortium blockchains could be used to develop factoring, it is important to examine how blockchains have been previously used in corporations and financial institutions. The term invoice finance includes financing

forms supply chain finance and factoring. Factoring includes the following products: purchase of receivables, invoice credit, and invoice financing. The forms of finance in invoice finance are so similar that use cases of blockchain are searched from each of them in order to find solutions that could work in traditional factoring. The use cases work as examples of how blockchains could be used in factoring and how it has been proven to work previously in invoice finance. In addition, use cases give a presentation on blockchain's abilities and opportunities in invoice finance. This research question is answered in chapters 3.2 "Review of blockchain use cases in invoice finance" and 4.3 "Results from the interviews". The data used to answer this research question is gathered from companies' websites, scientific publications, news articles, and qualitative interviews. The method used to provide an answer to this question is a use case review.

RQ2. How private and consortium blockchains can be used to develop traditional factoring according to the qualitative interviews?

This research question is crucial to be able to answer the main research question. This research is based on qualitative interviews with professionals from different finance and IT fields working in Finnish companies located in Finland. The professionals' contribution to this study is significant as they have provided their experience and enlightened vision to answer the main research question. This question is answered in chapters 4.3 "Results from the interviews" and 5. "Discussion and conclusions". The method used to answer this question is a semi-structured interview method combined with data-based content analysis and thematic design with data gathered from qualitative interviews.

SRQ2.1 How can consortiums be used in factoring?

This sub-question is set to provide an answer to the second research question (RQ2). To gain insight into consortiums and their use in factoring, qualitative interviews have been conducted. This research question is answered in chapters 4.3.1 "Consortiums" and 5. "Discussion and conclusions". The method used to answer this question is a

semi-structured interview method combined with a data-based content analysis and thematic design with data gathered from qualitative interviews.

SRQ2.2 How can smart contracts be used in factoring?

This sub-question is set to provide an answer to the second research question (RQ2). This question helps to understand how the smart contracts could be utilized in factoring, which are part of private blockchain solutions. This research question is answered in chapters 4.3.2 “Smart contracts” and 5. “Discussion and conclusions”. The method used to answer this question is a semi-structured interview method combined with a data-based content analysis and thematic design with data gathered from qualitative interviews.

SRQ2.3 What kinds of risks can blockchain solve in factoring?

This sub-question is set to provide an answer to the second research question (RQ2). This question focuses on examining if blockchain is useful to solve risks in the complex factoring business. The answer to this question is crucial in helping factoring companies to understand the possibilities blockchain can offer. This research question is answered in chapters 4.3.3 “Risks blockchain solves in factoring” and 5. “Discussion and conclusions”. The method used to answer this question is a semi-structured interview method combined with a data-based content analysis and thematic design with data gathered from qualitative interviews.

SRQ2.4 What are the key challenges in using blockchain technology in the context of invoice finance?

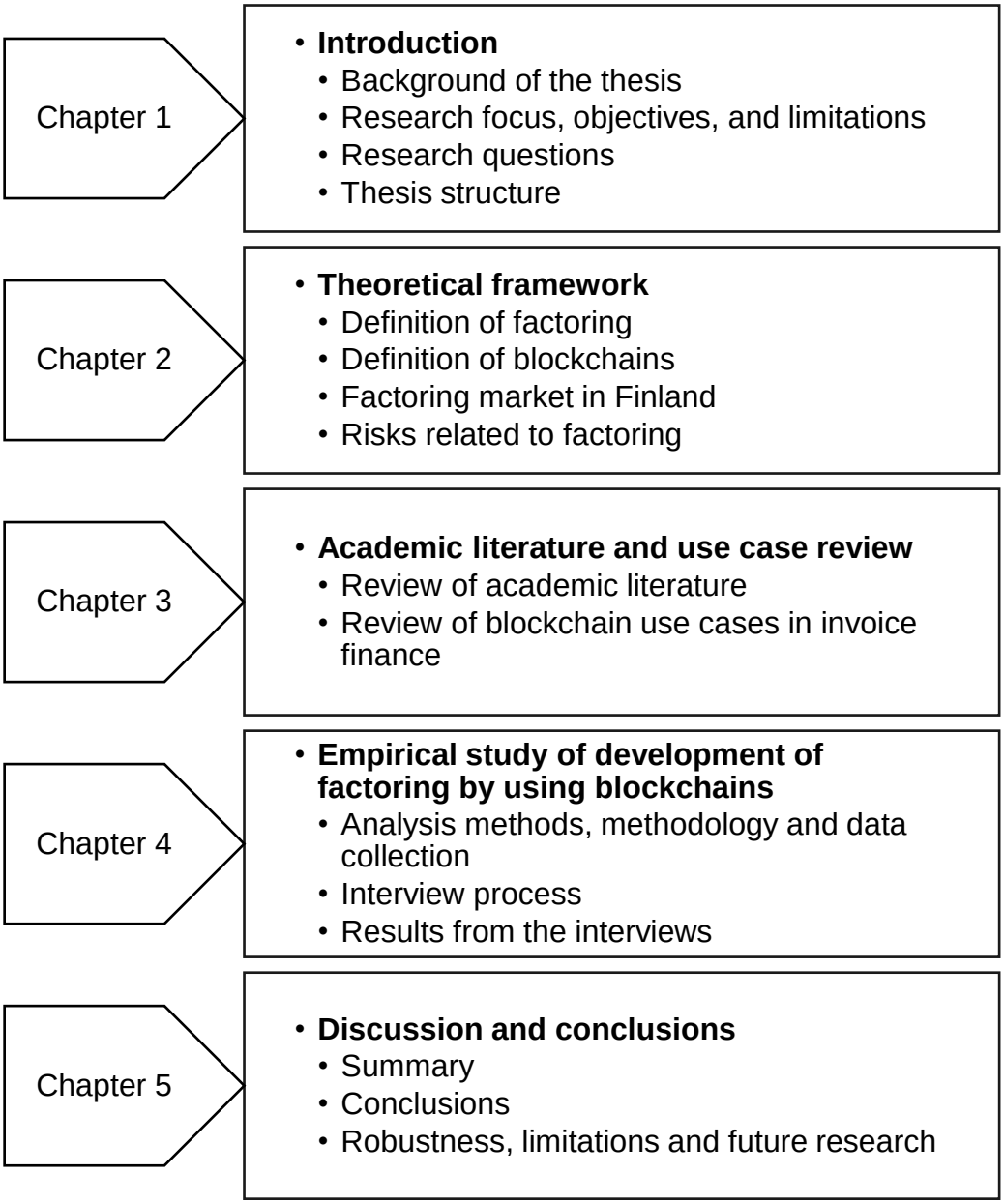
This sub-question is set to provide an answer to the second research question (RQ2). This answer is crucial as it gives the factoring companies an idea on what they are facing if they decide to implement blockchain solutions. This research question is answered in chapters 4.3.4 “Challenges in blockchain” and 5. “Discussion and conclusions”. The method used to answer this question was a semi-structured

interview method combined with a data-based content analysis and thematic design with data gathered from qualitative interviews.

1.4 Thesis structure

This thesis starts with the introductory chapter to the research, including the background of the thesis, research focus, objectives and limitations, research questions, and thesis structure, as presented in table 1. The theoretical framework sets the theory for the research and explains the main concepts and theories related to the topic and how they relate to one another. It includes definitions of factoring and blockchains and presents the factoring market in Finland and the factoring risks. The third chapter contains academic literature and use case review. A systematic review of academic literature is made when previous research is assessed concerning their contents and results. This is followed by a review of blockchain use cases in invoice finance, which assesses previous and current use cases of blockchain in invoice finance. The actual research is the empirical study of development of factoring by using blockchains. This chapter presents the analysis methods, methodology, and data collection process. Then the interview process and results from the interviews are presented. The research results are divided to separate sub-chapters according to thematic design. The final chapter first summarizes the thesis. Then the research questions are answered, and their relation to the research results and the academic literature and use case review are discussed. Finally, a robustness check, limitations to the research, and future research proposals are presented.

Table 1 Thesis structure



2 THEORETICAL FRAMEWORK

This chapter introduces the main concepts and theories of the thesis and how they relate to one another. First, an introduction to factoring and its products is given, and then a closer examination of blockchains is given. Finally, a description of the factoring market in Finland and the risks related to factoring are presented.

2.1 Definition of factoring

Term factoring is typically used to describe an arrangement where a company receives from a financial institution usually 80% financing against its sales receivables, and the rest 20% minus the financial institution's interest and financing fee after the buyer has paid the invoice to the financial institution. Factoring means that the financial institution gives out credit for the sales receivables but does not carry the credit risk. If the financial institution buys the receivables from a company, the receivables will be taken out of the company's balance sheet, and the financial institution will bear the credit risk. According to Finance Link, the longest payment term in factoring is typically 90 days, so it is considered short-term financing. In factoring, sales receivables can be either bought, which is called non-recourse factoring or financed, which is called recourse factoring. (Finance Link, 2020) According to Zavgorodniv, factoring provides help for companies in times of low working capital. It can also help to increase sales turnover. Factoring focuses on short-term debt for wholesale purchase of products. Zavgorodniv explains that payment delays can result in problems in business management. As money is not flowing into the creditor company, they might not be able to purchase new production batches for continuing their normal business. Long payment terms of 30-90 days can be solved by using factoring. (Zavgorodniv, 2019)

Figure 5 visualizes a very simplified factoring process with three main parties: vendor, financial institution, and buyer. The vendor sends invoices to the buyer and copies of invoices to the financial institution. Next, the financial institution pays 80% of the invoices' value of credit to the vendor. The buyer pays invoices to the financial institution, and then the financial institution pays the rest 20% of the invoices' value to

the vendor. Appendices 1 and 2 present more detailed but still simplified versions of the factoring process with 80% credit and with purchase of receivables.

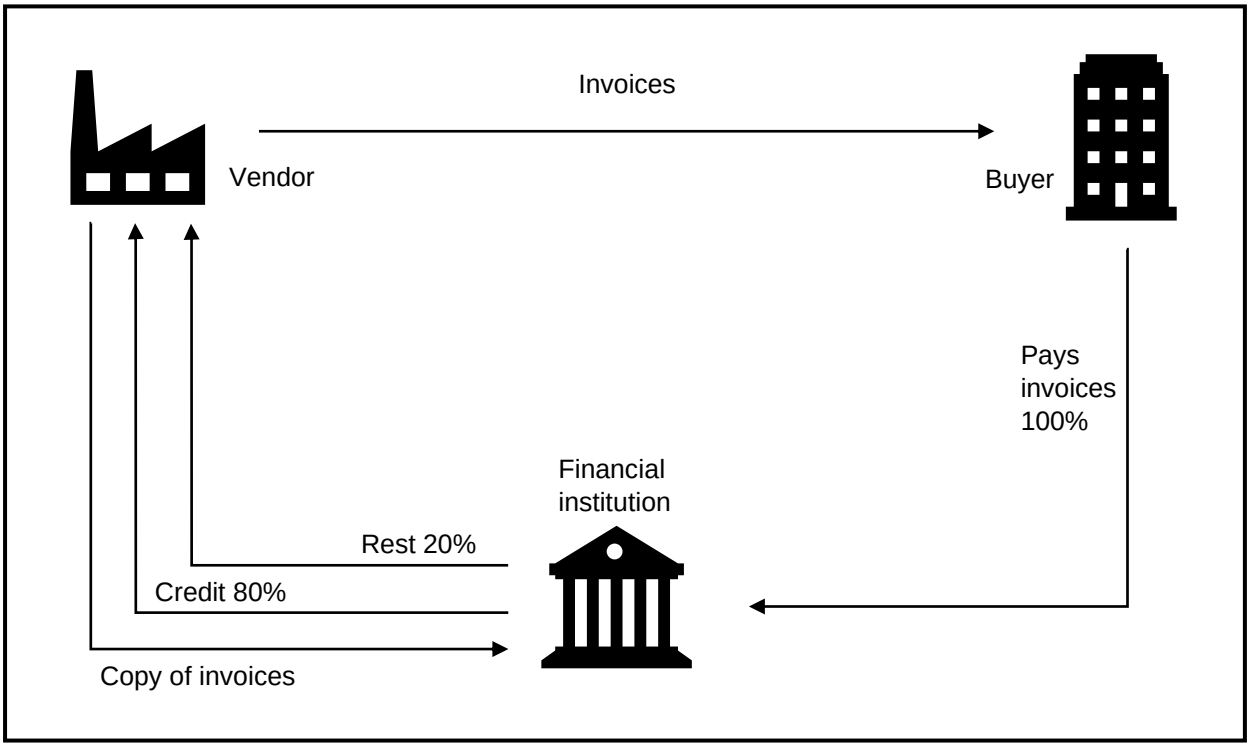


Figure 5 Simplified factoring process

Factoring is a financing method used by businesses to free working capital. According to Alma Talent, working capital is used to measure if a company can pay off its debts within a year. It can be seen as the company's ability to pay off its liabilities with its current assets. Working capital can be calculated by dividing current assets by current liabilities. This is called the current ratio. When the ratio is above 1, the company has an ability to convert its assets into cash quicker. The higher the ratio is, the better the chances are that the company can pay off its short-term liabilities and debt. It is good for a company to have a high current ratio because then the company can fund its daily operations better, and it does not probably need to take on debt to make new investments and grow its business. (Alma Talent, 2020)

According to Timo Nisumaa from Finnrisk, working capital might cause challenges in new businesses if sales increase rapidly. Nowadays, it is prevalent for buyers to demand longer payment terms, and it might be a bit of a challenge for smaller companies and some of the bigger ones to keep up with their cash flows. (Nisumaa, 2018) This problem is emphasized in export trade, where foreign buyers are accustomed to longer and more flexible payment terms. This causes issues in Finnish companies who are expecting to receive money in advance or in cash. (OP Financial Group, n.d.b) The products' suppliers also usually demand that their receivables need to be paid in no time already before the end-buyers have even paid their share of the invoices. Nisumaa also reflects that buyers who cannot maintain big storage facilities need their products to be delivered fast and that their inventory keeps moving. This causes a huge strain on the working capital. The financing of working capital needs to have a good flow, and there needs to be enough working capital within the company to keep the business running smoothly. (Nisumaa, 2018)

Ben Poly states that businesses' liquidity issues can be solved by selling invoices at a discount to gain immediate capital. Businesses will lose a part of their profit in these kinds of cases, but it is the cost of getting the payment faster. Liquidity issues can also be solved through factoring, but some issues are related to traditional factoring. There are problems with fake or inflated invoices and double financing through two factoring companies. Poly recalls that there are already processes in use in factoring companies for them to protect themselves from these risks, but they are costly and labor-intensive. Most of the factoring companies are not even bothered to check small invoices but focus on more complicated invoices with larger values. As factoring companies need to verify the validity of larger invoices, it takes more time for the vendor to receive the credit for the invoices. These kinds of delays can be costly and harmful to smaller companies' business. (Poly, 2018)

There are several different factoring products offered by banks, but the most common, simplified factoring process is following: Company A produces forestry machines. Company B is interested in buying a machine from company A and demands a relatively long payment term for the invoice. Company A agrees to the long payment

term but notices that it needs more working capital to make more investments and build up its inventory. Company A contacts bank C to agree to send all the invoices to the bank and to receive credit against the sales receivables of the prearranged percentage of the receivables. Company A sends company B invoice of its purchase with details to pay the receivable to the bank C when the invoice is due. When company B pays the invoice to bank C, bank C will then pay the rest of the receivables that it did not pay in the beginning when it received the receivables. Bank C holds the rest of the prearranged percentage of the receivables as a deposit so that company A will pay their fee and loan back to the bank C.

Below are presented more detailed descriptions of the factoring products.

Purchase of receivables is an arrangement where a company sells all (non-recourse factoring) or a part of their sales receivables to a bank within the agreed limit. Appendix 2 presents a detailed process model of a simplified factoring process with purchase of receivables. According to Nordea Finance, this form of factoring is most suitable for big companies looking to lighten their balance sheet and improve their financial indicators. The sales receivables' purchase price is paid to the company either as 100% of the invoices' value or as 90% of the invoices' value and 10% after the received payment from the debtors. Nordea Finance clarifies that purchase of receivables is not suitable for project billing or consumer or pay mail billing. Though, the purchase of receivables has its benefits in addition to the already mentioned. The arrangement does not increase the company's amount of debt because the purchase price of the receivables is registered in the cash register. Nordea Finance declares that they have a fully electric process that decreases manual work and lightens the management need. Also, if the capital freed from the financing is used to reduce debt, the balance sheet gets lighter, and the financial indicators will be improved. (Nordea Finance, 2018a) According to OP Financial Group, non-recourse factoring, where a company sells accounts receivables to a financial institution, is a better solution than factoring to large and international companies with annual net sales over 5 million euros. Non-recourse factoring improves liquidity and returns on capital. For OP Financial Group to finance companies with non-recourse factoring, the seller and buyer need to have

high creditworthiness and the claims need to be indisputable, and the payment terms for invoices need to be unequivocal. (OP Financial Group, n.d.a)

According to Nordea Finance, invoice credit is a credit limit secured by a company's accounts receivables. It can be used to finance both domestic and export receivables, and it typically includes ledger management services. It can also include additional products: debt collection service by a third party or by the financial institution itself and credit insurance to cover buyer risk. Appendix 1 presentes a detailed process model of a simplified factoring process with 80% credit. Nordea Finance says that invoice credit has multiple benefits; the amount of financing increases as the company increases, the company's liquidity increases, as a financial institution collects the invoices, the buyers will pay the invoices with better certainty. It is also beneficial to take additional credit insurance to accounts receivables to minimize the possible loss if the buyers do not pay their invoices. Invoice credit is used in Nordea Finance in business-to-business billing and when the yearly billing position is over 700 000 euros. Though, this is financial institution specific. Some financial institutions offer credit invoicing to smaller companies with smaller yearly billing positions. Nordea Finance also offers invoice credit for foreign export receivables. Usually, with foreign buyers, there is a bigger risk of the ability to pay the receivables. With credit insurance, this credit risk can be removed by 90 percent. (Nordea Finance, 2018b)

OP Financial Group offers a factoring service package, including ledger management services, credit control, reporting and debt-collection. (OP Financial Group, n.d.a) OP Financial Group also offers export trade services which help companies to free up working capital and improve their liquidity. In addition, they increase the turnover of companies' export receivables with longer payment periods and better credit control. OP Financial Group offers hedging solutions to cover credit risks. (OP Financial Group, n.d.b)

Financial institutions make risk evaluations of the companies they give credit to and their debtors to know if they can pay back their credit and the invoices. If the financial

institution evaluates that the debtor is insolvent, it will not buy or credit the debtor's invoices. Though there are financial institutions that offer collection services, and they are willing to buy receivables that are not creditworthy. These receivables will be covered on the risk of the billing company. Typically, these kinds of financial institutions also give credit to consumer invoices. (Finance Link, 2020) According to Nisumaa, in most cases, accounts receivables are enough guarantee against the credit given out, and there is no need for personal and third-party guarantees. If the buyer does not pay the invoices, the receivables will be returned to the vendor that has to pay back the received credit. (Nisumaa, 2018)

According to Finance Link, it is possible to acquire separate credit insurance to cover the credit risk. With credit insurance, the credit risk can be removed from the company by 90%. In a case where the financial institution buys the company's invoices, the credit risk will transfer to the financial institution by 100%. (Finance Link, 2020) According to Nisumaa, typically financial institutions transfer the credit risk to insurance companies through credit insurances to diversify the credit risks. In some cases, the companies acquire their own credit insurance directly from the insurance companies to cover themselves from the risks. When a financial institution buys receivables from a company, the company transfers the insurance coverage to the financial institution to receive the compensation if the receivables are not paid. Nisumaa states that in a case where the financial institution buys the receivables, it is responsible for collecting the unpaid invoices, and the credit risk is transferred to it. This benefits the company selling the receivables because they receive credit, but on the other hand, they lose all the management of the invoices. (Nisumaa, 2018)

According to Nordea Finance, factoring has many benefits to a company. It enhances the management of risks and the company's credit, and besides, it releases capital that is tied up to sales receivables. It also improves a company's financial indicators by freeing up working capital, improving receivables' turnover, and lightens the balance sheet. (Nordea Finance, 2018c) The capital that the company has managed to free from the receivables can be utilized in investments, debts, and other necessities. Also, as the company's liquidity gets better, it usually has a positive effect

on getting investors to invest in the business, and overall, the terms and availability of capital gets better. (Nisumaa, 2018). Also, the applications that have been developed to manage financing by financial institutions boost the companies' processes as they will be able to focus on other parts of their business (Nordea Finance, 2018c). According to Nisumaa, factoring can be very expensive to companies seeking financing. It is usually more expensive than a regular loan from a bank. Typically, in factoring, the credit risk lays on the vendor if no agreements or credit insurances have been taken. Nisumaa thinks that factoring has benefits in that it usually does not need real security as the receivables cover the risk. Also, the possibility of being able to hand over the management of accounts ledgers to financial institutions and other parties is seen as an asset by Nisumaa. The ability to cover the credit risk with credit insurance is seen as beneficial. (Nisumaa, 2018) According to OP Financial Group (n.d.b), as companies use factoring, they will be able to provide longer payment terms and this way enhance their competitive edge.

Invoice discounting, also called invoice financing, is a bit different from traditional factoring. In invoice discounting, the company manages the ledger and debt collection by itself, when in traditional factoring, the factoring company takes care of the ledgers and debt collection. Invoice discounting is suitable for medium and large size companies and for business-to-business invoicing when the number of debtors or number of invoices is large. The factoring company gives credit to the company against the company's accounts receivables, typically 80% of the invoice value. The invoice discounting that Nordea Finance offers is used for domestic invoices. Invoice discounting is not suitable for companies that do not have their own financial management nor applications or software needed to manage the financials. In invoice discounting, accounts receivables act as a security for the credit. Typically, factoring companies check from time to time that the ledger information is synced between their and their clients' ledgers. The factoring companies deduct fees directly from the payments on the invoices before forwarding the final amounts to the client's account. The fees are usually lower in invoice discounting than in invoice factoring as the receivables' management is not forwarded to the factoring company. (Nordea Finance, 2018d; Harbour, 2020)

The distinction between factoring and supply chain finance needs to be made. They are both used to optimize working capital, they help the supplier to get early payment to invoices and they both utilize financing sources external of the payment. Traditional factoring is initiated by the supplier who wants to get finance for its accounts receivables to optimize its cash flows and to get working capital to make, for example, investments. The buyer initiates supply chain finance, and the buyer invites its suppliers to participate in a financing agreement where they can sell their invoices to a factoring company. In the agreement, the supplier can utilize the buyer company's typically high credit rating to get immediate payment to its receivables minus a small fee. Contrary to supply chain finance, in factoring, buyers are not involved in the supplier's agreement. In factoring agreements, suppliers are typically paid credit of 70-80% of the invoices amount, or the invoices are bought for typically 90% or 95% of invoices amount. In supply chain finance, the supplier is paid the full amount of the invoices. Factoring transactions influence the supplier's balance sheet as they include a loan but in supply chain finance, transactions happen off-balance sheet as the invoices are sold to the factoring companies. In supply chain finance, financing fees are typically small fees per invoices as in factoring the fees are higher, typically 4-6 percent, that goes beyond small fees on the invoices. (PrimeRevenue, 2016, pp. 2-3)

2.2 Definition of blockchains

Typically, when people make transactions from their bank account to someone else's bank account, there are banks as senders and as receivers verifying and securing the transactions. Many laws bound them, and they monitor the transactions done in the banking system. Executing transactions is not cheap when banks and other third parties gather fees from their services. Financial institutions work as trusted parties who regulate the system, provide security and trust, process, and monitor payments. People have always trusted that financial institutions keep their money and credit card information safe. These financial institutions, like banks, are centralized. They maintain their own databases and systems. As financial institutions have always been trusted parties, people who are against these centralized banking systems have been looking for a better solution to handle their money. There are many countries where

people cannot trust the government and companies, making it risky to make transactions. In these kinds of cases, blockchain comes along. (Gates, 2017, p. 4)

As financial institutions are considered centralized systems, blockchain is a decentralized system that works without trusted intermediaries between transaction parties. (Gates, 2017, p. 4) Singhal, Dhameja and Panda (2018, p. 8) state that blockchain is a system that works through peer-to-peer verification without trusted third parties in between verifying, securing, and settling transactions. The blockchain is a shared, open ledger of transactions based on a large number of nodes. Mark Gates (2017, p. 4) defines blockchain as a database that contains records of value and transactions. The ledger database works so that you can only append information into it, but you cannot change or remove it afterward. The nodes in blockchain are pieces of information and every time new information is added to the blockchain, it gets reflected to all the copies of the database containing all the information previously added to the database. Blockchain system operates as another layer on top of the Internet, so as the Internet technologies develop, it coexists. (Singhal, Dhameja and Panda, 2018, p. 8) Figure 6 presents an overview of stock trading through an intermediary clearinghouse in a centralized system where trading is verified through a clearinghouse. This presentation visualizes the information flows in a centralized system. All the centralized market operators conduct their transactions through an intermediary who verifies, secures, and settles each transaction.

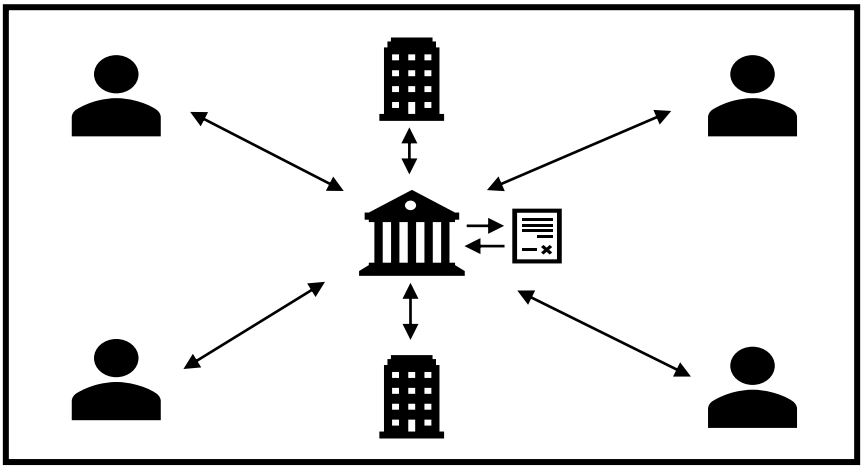


Figure 6 Stocks trading through an intermediary clearing house in a centralized system (Singhal, Dhameja and Panda, 2018, p. 6)

Figure 7 presents an overview of stock trading through peer-to-peer verification in a decentralized system where a peer-to-peer system verified trading. There are no intermediaries in the transaction, but companies and people can trade directly with each other when other operators in the blockchain verify the transactions made.

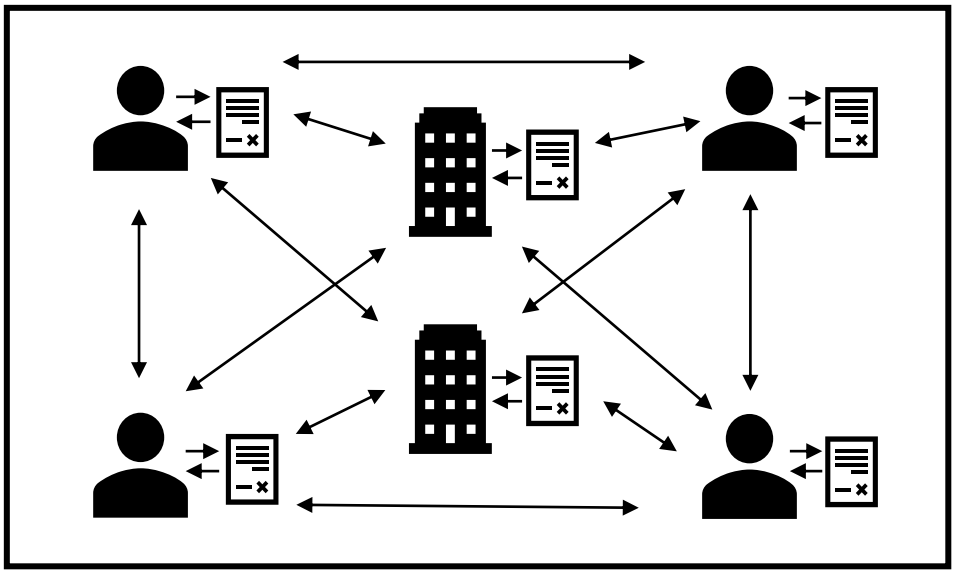


Figure 7 Stocks trading through peer-to-peer verification in a decentralized system (Singhal, Dhameja and Panda, 2018, p. 7)

In the blockchain database, the data is stored in nodes where every node has an identical copy of the blockchain. Blockchain consists of blocks containing the hash of the previous block and list of transactions and details related to them. The last block contains information about the whole chain of blocks. Transaction details hide who is participating in the transactions by using unique digital signatures comparable to usernames. (Singhal, Dhameja and Panda, 2018, p. 9). Figure 8 presents a visualization of the structure of the blockchain. The chain of blocks begins with a genesis block, which holds only the information that is created at that point, and then all the blocks from there on contain the information created at that point and the information from the previous block.

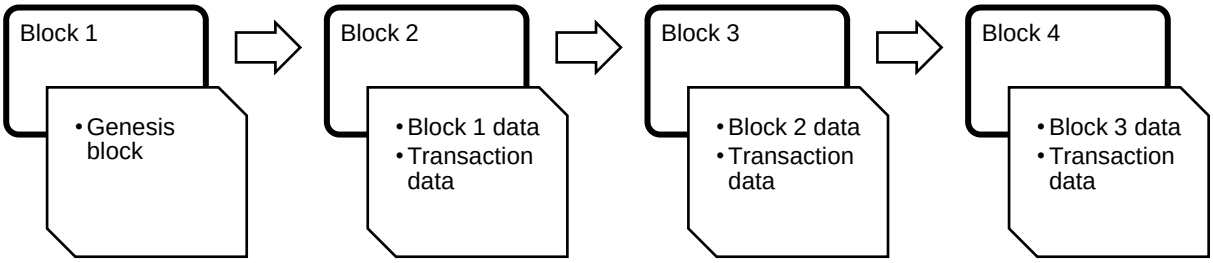


Figure 8 Structure of blocks in blockchain (Singhal, Dhameja and Panda, 2018, p. 9)

Each block contains a unique code called hash that separates it from the other blocks. These hashes are cryptographic codes created by algorithms consisting of a string of numbers and letters. One block can contain the data of thousands of transactions depending on the size of those transactions because the blocks have limited storage capacity. After the nodes have verified the block's transactions, the block is given its unique hash, and it is added to the blockchain. Blocks also contain the hash of the previous block added to the blockchain. Users can add their computers to the blockchain network as nodes. Every time a new block is added to the chain, the users get a copy of the updated blockchain. As the blockchain has a copy in every users' computer, it is impossible to manipulate the blockchain. To manipulate the information, one should manipulate every single copy of the blockchain. (Rahkola, 2019, pp. 17-18) Figure 9 visualizes the nodes in a decentralized, peer-to-peer system.

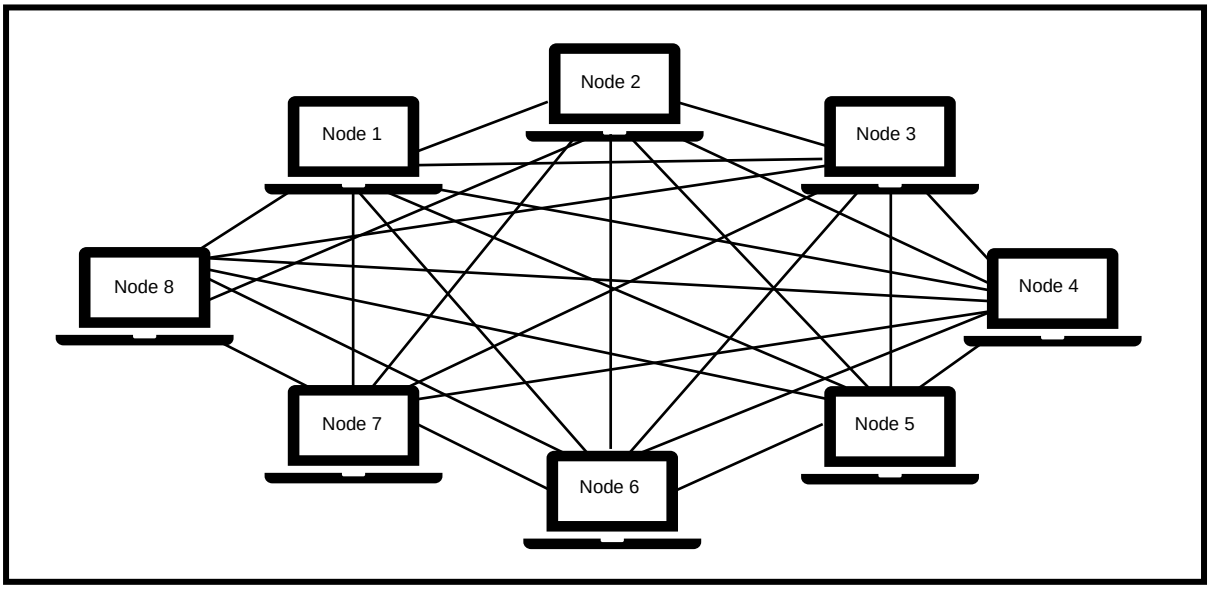


Figure 9 Nodes in a decentralized, peer-to-peer system (Singhal, Dhameja and Panda, 2018, p. 17)

Depending on the blockchain's functions, the nodes can operate as full nodes or as light nodes. The full nodes contain a copy of the whole blockchain, and its transactions as light nodes may have only a part of the blockchain saved to them. They can also focus on managing only one part of the blockchain. The separation of full nodes and light nodes is based on streamlining tasks and increasing transactions' processing. They can also be used to create higher-performing services regarding tokens between smart contracts and services. (Rahkola, 2019, p. 18)

Blockchain consists of five layers: application layer, execution layer, semantic layer, propagation layer and consensus layer. They are visualized in figure 10. Application layer is the layer where functionalities and application side are coded for the end users. Typically, it includes among others scripting, application programming interfaces (APIs), development frameworks and client-side programming constructs. The applications use blockchain as a backend and might require web servers, web application development, APIs, and server-side programming. (Singhal, Dhameja and Panda, 2018, p. 19)

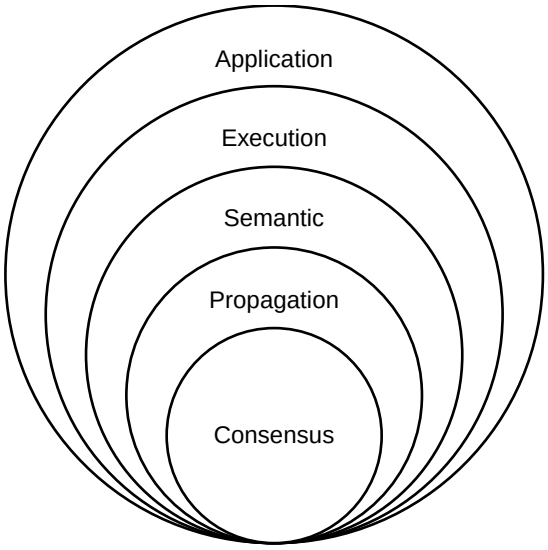


Figure 10 Five layers of blockchain (Singhal, Dhameja and Panda, 2018, p. 19)

The execution layer is used to execute instructions ordered by the Application layer which happen in the blockchain network. These instructions can be simple or complex and can be executed in the form of a smart contract. The simple instructions are not

Turing-complete and take place, for example, in Bitcoin. The more complex instructions are the result from Ethereum and Hyperledger. Ethereum's code or Ethereum-based smart contracts are written in Solidity coding language and need to be accumulated to Bytecode or Machine code to be executed on Ethereum Virtual Machine. Hyperledger's smart contracts are run by compiled machine codes inside docker images and can be coded through multiple languages, for example, by Java. The execution layer utilizes programs or scripts to ensure that the transactions are run correctly, which are then run independently in each of the blockchain nodes. (Singhal, Dhameja and Panda, 2018, p. 20)

The Semantic layer is a logical layer that validates instructions passed from the Application layer to the Execution layer. The Semantic layer validates, for example, if one is authorized to make a certain transaction or if a double-spend attack is happening in Bitcoin. The Semantic layer is also used to define rules of systems such as data models, storage models and structures. Singhal, Dhameja and Panda (2018, pp. 20-21) explain that smart contracts include so complex instructions that they are typically programmed into the contracts. A node in blockchain includes transactions and can include smart contracts as well. The Semantic layer is also the layer that defines how nodes are linked to each other.

The Propagation layer is the peer-to-peer communication layer, which is used for the nodes to talk and synchronize with each other about the blockchain's status. Most of the blockchains are designed so that when a new transaction is made, the information is forwarded to all the previous nodes in the blockchain. (Singhal, Dhameja and Panda, 2018, pp. 21-22)

The Consensus layer is the base layer for most blockchains, which focuses on finding the agreement on the ledger's coherent state between all the nodes in the blockchain. The Consensus layer is also the layer that ensures that the blockchain is safe and secure. To be able to reach proper consensus, incentive techniques called "mining" are in use. In Bitcoin and Ethereum, consensus mechanism Proof of Work (PoW) is

used, which randomly selects a node that can suggest a block. This suggested block is then presented and propagated to all other nodes, which then verify the block's validity. As other nodes approve the block, they append that block to their copy of the blockchain. PoW is based on confidence on maximum computing power as the more a node has computing power, the more likely it is to get validation tasks completed quickly and be the first node to suggest a block to be validated. These best miners get rewarded for their hard work. (Singhal, Dhameja and Panda, 2018, p. 22; Rahkola, 2019, p. 19)

Proof of Stake (PoS) is based on trust weighted by network management share. For example, if a node has a 3% share of all the tokens in the network, it needs to validate 3% of the networks' blocks. In PoS, validators do not get rewarded for their tasks like in PoW, but they get a validation fee, which amount, and currency are determined in the blockchain protocol. Other similar techniques are Practical Byzantine Fault Tolerance (PBFT), which is an algorithm for company consortiums where nodes are partially trusted, Proof of Authority (PoA), which is based on trust on trusted actors where only specified nodes are allowed to validate and add blocks in the chain and delegated PoS (dPoS) which is based on PoS but limiting the number of validators on the network. (Singhal, Dhameja and Panda, 2018, p. 22; Rahkola, 2019, p. 19; Konstantopoulos, 2018; Nolan, 2018)

Blockchains are divided into private, semi-private (hybrid), public, and consortium networks. Public blockchains are open for anyone to join, access, and append information. They involve tokens to compensate the members of the networks for their technical resources. Public blockchains work so that all the nodes of the network typically have a copy of the whole blockchain. For example, Bitcoin is an open blockchain system. Private blockchains have an administrator who is responsible for approving access to the blockchain for new users. All the information added to private blockchains is managed through reading and writing accesses based on members' roles. Tokens can be used inside a private blockchain as a value transfer tool. Typically, companies utilize private blockchain systems in their restricted user systems. (Rahkola, 2019, p. 17)

Public blockchain solutions utilize tokens, which are basically tools to preserve value. Schueffel, Groeneweg and Baldegger define tokens in their book The Crypto Encyclopedia (2019, p. 57) as cryptocurrencies created and managed in distributed ledger systems. An asset's or unit's value or a usage right can be represented as a token. They can be divided into three categories: payment tokens, also called as cryptocurrencies, which are used as means of payment or as currency (e.g. Bitcoin, Ethereum), commodity tokens, which include an access to some service or a right to do something (e.g. Storjcoin to acquire secure storage) and asset tokens which include a share or a right to company's or someone else's property (e.g. company's share). Tokens are also used as a form of crowdfunding where tokens are sold to investors in Initial Coin Offerings (ICO) where a sum of tokens' value is sold against FIAT currency and the acquired assets are used to finance the operations of a network or a service. Tokens can be issued by organizations through ICOs but also through Initial Token Offerings (ITO) and through private sale. Tokens are used in blockchains e.g. Ethereum. (Rahkola, 2019, pp. 20-21; Schueffel, Groeneweg and Baldegger, 2019, p. 57)

Semi-private blockchains, also called hybrids, are partly private and partly public. According to Imran Bashir, the writer of the book Mastering Blockchain, a group of people control the private part of the blockchain while the public part is open for everyone to join in. The private part functions as an internal side, for example, for a company which can then distribute access to specific network participants. The public side is available to anyone to participate by following pre-set procedures. Semi-private blockchains can be validated and secured by PoW if the public side is given the option to mine to secure the blockchain. (Bashir, 2018, p. 32)

According to Intellectsoft, consortium blockchains are also somewhat hybrid versions of private and public blockchain networks but a bit closer to the private ones. A consortium blockchain is a coalition of companies who have decided to solve problems to decrease development costs and required time to build new solutions. The infrastructure of consortiums is decentralized compared to private blockchains' distributed ones. In addition, the consensus of the network is managed by a set of

participants of the consortium network as in private networks, the consensus is managed by a single entity. Otherwise, the features of consortium and private blockchains are similar. (Intellectsoft, 2019)

Smart contracts are algorithms programmed into blockchain ecosystems. They are used to manage many kinds of processes and tasks to amend and transfer information. They are like traditional contracts, but they run autonomously, executing predefined code and business logic. When certain conditions are met, set functions are executed. Imran Bashir states in his book Mastering Blockchain that business processes and different scenarios can be programmed to automatically run inside smart contracts. This can lead to remarkable cost-savings, increased security, and flexibility. As the processes are run automatically inside the contracts, they take less time, and resources can be freed up to other tasks. (Bashir, 2018, p. 28; Rahkola, 2019, pp. 23-24) In addition, smart contracts utilize tokens as representations of value. According to Markus Rahkola, smart contracts are available to all the contract stakeholders or openly available for everyone to view. Every stakeholder of the contract has the same copy of the contract, and the tasks performed in the contract are saved simultaneously to everyone's copy. Nobody can amend the contract's details without access rights and without every stakeholder getting information about the change. The smart contracts work so that they exist passively in the blockchain, and as soon as the pre-set conditions are met, the contract activates itself. (Rahkola, 2019, pp. 23-24)

As presented in table 2, traditional contracts and smart contracts have quite a few differentiating factors. Traditional contracts typically have third parties connected to them, for example, lawyers. Smart contracts do not have those as they are created between the set stakeholders. For traditional contracts, typically, you need to be physically present to sign the contract. For smart contracts, this is handled by a digital signature. (366Pi Tec, 2020)

Table 2 Traditional contract vs. Smart contract (366Pi Tec, 2020)

	Traditional contract	**Smart contract**
Third party	Typically, yes	None
Signature	Physical	Digital
Cost	Expensive	Cheap
Remittance	Manual	Automatic
Execution time	1-5 days	Minutes
Security	Limited	Cryptographically secured
Archiving	Manual, difficult	Automatic, easy
Transparency	None	Available

Traditional contracts are a lot more expensive than smart contracts, which are only a fraction of traditional ones' cost. Remittance is done manually in traditional contracts as it is automated in smart contracts. Typically, it takes from one to five days to execute a traditional contract, as for smart contracts, it only takes a couple of minutes. The security of traditional contracts is limited, but smart contracts are secured by using cryptography. For traditional contracts, archiving is done manually. The contracts can take a lot of storage space if stored physically and not digitally. The archiving of smart contracts is done automatically to digital databases. The transparency of traditional contracts is typically non-existent, and the counterparties are unaware of another's situation with the contract process. Smart contracts are transparent, and all the stakeholders can see each other's input to the contract. (366Pi Tec, 2020)

There are some issues with blockchain technology. Markus Rahkola states that it is a problem that information cannot be amended or deleted once it has been appended to the blockchain. This is typical, for example, with Bitcoin. Many distributed ledger technologies enable the management and removal of information inside a blockchain with the right kind of planning and regulation. The problem of not being able to amend or remove information arises when the information has been incorrect when it has been appended, or it has drastically changed, and appending new information does not fix the underlying incorrect information. There have also been some issues regarding the reliability of tokens and their double use. Rahkola raises a case from

January of 2019 when criminals were able to return for their own use Ethereum Classic cryptocurrency tokens worth 460 000 dollars. A vulnerability enables this in PoS. It is possible to amend information in blockchain in PoS without validating the whole network of nodes if one node has over 51% stake of the computing power of the whole network. In the January of 2019 case, the criminals had a 51% stake of the computing power momentarily, and they were able to rewrite the information in the blockchain. If the network's total computing power is low or it decreases unexpectedly, the possibility of getting dominant share increases, which can lead to situations like this. (Rahkola, 2019, pp. 32-33)

Rahkola points out that in practice, blockchains are as secure as they have been designed to be. The blockchain technology itself is not secure or ensures that the information appended is correct. In addition, blockchain itself does not ensure privacy policy nor transparency of information. Blockchain solutions need to be designed to meet the requirements set to them and to ensure the process to validate information to be appended. Some solutions focus on making sure that the source of the information that is appended is correct. It is also crucial to ensure access control over the privacy of block-written data as the blockchain technology does not guarantee privacy protection nor transparency of information. Some cryptocurrencies also cause issues on the energy consumption side. The chosen consensus mechanism typically causes this as they have different energy consumption levels. Some services also have problems with a lack of storage capacity and with the storage capacity's management. (Rahkola, 2019, pp. 33-34)

In Applicature's interview of Business Analyst Stanislav Sheliakin from 2018, Sheliakin raises issues concerning blockchain's implementation. He states that it is not possible to make a lot of changes to blockchain technology as it is an open-sourced system with its own infrastructure. The development steps needed for the business must be adjusted to blockchain requirements. Sheliakin also mentions that there is such an issue with smart contracts that once you have adopted a smart contract on the public main network and mined it, you can no longer amend the contract. That is why it is very important to review the code for smart contracts multiple times to make sure all

the aspects of the contract and of the code are taken into consideration. If the smart contract turns out to be incorrectly coded or otherwise not working correctly, a new smart contract needs to be adopted. (Applicature, 2018)

2.3 Factoring market in Finland

The factoring market is quite small in Finland than the markets in Central Europe and the United States. It is divided mostly between big financial institutions that dominate the market with old technologies. There are smaller financial institutions and accounting firms ready to gain more ground in the factoring market. Some of them have realized that investments in new technologies and systems can bring them a competitive advantage against the big banks and financial institutions. However, as the clientele is established in the big banks, it is difficult for the smaller companies to gain ground in the business. According to Nisumaa from Finnrisk, Finnish companies prefer to finance their companies through banks. After the latest financial crisis in 2008, companies of all sizes applied funding from banks. Nowadays, it is more common that banks are not the only source of capital as other operators have surfaced the market. Companies use more diverse ways to acquire capital, for example, through bonds. It is also more common to use accounts receivables to gain capital since typically, 40% of the companies' balance sheet consists of accounts receivables. (Nisumaa, 2018)

According to Viisas Raha's article about data handling using artificial intelligence, banks are more afraid of fintech companies' ability to steal their customers than before. Nowadays, financial technology companies (fintechs) focus on building partnerships with other parties in the market, including banks. New technologies, including blockchain, big data, platform economy and artificial intelligence, break established market practices, and create new demand on the market. Consumers are interested in applications and Payment Services Directive PSD2, which was implemented in September of 2019, gave an extra boost to the application supply. According to digitalization specialist Hanna Heiskanen from Financial Supervisory Authority, registrations and licenses that are congruent with PSD2 have been admitted to

Checkout Finland Oy, Holvi Payment Service Oy, Paytrail Oyj, Skadi Oy, and Suomen Asiakastieto Oy. It is difficult for new companies to enter the market when there are so many market operators. For the last few years, the top 3 operators in the banking market have been OP Financial Group, Nordea, and Danske Bank. Kirsi Suopelto, CEO of Fintech Finland, believes that the collaboration of new and established operations in the market will be increasing. Though, smaller companies might think twice about applying for a license. (Viisas Raha, 2019)

According to Erik Zingmark, Head of Transaction Banking at Nordea, fintechs are looking for ways to gain more ground in the banking markets. They will either try to partner up with banks, or they will try to invade their space. BigTechs will most probably try to partner up with banks to avoid the need to acquire a banking license and to be able to access transaction data. Zingmark predicts that banks will begin commercializing data in 2020 as they will begin to provide anonymized and aggregated data against a fee. (Zingmark, 2019)

2.4 Risks related to factoring

Charles Yoe states in his book Principles of Risk Analysis: Decision Making Under Uncertainty (2019, p. 1) that "*Risk is a measure of the probability and consequence of uncertain future events.*" He defines risk to consist of the undesirable outcome and the probability of its occurrence. It can be presented in an equation form as

Risk = Consequence x Probability

Risks need to be identified to be taken into consideration when making decisions about new investments and development steps. Table 3 presents the risks related to factoring. The risks identified that are related to factoring are divided under strategic and market risks. Strategic risks are divided to operational risks and financial risks. Market risks are divided into interest rate risks and currency risks. Below the risks are presented more closely.

Table 3 Risks related to factoring

Strategic risks arise from changes in the competitive environment, unsuccessful strategy, unsuccessful execution of strategy or too slow reaction pace to occurring changes, according to OP Financial Group's annual financial statement from 2015. Strategic risks can be decreased by building analysis and predictions of the development of the markets and operating sectors, competitive environment, and customer demand. In table 3, operational and financial risks are grouped under strategic risks following Finnish Risk Management Association's guidance. (SRHY, 2012-2020a)

Operational risk is a risk that results in direct or indirect losses. It arises when people, systems, or internal processes fail in their tasks or unexpected external events take place. (Bessis, 2015, p. 4) According to OP Financial Group's annual financial statement from 2015, operative risk management is used in organizations to ensure

that there will not be any unexpected financial losses or consequences and that the organizations' operational side is functioning properly. It is crucial to identify the operation's risks and to assess necessary ways to ensure adequate control and management procedures. (OP Financial Group, 2015) Four risk types are categorized under operational risks according to Finnish Risk Management Association's guidance: human risk, information risk, product risk, and conduct risk. They are presented in more detail below. (SRHY, 2012-2020a)

Human risk is the risk that is caused by the personnel to organizations' operations. In addition, it includes risks that can be directed towards the personnel. Human risk can arise from inside or outside of the organization. Human risk includes the risk that key competencies needed in the business accumulate to one employee or to a small group of employees. (SRHY, 2012-2020b) Information risk is the risk that organizations' information is correct, trustworthy, up to date, and always available to correct employees. It is also crucial that the information does not end up to the wrong people inside or outside the organization. (SRHY, 2012-2020c) Product risk is the risk of launching new products and making bad decisions concerning products and their development. Well-handled risk management can decrease product risks. (SRHY, 2012-2020d) Conduct risk is the risk of action of an individual or a financial institution that causes harm to customers or detrimental effect on effective competition or stability of the market. According to Lucas Ocelewicz from KPMG UK, conduct risk arises from structures and behaviors, environmental factors, and inherent factors. Structures and behaviors refer to the financial sector's way of working inefficiently to ensure markets' efficient operation. Environmental factors refer to macro-economic variables that influence the financial markets. Ocelewicz states that inherent factors are aspects of financial markets and their participants. As an example, he argues information asymmetries arising between companies and their customers. (Ocelewicz, 2017)

Liquidity risk is a risk that reflects companies' ability to raise cash. It is divided into funding liquidity and asset liquidity. Funding liquidity is defined as a company's ability to borrow money to get cash together. If a company is unable to borrow cash, risk materializes. Asset liquidity is defined as a company's ability to sell financial assets in

the market to raise cash. Liquidity risk results typically from other risks occurrence. If a company does not have enough liquidity, and credit or market losses take place, a company might face a decrease in their creditworthiness. (Bessis, 2015, pp. 3-4)

Solvency risk is when a company is not able to cover its losses with its available capital. Banks are required to maintain a capital buffer for events when unexpected losses arise. Many banks would be in trouble without these capital buffers when unexpected losses would exceed their capital base. This capital buffer can be seen to set the probability of default of the banks and is therefore regulated heavily. (Bessis, 2015, p. 4)

Credit risk is used to describe the situation where a buyer defaults and causes losses or that a company's creditworthiness regresses. In factoring, credit risk is seen in events when the buyer does not pay its invoices, which leads to a total or partial loss in the vendor and/or financial institution's side. Term credit risk is used also in cases where the buyer company's creditworthiness regresses. This does not mean that the company defaults but its probability of default increases. This also leads to lower economic value. Counterparty credit risk occurs when there is a possibility for loss when the counterparty of an agreement defaults. This risk exists when position exposures are valued in the market. In addition, recovery risk is related to credit risk as it measures the uncertain value of recoveries under default. These recoveries are dependent on the guarantees related to the transaction itself, the seniority of the debt, and the repayment agreement that the company, in default, agrees with a lender. Loss after repayment agreements is the actual loss of the default. (Bessis, 2015, p. 3)

Supplier fraud risk is present when the invoice offered for financing is fake, altered, or a duplicate. Receivable title risk is present when the vendor has offered the invoice to another financial institution to be financed. Receivable transfer risk is present when there is no applicable law that would allow the party who has provided the funding for the invoice, to obtain a right to the receivable, which is free and also free from third party claims. This risk also includes that the funding provider might need to take

actions that it was not aware of. Dispute risk is considered when the buyer files a reclamation on the invoice that the goods or services provided are not satisfactory. A reclamation may lead to a partial payment, modified payment, or a situation where no payment is made. Payment delay risk is considered when the buyer will not pay in due time. Payment direction risk is present when the buyer pays the invoice to the vendor or to some other party related instead of paying the invoice to the financial institution providing the invoice's funding. Debtor credit risk is present when the buyer defaults and will not pay the invoice on the grounds of insolvency, bankruptcy, or financial inability. This risk is most common in the invoice finance sector. Discount risk is considered when the buyer pays only a partial amount of the invoice's value for reasons that are not directly connected to the vendor's actions on the invoice or goods at hand. For example, this risk takes place if a buyer considers early payment discounts or utilizes credit notes assigned to it. The buyer might also return goods to the vendor if they have agreements that goods that have not been sold will be returned. The buyer might also use discounts as ordinary action in its business or as a fee as the vendor has not performed well regarding prior deliveries. (Incomlend, 2017)

According to OP Financial Group's annual financial statement from 2015, in order to assess corporate client's ability to service debt and credit risk, banks use credit ratings, credit records, financial statement analysis and predictions, statements, assessments of creditworthiness, outlooks on sectors and corporate analysis. Customers can be taken into special monitoring to control their credit risk, payment behavior, and financial stability. Financial institutions assess customers' credit ratings and the probability of default. These assessments are used to form credit ratings. Credit risk can be decreased by using statements of counterparties and guarantees. It is crucial to ensure the trustworthiness of counterparties. Financial institutions are not as strict with guarantees with bigger players in the market with higher credit ratings. Credit risks need to be managed in accordance with customer limits, coverage of collateral and problematic receivables. Furthermore, customers' overall situation and liabilities' structure and quality needs to be monitored. (OP Financial Group, 2015)

Market risk is the risk that the market movements affect the positions of market players leading to losses. The markets' movements are affected by risk factors, which include interest rates, equity indexes, and foreign exchange rates. According to Joël Bessis, market risks depend on the period of time that it takes to sell assets as the market fluctuations are typically more volatile over longer periods of time. Instruments that are traded over-the-counter (OTC) are at more risk than the instruments that are actively traded in the markets. For these traded instruments, the market risk can be said to be a price risk. (Bessis, 2015, p. 3) Market risk includes currency risks, which are called foreign exchange risk and interest rate risk, as shown in table 3. Currency risk takes place when exchange rates change and might lead to losses. Interest rate risk is present when interest rates are volatile. It is a risk of decrease in net interest income, which can be calculated as interest revenues minus the interest cost. Parties engaging in floating interest rate or fixed interest rate agreements are exposed to interest rate risk as the market movements affect the cost and revenue of the chosen rate. (Bessis, 2015, p. 4)

3 ACADEMIC LITERATURE AND USE CASE REVIEW

This chapter presents a review of academic literature published related to the topic of this thesis. Previous studies' insights and results are analyzed and compared in this chapter. In chapter 5 "Discussion and conclusions", the examined research is compared to this thesis and the research results. Also, a review of blockchain use cases in invoice finance is presented partly relying on the research found from the academic literature review. Earlier use cases are examined and compared to each other. In chapter 5, the use cases are compared to this thesis's research results and earlier use cases and provided suggestions for use cases presented in the research results.

3.1 Review of academic literature

For the systematic literature review, six databases were selected to search for research related to the thesis's topic and the research questions. The chosen databases were: Semantic Scholar, IEEE Xplore, LUT Research Portal, LUT Primo, LUTPub, and Theseus. Semantic Scholar is a research tool for scientific literature that applies artificial intelligence to its searches. In 2020, Semantic Scholar includes over 180 million research papers from different fields of science. (Semantic Scholar, 2020) Semantic Scholar was selected as one sources of research as it is seen as a trusted source of research. It contains a lot of research from multiple fields of science, which is good as this thesis is a combination of different fields of study, so by searching from a database that contains publications from different fields, the odds of finding relevant research are high. IEEE Xplore is a digital library that includes publications from the Institute of Electrical and Electronics Engineering (IEEE) and its publishing partners. The library contains over 5 million publications in electrical engineering, electronics, and computer science. (IEEE Xplore, 2020) IEEE Xplore was selected as one of the research sources as it contains research from the computer science field. This way, the odds of finding suitable and relevant research concerning this thesis's technical side are high. LUT Research Portal offers information on LUT research projects and publications in LUT University. LUT Primo is a LUT University's library database that

includes, among others, books, e-books, and research. These LUT University's databases were in scope of the literature review as they contain a lot of reliable research from different fields of study. LUTPub is an open publishing archive for LUT University, which contains, among other bachelor's theses, diploma theses, master's theses, and licentiate theses. Theseus is a service that offers dissertations and online publications from Finnish polytechnics, for example, theses. LUTPub and Theseus were chosen as databases to collect information if and when students have done theses on the topic of this thesis or related topics.

In total, 23 search words and sentences were used to find relevant research. 12 of the search words/sentences were in English, and 11 of them in Finnish to get more coverage in the searches. Search words/sentences contained variations of words, as there are multiple words to describe factoring. Search words/sentences included keywords and sentences referring to the research questions. Appendix 3 and 4 present the search words and sentences, databases, and the number of search results that came up and the number of relevant search results. If a search word/sentence gave more than 500 results, only the first 500 results were examined for relevance due to the heavy workload. Relevant research in the searches described as relevant search results in appendix 3 and appendix 4 was selected by reading the titles and summaries of the studies. The relevant studies were collected to an Excel list containing their source and the used search word/sentence. In Excel, the following information was collected from the studies: title, source website, authors, year of publication, type, number of citations, and whether the study was peer-reviewed. In total, 100 relevant studies were found. If the same study came up in many searches, it was marked as a relevant reference to all the search words/sentences it was concerning. 27 studies of the 100 relevant studies were behind payment walls or otherwise not accessible, so they were excluded from the scope.

In total, 24 relevant theses were found from Theseus, LUT Primo, and LUT Pub. They were published between 2014-2020. They were all classified as not reliable as they are theses without citations and peer reviews. Three theses were about factoring, its different forms, financer's risk management, insurance, and accounting. One thesis

was about risk management in corporations and whether digitalization can improve risk management in cash management. Four of the theses concerned the use of smart contracts. 16 of the theses concerning utilizing blockchain in the financial industry and supply chains and blockchain's use cases.

In total, 49 studies were selected to be examined in more detail. After a more detailed examination, 18 of the 49 studies were excluded from the scope as they did not include suitable material to be utilized in this thesis. The remaining 31 studies were classified based on thematic design. Identified themes were opportunities and challenges of blockchain, smart contracts, marketplaces and frameworks, consortiums, and use cases. The use cases were transferred to chapter 3.2 "Review of blockchain use cases in invoice finance". As there were in total 31 studies, a review of methods used in conducting the studies was considered unnecessary as it was considered more important to go through the insights and results of the 31 studies. The studies' insights and results were divided into these identified themes in the following sub-chapters 3.1.1 "Opportunities and challenges of blockchain", 3.1.2 "Smart contracts", 3.1.3 "Marketplaces and frameworks", and 3.1.4 "Consortiums".

3.1.1 Opportunities and challenges of blockchain

Waseem Akram describes in his 2017 study "Blockchain technology: challenges and future prospects" (pp. 642-644) the advantages and challenges of blockchain technology. Akram states that there are many challenges with blockchain. These include development costs, unverifiable administrative status, incipient innovation, control, protection, and security, and the need to update existing systems to work with blockchain applications. Ghode et al. instead examine in their study "Blockchain adoption in the supply chain: an appraisal on challenges" (2020, pp. 4-6 and 14) challenges concerning blockchain implementation in supply chains. They have identified eight challenges: inter-organizational trust, immutability, selection of product, societal change, governance, exchange of information, transparency, and participant behavior. In the 2018 study "Blockchain technology and its relationships to sustainable supply chain management", Saberi et al. describe four barriers to implementing

blockchain to supply chains. They have identified technical, external, inter-organizational, and intra-organizational barriers similar to those identified in Ghode at al.'s study. The most critical challenges in blockchain adoption are transparency, governance, and immutability. Societal changes and behavior of participants is something that can be evaluated according to the situation at hand. To ensure a good and steady implementation, one should pay attention to the exchange of information, selection of product types, and inter-organization trust. (Ghode et al., 2020, pp. 4-6 and 14)

In the 2019 study "The power of a blockchain-based supply chain", Azzi et al. discuss the benefits of implementing blockchain technology to supply chains. They emphasize that in addition to focusing on the technology's suitability to a company's processes, one should examine that the improved processes' data is reliable. Companies need to focus on blockchain solutions' latency, capacity, scalability, and throughput when adopting blockchain to supply chains. Security of tracking solutions should be ensured by authenticating the tracking devices connected to the system and ensuring that all the data handled in the environment is signed and encrypted. Security and capacity vulnerabilities should be identified and addressed. (2019, pp. 582, 584, 586 and 589-590)

In the 2016 study "Where is current research on blockchain technology?", Yli-Huumo et al. seek to understand the challenges and future developments of blockchain technology from a technical viewpoint. They conclude that blockchain has technical challenges and some limitations, but it is a good solution for making transactions using cryptocurrencies. They have identified seven technical challenges and limitations: throughput, latency, size and bandwidth, security, wasted resources, usability and versioning, hard forks, and multiple chains. They are very similar to the ones Azzi, Chamoun, and Sokhn have identified in their 2019 study. Yli-Huumo et al. state that Bitcoin networks' capacity and throughput to process transactions is only a small part of VISA's capacity. To achieve sufficient security for the transactions, in 2016, it took around 10 minutes to complete a transaction. It takes a lot of time to process a block in the blockchain, resulting in an increased risk of double-spending attacks. The size

and bandwidth issues need to be addressed to solve the limitations in transaction processing per block.

Hasanova et al. go through blockchain's vulnerabilities and potential attacks towards the technology in their 2019 study "A survey on blockchain cybersecurity vulnerabilities and possible countermeasures". They agree with Yli-Huumo et al. that there is an issue with data storage limitations as the cost of storage is high. Cocco, Andrea, and Marchesi (2017, pp. 1 and 9) present in their study "Banking on blockchain: cost savings thanks to the blockchain technology" challenges and opportunities in integrating blockchain as part of banking systems. They see block size's limitations as a challenge as they can only store a limited number of transactions. They see this size limitation as the biggest issue with blockchain technology and the enormous energy consumption blockchain networks take to run.

Randy Myers discusses in his book "Betting on Blockchain: the widely hyped technology continues to attract converts intrigued by its potential to eliminate the frictional costs of executing and reconciling transactions" (2017, pp. 31-33) the opportunities blockchain provides. Myers aligns with Cocco, Andrea, and Marchesi that blockchain's biggest challenges are speed of transactions, blockchain's storage capacity, verification process, collaboration, and integration to existing systems and processes. The integration and development costs can be high, which might be an obstacle for some companies to adopt blockchain solutions. Riki Fujini-Rajani discusses in his study "FinTech developments in banking, insurance and FMIs" (2018, pp. 8-10) DLT systems and non-DLT legacy systems ability to communicate. This is an issue that needs to be solved to develop better blockchain solutions in the future. (2018, p. 9)

Hasanova et al. and Yli-Huumo et al. have identified that 51% attack or Goldfinger, wallet security, and double-spending are general risks related to blockchain. Hasanova et al. state that to secure blockchain solutions, all the nodes in a blockchain network need to update their versions to the newest one. It causes issues if nodes

have different versions. Because of this, a new rule has been added to the cryptocurrency protocol called hard fork. The nodes that have not been upgraded to the newest version cannot be accepted by the newest version. Hasanova et al. present an issue in blockchain's privacy as transactions in blockchain are registered in a public ledger. Users' identities making the transactions are not public information, but through the public transaction data, patterns can be recognized, and user identities can be linked to addresses. Yli-Huumo et al. identified issues with energy consumption. Proof-of-Work verification takes a lot of energy. PoS could solve this issue as in PoS; for example, if someone holds 5% of Bitcoin, he/she can mine 5% of the blocks in the network. Blockchain also has i usability issues; for example, Bitcoin's API is not a user-friendly solution for blockchain developers. Also, multiple chains and versioning cause issues. (Yli-Huumo et al., 2016, pp. 1 and 3-4)

Remko van Hoek examines in his study "Developing a framework for considering blockchain pilots in the supply chain – lessons from early industry adopters" (2019, p. 115) how blockchain could be utilized in supply chains. He conducted case studies where he studied how blockchain in supply chains has been seen through the eyes of early adopters. He concluded that it is important to scope pilots in a targeted way. It should also be considered to use the company's existing technology to do the pilots instead of immediately replacing all present technology with the new one. Yinsheng Li describes in her study "Emerging blockchain-based applications and techniques" (2019, p. 279) blockchain as a secure and autonomous system that needs a credit system by its side to provide creditworthiness to the blockchain systems. There is creditworthiness in blockchains operations and data storages, but according to Li, not enough. Many blockchain techniques are still underdeveloped, and their performance, efficiency, security, creditworthiness, supervision, privacy, and online-to-offline integration should be highly developed. She sees that only a few newly developed blockchain ventures are necessary, efficient, and feasible to execute.

Chang et al. interviewed sixteen professionals in their 2020 study "How blockchain can impact financial services – The overview, challenges and recommendations from expert interviewees" on blockchain's abilities. They concluded that governments

should build regulations and policies to prevent the blockchain's illegal, including terrorist financing, money laundering, and capital control. Supervision systems should be developed to monitor blockchain systems. Companies should start integrating blockchain into their infrastructure before being terminated by competition. (2020, p. 10) Fujini-Rajani sees that settlement, payment, and clearing could be handled through blockchain to save time and be more efficient. Blockchain also enables transparency and resilience. As the data on the blockchain is distributed to all the network nodes simultaneously, the risk of a single failure that could potentially harm the data can be significantly reduced. (2020, p. 10)

Ashutosh and Vishnu provide examples of how to improve supply chains through blockchain technology in their study "Effect of blockchain technology adoption on supply chain adaptability, agility, alignment and performance" from 2019. They concluded that blockchain technology could enhance company performance and competitive advantage by increasing alignment, agility, and adaptability of supply chains. Ashutosh and Vishnu suggest that companies should increase the awareness of blockchain technology in their companies and collaborate with blockchain-driven IT companies to create new blockchain solutions. (2019, pp. 1353, 1356 and 1366-1367) Saberi et al. (2018) explain that blockchain could offer automated smart contracts, trustworthy, secure networks based on secure, shared, decentralized ledgers. Blockchain would also allow the removal of intermediaries in transactions. Spend Matters article "Why Bitcoin's blockchain technology could revolutionize supply chain transparency" from 2015 discusses bringing blockchain to supply chains. Blockchain would bring transparency to supply chains as in the current situation when one party oversees the supply chains, a bias can develop where the one party does not share information to other parties in the supply chain that would be harmful to it. Ethereum's smart contracts would allow the automatic creation of invoices that would make a payout when a shipment arrives. They would also enable automated share certificates to be programmed to payout dividends to the shareowners when certain conditions are met. (2015, pp. 31-32)

Waseem Akram explains that blockchain provides security, secrecy, protection, and sincerity to the participants of blockchain networks. He lists blockchain's advantages: high quality of data, speed of transactions, empowered customers, lack of intermediaries and trustless trades, trusted transactions, transparency and non-altered data, and decrease in transaction costs. (2017, pp. 642-644) Cocco, Andrea, and Marchesi see that with blockchain comes the ability to make financial systems more efficient and optimize the global financial infrastructure. Azzi et al. agree with Akram that blockchain would improve trust between suppliers and customers by transparency and product compliance, including adhering to international standards. Paperwork and administrative costs could be decreased. The detection of fraud and counterfeit goods would be easier, and the origins of goods could be tracked better than before. Blockchain would also enable faster processes for calling back products. (2019, pp. 582, 584, 586 and 589-590) Fujini-Rajani states that with blockchain, banks' reconciliation costs could be reduced and duplicate work as systems could be synchronized to update information from blockchain simultaneously as it is updated there. Blockchain makes it unnecessary to have paper documents as all agreements, and other documents can be stored on the blockchain. These kinds of development steps would though, require lots of collaboration with companies' stakeholders. Ankenbrand and Bieri analyze in their study "A structure for evaluating the potential of blockchain use cases in finance" (2017, pp. 77 and 92) use cases of blockchain technology in the financial services industry. They agree with Azzi et al. that DLT offers decreased costs, risks, and time and increased revenue flows when institutions and individuals are examined. When intermediaries are examined, they can benefit from the same decreases, and their revenue flows decrease.

In the 2017 study "Blockchain-driven supply chain finance: Towards a conceptual framework from a buyer perspective", Omran et al. focus on examining a framework for supply chain finance solutions based on blockchain. Streamlining of financial flows can be done with blockchain technology. All network participants can see the financial information data, invoice status, credit limits, and transactions in the network. Blockchain allows less complex and less costly systems with data security. Ankenbrand and Bieri agree that blockchain enables transparency and increased trust in the financial systems and offers efficiency. Blockchain offers solutions to make

financial systems less complex. (2017, pp. 77 and 92) Omran et al. state that blockchain can show transparent data of goods and money in blockchain platforms. They consider that with blockchain, autonomy and efficiency can be achieved. Blockchain has been studied to benefit reverse factoring by increasing security and quality of services. Omran et al. see that in comparison to conventional, centralized technology, blockchain is better with qualitative factors as conventional technology is better with quantitative factors, including speed. It is seen that blockchain wins conventional technology infrastructures with its robustness, trust, and interoperability. These factors enable autonomy in peer-to-peer systems. Omran et al. conclude that blockchain's key competitive advantages are automation, trust, and transparency. (2017, pp. 1-2 and 11-13)

Spyros and Klitos examine in their study "Blockchain: Current challenges and future prospects/applications" (2019, pp. 3 and 10) the advantages and risks of blockchain. They align with Omran et al. and Ankenbrand and Bieri that blockchain offers transparency, immutability, trust, security, and disintermediation. They see that the cost to integrate blockchain into existing processes can be high, but as blockchain becomes the company's main technology, the costs decrease. As more and more people get excited to develop blockchain, the scalability issues and usage costs should decrease.

Randy Myers explains that there are four ways concerning blockchain applications that could be useful in finance. These are eliminating reconciliation, streamlining settlement activities, simplifying supply chain financing, and liquidity optimization, and its release. Reconciliation can be eliminated through blockchain's immutable and verifiable features. A full audit trail and assurance capabilities can be created in the blockchain. With blockchain, settlements that typically take days to be completed can be completed in a few seconds. This could also be exploited with collaterals using smart contracts. Almost all properties of the supply chain could be integrated into the blockchain, which would decrease financing costs. Myers explains that through digitized assets on the blockchain, companies could register their foreign accounts receivables. This way, the place of origin of the receivables would be known, audible,

and trustworthy. This could make the financial institutions more interested in financing foreign receivables. (2017, pp. 31-33)

3.1.2 Smart contracts

Zheng et al. describe in their 2020 study “An overview on smart contracts: Challenges, advances and platforms” features of smart contracts. With smart contracts, administration and service costs can be decreased as intermediaries are removed from the transactions. Smart contracts can also reduce risks and make business processes more efficient. The transactions completed on the blockchain are traceable and auditable. Frauds can be significantly reduced this way. Once data is added to the blockchain it cannot be altered later. As business agreements are processed through smart contracts, the turnaround times can be reduced as settlements are automatically processed. (2020, pp. 475-476) Fujini-Rajani states that mortgage contracts and trade finance agreements could be automated using smart contracts. He explains that JP Morgan has collaborated with Ethereum to launch a permissioned blockchain and smart contract platform called Quorum. The platform is used to process private transactions with only known participants in the network. (2020, pp. 8-9)

Singh et al. examine in their 2020 study “Blockchain smart contracts formalization: Approaches and challenges to address vulnerabilities” smart contract’s features. The underlying code behind smart contracts usually causes smart contracts’ vulnerabilities. The smart contracts need to be programmed to address vulnerabilities, and failure-prone scripts need to be removed. The programmed code must be secure. Researchers have highlighted that the smart contracts need to be verified through formal methods before deploying them on the blockchain. The formal methods include tests where the code is run with all inputs in its state space to verify that the code behaves as it should, and all exceptions are handled correctly. Singh et al. state that there are some major issues with smart contracts: domain-specific languages for the Ethereum platform, formal testing, and automated formal verification of smart contracts. These issues still need to be addressed and solved. Many issues with smart

contracts have been solved through the formalization of the smart contracts. (2020, pp. 1-2 and 11-12)

3.1.3 Marketplaces and frameworks

Johnson et al. present in their study Invoice Financing of Supply Chains with Blockchain technology and Artificial Intelligence (2019, p. 3) a decision-making tool for invoice financing of suppliers who are positioned high in the supply chain. It could be implemented as a smart contract in private blockchains. The solution is based on Bayesian Networks, and cross-chain function calls in private blockchains. It allows informed decision-making under uncertainty regarding the funding of invoices. Pieper presents in the study “Invoice financing on a multi-sided platform an action design research using transaction costs economy” (2015, p. 1), an invoice marketplace that offers invoice financing for SMEs. Pieper describes it as a digital multi-sided platform that utilizes transaction cost economy. Typically, factoring is seen as expensive finance because of the high transaction costs, but an invoicing platform could solve this issue. Schär presents in the study “Decentralized Finance: On Blockchain- and Smart Contract-based Financial Markets” (2020, p. 1) a decentralized finance ecosystem. It enables efficiency, accessibility, transparency, and interoperability, but it also contains risks in operational security and smart contract execution, and it has dependencies.

Nijeholt, Oudejans, and Erkin examine in their 2017 study “DecReg: A Framework for Preventing Double-Financing using Blockchain Technology”, a blockchain-based DecReg framework that would solve the double-financing issue that is one of the main issues in invoice financing. DecReg is designed in a private blockchain governed by a Central Authority (CA) to limit access to the blockchain and secure that sensitive information is not shared with unauthorized parties. CA cannot alter data in blockchain but only keeps track of who can enter and who needs to leave the blockchain network. To keep the processing data limited in the blockchain, invoices would have to be paid in the set times as a mechanism would clean the blockchain from any access invoice data. This would allow faster search queries. (2017, pp. 1, 4 and 7) Nijeholt, Oudejans,

and Erkin see a challenge that if a seller is not allowed entrance to the network, it cannot verify agreements that would make it possible that double-financing might happen. This issue could be solved by the seller restraining from invoice financing until granted access to the network. It is also crucial from a double-financing perspective for all the companies to use correctly formatted, unique numbers for invoices. In DecReg, factoring companies would publish all the agreements with sellers to the network, enabling analysis of operational information about competing factoring companies. This information leak can be solved by group signature schemes that allow nodes to see a transaction signed by one of the nodes in the network, but they would not identify which of the nodes has done it. To avoid malicious behavior in the network, the Central Authority would be able to see the nodes' identities. (2017, pp. 6-7)

Battaiola et al. (2019, p. 2) researched how blockchain-based invoice factoring would work in theory and practice. They have recognized two features of an invoice market are challenging to be assessed by the factoring companies: whether an invoice has already been financed through factoring and authentication of identities of the agreement's stakeholders. These weak spots lead to multiple fraud risks. Battaiola et al. present a centralized system as a quick solution to these problems. In a centralized system, invoices could be stored and verified by interested parties. All the system stakeholders would send their private inputs to a trusted third party who would then manage the marketplace. Battaiola et al. present that information could be gathered through a permissioned, distributed ledger with commitments that would enable the data's confidentiality and all the stakeholders. In the solution, authenticated peers maintain the consensus of the ledger. The ledger contains all commitments of secret values, and these secret values are stored locally by the peer that acts as the data owner. If a peer wants access to the data, it needs to be approved by the data owner, and then the data is sent through a private, secure channel containing only the two peers. Battaiola et al. (2019, p. 14) conclude in their research that a distributed ledger solution would be a significant development step for invoice factoring. Blockchain would enable factoring companies to verify that an invoice has not already been factored in without the need for all the stakeholders of the factoring agreement to share their data. In their research, Battaiola et al. presented how a distributed invoice factoring market would work, its security requirements, and main processes. Their

centralized market solution is fully distributed and independent of time and assumes that there is a distributed ledger available.

Fabrizio et al. examine in their study “Invoice discounting: A blockchain-based approach” from 2019 an invoice discounting system called Distributed Ledger Invoice. They examine blockchain solutions available for their invoice discounting scenario and present a decoupling layer based on Attribute-Based Access Control language. It would allow unification of access controls to reserved information and solve interoperability issues. Fabrizio et al. present in their study a Blockchain Assessment Model (BAM) that is designed to assess blockchain frameworks. The model is used to evaluate the most suitable blockchain framework for specific inter-banking scenarios. (2019, pp. 1 and 4)

3.1.4 Consortiums

Naeem, Kyleen, and Shavers discuss blockchain usage in supply chains in their 2019 study “Is your supply chain ready to embrace blockchain?”. They state that DLT enables access for all the participants of an agreement to see an updated copy of the ledger transparently and simultaneously. Also, no third parties are needed to verify transactions. Consortium blockchains enable immediate access to all information with up-to-date permissions, which removes issues concerning the trust. Consortiums also allow everyone in the network to use the data added, so the same data does not need to be added more than once. (Naeem, Kyleen and Shavers, 2019, pp. 57-59) Joy Macknight describes in her 2018 study “Faster, cheaper, smarter: blockchain in trade finance - Distributed ledger”, consortium use cases and distributed ledger’s possibilities. The use cases are handled in detail in chapter 3.2 “Review of blockchain use cases in invoice finance”. Macknight aligns with Naeem, Kyleen, and Shavers’ vision that participants can see the same data simultaneously as everyone’s ledger is updated in real-time with the latest copy of the blockchain. Once data is added to the blockchain, it cannot be changed, and everyone in the network has a single source of truth. The use of blockchain also brings transparency to transactions as all network participants can see all the transactions done in the blockchain. (Macknight, 2018, pp.

2-3) Naeem, Kyleen, and Shavers (2019, p. 56) state that with transparency, unnecessary disputes can be avoided, and fraud attempts diminished. No transparency can cause incorrect data and lead to incorrect business decisions. Macknight (2018, p. 3) adds that fraud can be reduced by transparency and transaction validation.

Macknight explains that with blockchain adaptation, trade finance costs can be reduced as smart contracts enable a decrease in transaction costs as documents do not need to be moved so much as they are inside the smart contracts. Blockchain also enables banks to finance parts of the supply chain towards their own risk appetite. Many banks can finance parts of the same supply chain. Macknight adds that in consortiums, consensus can be reached through a much lower computing power than in traditional blockchain solutions as the participants in permissioned consortium networks are known. (Macknight, 2018, p. 3) Naeem, Kyleen, and Shavers (2019, p. 62) conclude that technical capabilities and organizational readiness are the greatest challenges in blockchain implementation. Also, investment costs in the new technology, scalability issues, and integration with stakeholders can be challenging for companies. It is crucial to decide who is the main leader of a consortium and who has the resources, skills, and knowledge to implement the consortium technology. In addition to these, companies need to consider risks emerging from cybersecurity, smart contracts, and architectural decisions.

3.2 Review of blockchain use cases in invoice finance

For the review of blockchain use cases in invoice finance, data was collected through Google searches and the systematic literature review. Six studies were identified through the literature review to contain details of use cases of blockchain in invoice finance. Also, use cases were found through Google searches to find use cases related to the thesis's topic. The use cases were divided into categories using thematic design. The identified categories were smart contracts and consortiums. The use cases are handled in the following sub-chapters 3.2.1 "Smart contracts" and 3.2.2 "Consortiums".

3.2.1 Smart contracts

According to business analyst Stanislav Sheliakin from Intellectsoft, there is a huge potential in blockchain technology to be used in factoring. However, in order for companies and financial institutions to get on-board with blockchain, they need to develop their infrastructure. For blockchain to handle factoring agreements properly, a hash needs to be utilized to validate the invoice in a smart contract as security to confirm that there are not identical invoices already in the system. The smart contract hashes the invoice and stores it inside the blockchain as a transaction with a timestamp until the receivable is paid. Sheliakin remarks that it is also important to develop partially permissioned blockchain networks. The smart contract should be available for actions only for parties who have KYC in place and who have fixed account addresses. For parties who do not have these in place, they should only be able to retrieve information from the blockchain and not interact with it. According to Sheliakin (2019), multi-signature agreements could be utilized in smart contracts. To be able to transfer tokens or cryptocurrencies or to make changes to the smart contract, multiple signatures would be needed. If automated contracts were used, there would be fewer disputes and needed communication between the parties involved in the transaction.

Blockchain solutions for factoring are typically created into smart contracts into an open blockchain platform. Usually, they are created into the Ethereum ecosystem and platforms like Hyperledger, NEO, and R3CORDA can be used, according to Aleksey Zavgorodniy (2019), CEO of Unicsoft. He says that especially algorithms in Ethereum enable decentralized execution and storing of smart contracts. The processed data is public, but the actual hashing process is done locally. These aspects enable improvement in the security of the network. The factoring agreement in the blockchain is made up of nodes verified by clients of the Ethereum network every time a new node is added to the blockchain. These nodes are different stages of the agreement. Many companies that focus on developing blockchain solutions for factoring purposes use a payment processing mechanism where the smart contract is first hashed and the deal requisites. The payout of the invoices is paid only if hashes correspond on both the

creditor and debtor's side. This kind of process decreases the risks of a scam to the stakeholders like banks, who are obligated to pay the creditor. Zavgorodniy states that they have launched a software solution based on the Ethereum platform and Parity client. The system is divided into two nodes, of which one is public, and the other one is private. The private one is used to administer the system, automate factoring agreements, and the tokens representing the value of the factored invoices. The public one enables customers to operate their side of the contract.

According to Stanislav Sheliakin (2019), there is a problem in factoring in ensuring that vendors are not creating fake invoices. Smart contracts would decrease fraud related to invoices as hashing happens inside the blockchain. The overall cost of factoring would be lower as there would be fewer risks associated with each invoice, and operational costs would be distributed on each transaction. Blockchain offers anonymity to parties involved in the factoring agreements; it solves most trust issues and fraud attempts as it is transparent. Ethereum has the ability to generate non-fungible digital assets as tokens. These tokens match the value of the invoices as they exist in smart contracts. These tokens can be split into smaller parts of different values that can be sold to factoring companies, or their value can only be covered partially with factoring. All these partial tokens can then be tracked back to the original invoices, which have been hashed in the blockchain.

Figure 11 presents the flow of a factoring smart contract. The process begins as an invoice is created and confirmed by the vendor and the buyer. The invoice is then added to the smart contract, where a unique hash is generated to the invoice. The hash includes a timestamp, which can be used to check when the invoice was added to the blockchain. The invoice's details can be separated into different hashes to validate and compare different parts of the invoice to another invoice added on the blockchain to validate that the invoices are different. As the buyer makes a payment to cover the receivable, the transaction is registered into the smart contract, and a payout happens. This generates another timestamp for the completed payment of the receivable invoice. Finally, the invoice amount is paid to the vendor by the factoring company.

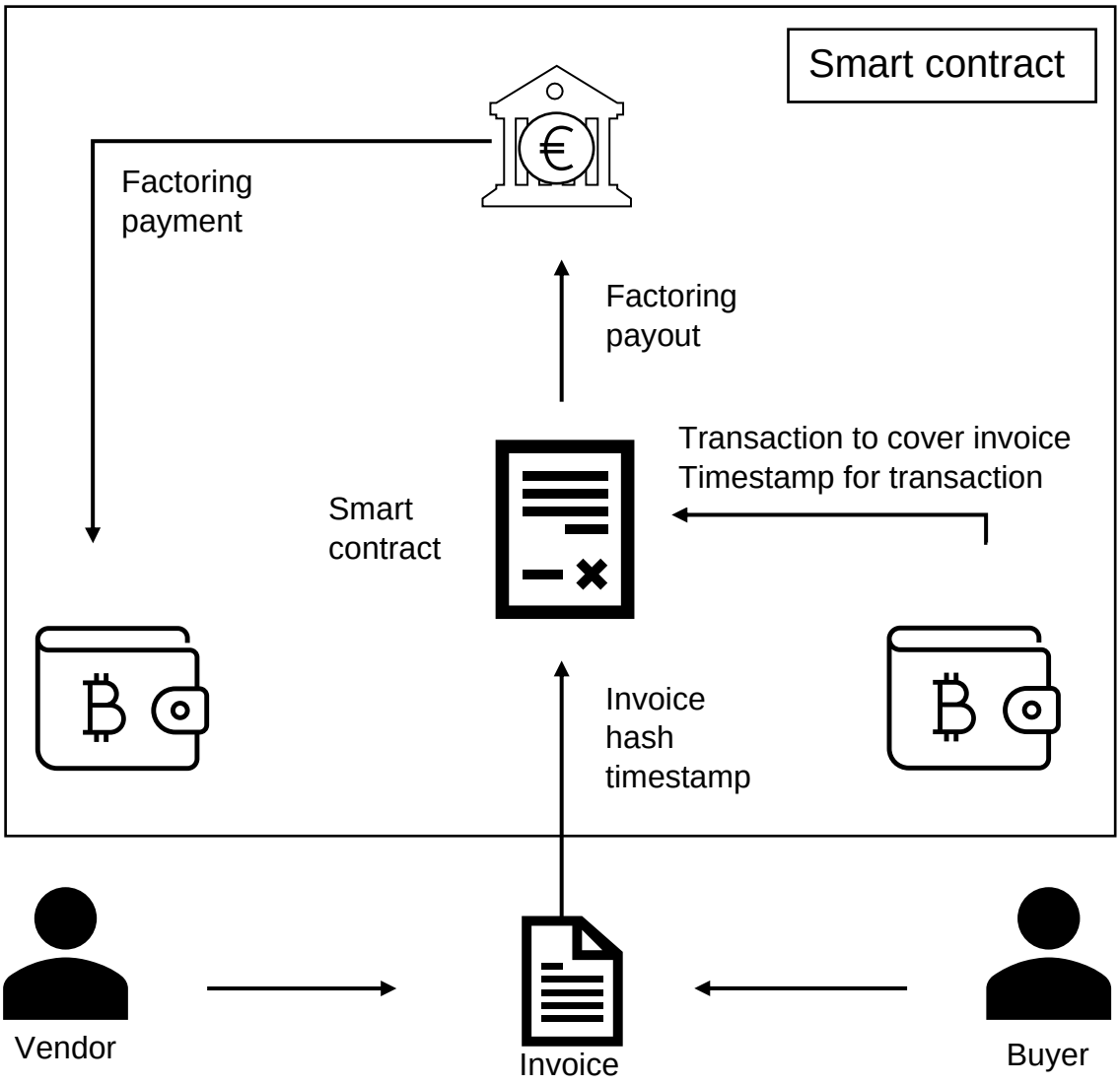


Figure 11 Flow of a smart contract (Sheliakin, 2019)

Figure 12 presents the flow of a factoring smart contract with non-fungible assets. The process begins as an invoice is created and confirmed by the vendor and the buyer. The invoice is then added to the smart contract, where a unique hash is generated to the invoice. The invoice's details can be separated into different hashes to validate and compare different parts of the invoice to another invoice added on the blockchain to validate that the invoices are different. The invoice value is converted into a non-fungible asset value, for example, invoice value of 100 euros is converted into 100 tokens. Then the tokens are divided into vendor's tokens and tokens for factoring. Typically, 80% of the invoice value is given as credit to the vendor by the factoring

company. These functions happen on the blockchain, and each step is given a permanent timestamp. These timestamps can be later used to track the history related to the invoice and the smart contract. Then, 80% of credit payment is made to the vendor. As the buyer makes a payment to cover the receivable, the transaction is registered into the smart contract with a timestamp, and the factoring payout happens to the factoring company. Finally, the rest 20% of the invoice amount is paid out to the vendor by the factoring company.

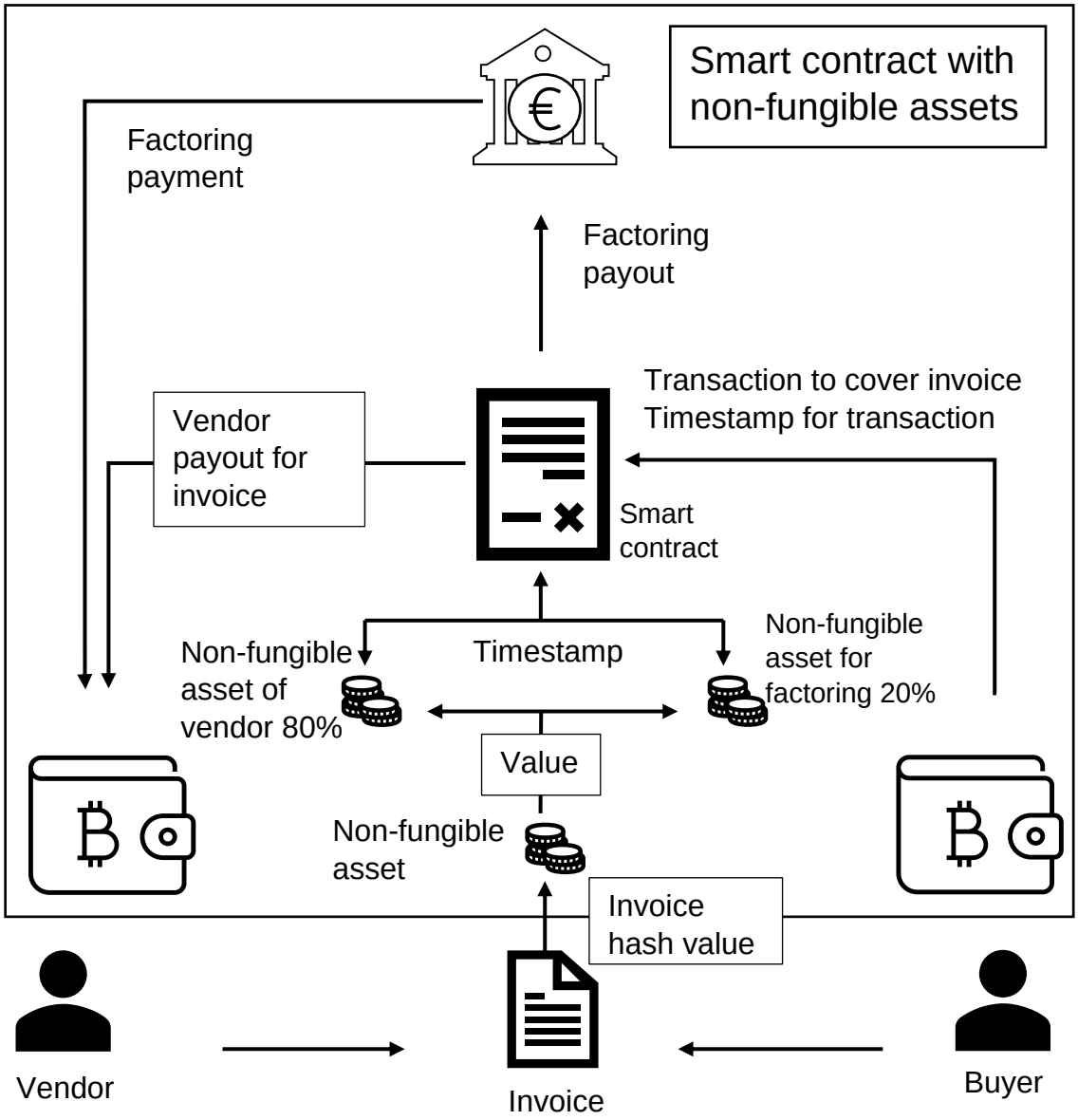


Figure 12 Flow of a smart contract with non-fungible assets (Sheliakin, 2019)

Kush Patel, CEO, and Founder of Tallysticks, presented a supply chain financing software called Tallysticks at the EuroFinance Demo Pit in Barcelona in 2017 that utilizes smart contracts. (Patel, 2017) The operating status of the start-up is closed. (Crunchbase, 2020) The idea behind Tallysticks' software was promising. It used blockchain technology for trade finance and supply chain financing solutions. Tallysticks recognized that large corporations think that SMEs are unsophisticated and provide a risk to supply chain stability. It is also difficult for them to find good SMEs to trade with. Tallysticks was developed to enable seamless collaboration between large corporations and SMEs. It documented all the details of the trades and provided liquidity and finance for the SMEs. It also had a procurement platform, which enabled the large corporations to define what they wanted to buy. They were able to define the product, its quantity and price, the international commercial terms, and the delivery date. The software then made the activity anonymous and asked for bids against the procurement activity. The software was fully automated, and the bids could be converted into trade transactions. The software's idea was that the employee of a large corporation first selects if they are buying or selling goods and selects the counterparty. Then they would define the currency, goods, governing law, delivery date, incoterms, payment conditions, partial advance payment, pre-shipment inspection, required documents, additional costs, and additional clauses. The software would provide additional information on the alternatives to be chosen on who is bearing the costs, bearing the risks, and providing the insurance. The software would help to log and document what was agreed upon. One of the trade parties could fill in all information into the contract, and it was enough for the other party to review it. When both parties would approve the contract, the execution phase would begin, where the timeline for execution would be agreed on. After the goods would have been shipped, the user would upload a Bill of Lading, which would finalize the trade. As the money would have already been prepaid, the Bill of Lading would release the tokens out of the underlying smart contract. The software was built on a legitimate banking infrastructure that initially created trust between the counterparties. Patel considered in 2017 that this software solution would remove the need for advising banks, for issuing banks, and for confirming banks. (Patel, 2017)

3.2.2 Consortiums

Naeem, Kyleen, and Shavers discuss in their study “Is your supply chain ready to embrace blockchain?” (2019, p. 63) the global trade platform created by IBM and Maersk called TradeLens. The platform is based on open-sourced blockchain technology that shares shipping transaction data to all the network participants simultaneously as nodes verifying transactions in the network. In 2019, the platform included around 55 participant companies from a minimum of 10 countries. In his study, Peter Lee presents “Seven-bank consortium to deliver trade finance on blockchain this year” (2017, pp. 1-4) a Digital Trade Chain platform. It is based on a consortium of seven European banks, and it uses blockchain technology to secure trade finance transactions. The solution brings security, transparency, efficiency, and simplicity to the participants of the consortium. The network includes the seven banks and their SME clients who have had to go through necessary regulatory checks to participate in the network. The solution uses track-and-trace technology to track shipped goods' locations and make automated payouts when certain conditions are met. The payments are not processed on blockchain but through traditional payment rails, for example, Swift. The platform has enabled companies to cut down on administration costs and make their documentation exchange processes more efficient. Peter Lee ponders that it seems that SMEs who trade with only a few regular buyers might not be interested in taking part in the platform. Lee sees that the platform is more tempting to companies looking for fast expansion.

Aarti Dua presents in her 2017 study “Banking on Blockchain: Why Indian companies and financial institutions are rapidly taking to the new technology” a blockchain consortium called Primachain Money, which has been launched by a fintech company Primechain Technologies. The consortium consists the of co-operation of thirty banks and non-banking finance companies. Blockchain offers faster, smarter, more secure, cheaper, and transparent transactions. (2017, pp. 1-4)

Aarti Dua also presents an invoice financing blockchain solution launched by Yes Bank to serve Bajaj Electricals and its 32 vendors. Cateina Technologies developed the

solution. Through it, Yes Bank can provide financing for Bajaj Electricals' vendors. The solution works so that Bajaj Electricals vendors send the invoices to Bajaj Electricals, verifying the invoices and adding them to the ERP portal. The blockchain solution is based on an underlying smart contract that has been programmed to include the business rules that go into the transactions. When an invoice is added to the ERP portal, the smart contract automatically takes the invoice's information onto the blockchain. The vendor is asked to submit the details of the invoice as a confirmation to the system. The smart contract validates the invoice details to the vendor's details, and the invoice is then provided for the bank's use. The smart contract then checks the vendor's KYC information and credit limit. Also, the credit limit is checked against Bajaj Electricals. If all the checks are ok, the loan towards the invoice is debited into the supplier's bank accounts. As the credit is due, the debt amount is automatically credited from the company's bank account and transferred to banks' account. The smart contract's interface is like a normal website where the blockchain parties can see necessary details. Dua recalls that there are still issues with trust in blockchain solutions, as not all companies want to share their proprietary data. (2017, pp. 1-4)

Joy Macknight describes in her 2018 study "Faster, Cheaper, Smarter: Blockchain in trade finance - Distributed ledger" consortium use cases. Macknight presents the R3 consortium, which is developed by IBM and 12 global banks. It was the first trade finance solution based on blockchain focused on letters of credit (LoC). The solution takes around 24 hours to make a LoC transaction when it normally takes 5-10 days when executed through paper. Macknight (2018, p. 1) also presents another blockchain-based solution called Marco Polo developed by R3, TradeIX, and 10 other operators, including banks. It was launched back in 2017. The solution is focused on supply chain finance and open accounts.

IBM teamed up with nine European banks to create a solution called We.trade to manage, track, and secure domestic and international trade transactions.. We.trade focuses on serving SME supply chain companies through invoice factoring and open account solutions. The solution was developed to fill the SME gap in the factoring market where SMEs have not typically been large enough factoring customers for

banks to finance. As the platform is very secure and transparent from end-to-end, it enables the companies to make trades with new trading partners with fewer risks. Also, the platform enables companies to track and trace their shipment in real-time. It also enables them to trace their conditional settlement in the banking system and identify all the known counterparts in the supply chain. (Nordea, 2017; Macknight, 2018, p. 2) Macknight explains that with We.trade, there were challenges to develop a framework that would suit all the nine banks' systems and processes. There were challenges with different payment systems, security and compliance processes, and different rules to process transactions. (Macknight, 2018, p. 2) According to Nordea (2019), We.trade is one of the first platforms that enables SMEs and large companies to make paperless trades and fill up the KYC demand. The platform links the trading parties and registers the trade process from end to finish in a user-friendly form. In a situation where all needed contractual agreements have been met, the platform guarantees an automatic payment. (Nordea, 2017)

Crosman presents in her 2018 study "Anti-fraud blockchain for invoice financing goes live" a blockchain solution that can track digital assets and detect fraud. She explains that three factoring companies from India (RXIL, A.TReDS, and MYND Solutions) and MonetaGo are launching in 2018 a blockchain network built on Hyperledger Fabric. The network includes exchanges that are a marketplace for SMEs to provide their invoices to receive funding from Indian banks and banks abroad. MonetaGo has offered the application, the logic behind it, the application programming interfaces, and invoice hashing algorithms. The system works so that when an invoice is added to the marketplace, the system analyzes the different fields on the invoice and creates combinations of hashes on them. This allows the system to identify differences between invoices when new invoices are added to the marketplace and detect malicious attempts of fraud. If an invoice is added to the marketplace that is too similar to an existing invoice in the marketplace, it is flagged to the exchanges as an attempt to finance an invoice that might have been funded already. Then the exchanges determine the fate of the invoice. The marketplace allows privacy and protects the customers by sharing only the necessary details of the invoices to the marketplace participants. (2018, p. 1)

Bridget McCrea discusses in her 2019 article “7 supply chain financing trends to watch” a supply chain finance platform based on blockchain technology launched by Chained Finance in 2017. According to McCrea, the platform enables transparent, easily authenticated transactions and more efficient supply chains. The platform allows different sized suppliers to transport goods efficiently through the supply chain with the platform’s help. Also, Macknight (2018, p. 3) presents a Commerzbank’s integration between S/4HANA, R3’s Corda blockchain, and SAP's ERP system. This solution enables existing APIs to connect to systems and business networks in all industries, and native integrations can be done where trade assets can be integrated into the underlying infrastructures.

4 EMPIRICAL STUDY OF DEVELOPMENT OF FACTORING BY USING BLOCKCHAINS

This chapter discusses the methods and methodology that was used to complete this study. It describes the characteristics of the selected methods and methodology and explains the reasoning for selecting them. This chapter includes description of the data collection process and data sources. Also, the interview process is explained, and the interviewed professionals are presented.

4.1 Analysis methods, methodology and data collection

The objective of this thesis was to describe ways on how to develop traditional factoring through private and consortium blockchains in Finnish factoring companies located in Finland. This study is based on the Finnish factoring companies' perspective and the focus is the development of traditional factoring using private and consortium blockchains. The research questions of the thesis are presented in table 4.

Table 4 Research questions

How could factoring be developed by using private and consortium blockchains?
1. What has been previously written about the use of blockchains in connection with invoice finance? 1.1 What kinds of previous blockchain use cases are there in invoice finance?
2. How private and consortium blockchains can be used to develop traditional factoring according to the qualitative interviews? 2.1 How can consortiums be used in factoring? 2.2 How can smart contracts be used in factoring? 2.3 What kinds of risks can blockchain solve in factoring? 2.4 What are the key challenges in using blockchain technology in the context of invoice finance?

As stated in Saunders, Lewis and Thornhill's book Research methods for business students (2016, p. 4) methodology is recognized as the theory of how research should be commenced. A method then is defined as the procedures and techniques that are applied to collect and analyze data for the research. Methods consist of quantitative and qualitative analysis techniques, interviews, surveys, and observations. This study has been conducted using a qualitative research method as it was examined to be the most suitable method to look into the topic. In qualitative research the research is based on comprehensive data collection. It is typical that the material of the study is analyzed using data-driven analysis. The research is not focused on finding generalized results as the results are unique. In qualitative research, there are typically only a small number of individuals as sources. The sources are selected based on their usefulness for the research and based on their quality. Data sources are selected based on their quality rather than focusing on quantity. Data is collected through interviews, questionnaires, observations, and documents. It is important to ensure that the professionals, whose viewpoints are under inspection in the study, have sufficient experience and knowledge regarding the topic. These methods can be combined or seen as alternative methods. Typically, a qualitative research's goal is to describe a phenomenon or an event, understand a particular type of activity, or present an interpretation of a phenomenon. (Tuomi, 2007, p. 97; Tuomi and Sarajärvi, 2006, pp. 73 and 87-88)

The research design of this study is exploratory. According to Saunders, Lewis and Thornhill's book Research methods for business students (2016, pp. 174-175) exploratory study includes open questions which are aimed to examine a topic of interest. Research questions and interview questions typically start with "What" or "How". The exploratory study is the most suitable design for the research as the goal of the research is to understand a problem, phenomenon, or an issue. It is typical that an exploratory study is started with a quite broad focus but as the research approaches the end, the focus might have narrowed a lot. Saunders et al. state in their book that there are multiple ways that the exploratory research can be conducted. It can be done through comprehensive individual interviews or focus group interviews where the interviewees are professionals in the field of the study. These interviews are commonly unstructured. (Saunders, Lewis and Thornhill, 2016, pp. 174-175). The research

questions of this study are exploratory as they begin with the words “How” and “What” and are intended to gain insight on the selected topic and understanding on how traditional factoring could be developed by using private and consortium blockchains. (Saunders, Lewis and Thornhill, 2016, p. 43) This study has been conducted as a cross-sectional study as it focused on examining the application of technologies into factoring at a particular time and not in a longer period of time as in longitudinal studies. This time horizon selection is supported also by the fact that the interviews were conducted over a short period of time.

An inductive approach is applied to this study. Saunders, Lewis and Thornhill (2016, p. 74) define inductive approach as a procedure where the researcher examines the data of the research and then develops theories based on that data. Finally, the researcher connects the theories to the study’s literature. The basis for an inductive approach is that theory follows data and not the other way around. The researcher collects data, identifies patterns and relations to form a conceptual framework. (Saunders, Lewis and Thornhill, 2016, pp. 51-52) Research using inductive approach can be argued to be better than deductive approach on the size of the sample. A small sample in inductive study might be more appropriate than deductive studies’ larger samples. Inductive approach is applied typically to qualitative research with qualitative data. Different methods are commonly combined to gain different views of the topic at hand. (Saunders, Lewis and Thornhill, 2016, p. 147)

The research strategy for this study is a case study. Eriksson and Koistinen define case study in their publication “Diverse Case Study” for the National Consumer Research Centre (2005, pp. 4-5) as a research strategy which is difficult to be given a general, comprehensive definition. Perhaps, the only commonality in case studies is that one or multiple cases are examined which have a goal to define, analyze and solve those set cases. It is typical for case studies that versatile data collection and analysis methods can be used, and the data can be collected from versatile sources. Typically, the data is qualitative but also quantitative data is used. Eriksson and Koistinen explain that usually in case study some of these following conditions are met:

- The researcher has only a little control over the events happening
- Questions “What”, “How” and “Why” are the main questions asked
- There is only a little empirical research on the topic
- The research object is a real phenomenon taking place in present time

Data for this thesis was collected through primary and secondary data sources by interviewing professionals of the topic and by collecting data from secondary sources. Interviews were chosen as one of the data collection methods as interviews offered an opportunity to get a versatile, profound outlook on the topic. Companies using blockchain technology in factoring might advertise that they are using it but they do not typically announce any technical details or detailed processes of how it is being used, so the interviews gave a good opportunity to access this kind of information. Secondary data was collected from scientific publications, research articles, news articles, literature, blogs, organizations’ financial statements and company websites using LUT Research Portal, LUTPub, LUT Primo, Semantic Scholar, Google, Google Scholar, ResearchGate, DEStech Publications, Theseus, IEEE Xplore and libraries in the Helsinki area. There were some issues with restricted data sources where it was not possible to access research and statistics without large fees which limited the data collection to some amount.

This study was constructed using a semi-structured interview method where there was a ready interview question set based on the topic’s title. Interviews included open questions based on interviewees’ answers to the ready set questions. The interview question set was used as a frame for the interviews to support the flowing conversation with the interviewees. As the questions were quite open, it allowed the interviewees to answer broadly and offer answers that fit their knowledge and experience on the topics. This way it was possible to take the interviews to a deeper level. The interview questions were following:

1. Have you worked with blockchain technologies?
2. What kind of applications have you used/seen used for these technologies?
3. Are you familiar with factoring, its products, and processes?

4. How do you see that blockchain could be utilized in factoring?
5. What kind of risks do you think that blockchains are able to solve in factoring?

The interviews were conducted as Teams and Skype meetings and they were recorded using Teams or Skype, and an external recording application to ensure the quality of the recordings. During the interviews, key findings were written down and additional, supporting questions were asked. After the interviews, the recordings were transcribed and written open as text. From the written text, first answers to the interview question set's items were collected. After that, another analysis on the answers was made to focus on additional findings. Then the interview results were grouped based on the interview's sub-topics and they were analyzed more deeply.

Data-based content analysis and thematic design were used as the methods of the data analysis. Thematic analysis is one of the basic methods in qualitative research and it focuses on finding themes arising from the material that reoccur while reviewing the material. It is typical to the data-based content analysis that the objects of the analysis have not been pre-targeted, but they arise while reviewing the material. These themes are first defined and after that, they are analyzed as more specific ensembles. (University of Jyväskylä, 2016; Tuomi, 2007, p. 130) First, the collected data was reduced and split under the topics that rose from the review. The interviews focused slightly on different topics within the interview question set based on the interviewees' knowledge and experience. The data-based content analysis was executed in the order presented below following the guidelines of Tuomi and Sarajärvi (2006, p. 111).

1. Listening to the interview and transcribing it
2. Reading the written, transcribed interview and reviewing it
3. Analyzing reduced expressions and highlighting them
4. Gathering reduced expressions as a list
5. Dividing reduced expressions based on similarities
6. Combining similar expressions into subsets
7. Combining subsets into topics
8. Combining topics and creating concepts

4.2 Interview process

For this study four professionals were interviewed from different fields of finance, and IT who work in Finnish companies located in Finland. The interviews were conducted through interview questions as a base for the discussion as remote meetings through Skype and Teams. During the interviews, additional questions were asked to gain better understanding of the topic and to clear out unclear topics. Two of the interviews were from professionals from Nordea Finance. Both professionals work at the moment in Nordea Finance IT but have versatile backgrounds. One of the interviewed professionals was the lead of the innovation lab in OP Financial Group. One of the interviews was handled as anonymous. The interviewed professionals were given the chance to decide whether they prefer that their answers will be presented as anonymous or whether their name, title and company name can be used in the thesis. Their consent on these matters has been documented through emails and/or meeting recordings. One of the interviewed professionals decided to stay anonymous due to confidential matters which will not be addressed in this thesis.

The interviewed professionals were selected from fairly large companies with good ground on the factoring business. These companies were considered to be good places to look for professionals to be interviewed as they are trusted partners in the finance sector and have a wide range of products and experience in-house. The professionals are a leader in IT, a head of innovation lab, a COO and a Senior IT Developer. They have versatile work experiences and knowledge. They provide a sufficient scope for this study to have reliable, saturated results. They come from different parts of organizations except for the two IT professionals from Nordea Finance who were both chosen to take part in this study because of their versatile backgrounds and long careers in fields related to the thesis' topic. The professionals are in positions in their organizations where they are considered to be trusted sources of information related to their long, successful careers and experience. The number of interviews was kept low as the interviews conducted are long, in-depth interviews. The research results are well saturated and provide a sufficient outlook to the finance sector's general outlook on this topic.

Markus Laatikainen was interviewed on 7th of May 2020 through a one hour 33-minute-long Teams meeting. Laatikainen is a Leader in IT in Nordea Finance and he works in IT Development in Consumer Finance. He runs a team of around 40 coders including IT-architects and coders. His team focuses on cards and consumer credit. He is a professional in his area and he has experience from open bank interfaces. He has been interested in blockchain for a longer time. He acquired his first Bitcoins back in around year 2013 when Bitcoin cost circa 70 euros. He later moved onto Ethereum as he found that they held more opportunities for banks and finance.

Kristian Luoma was interviewed on 27th of July 2020 through a 28-minute-long Teams meeting. He is the head of OP innovation lab in OP Financial Group and he is responsible for all the innovation activities there. The innovation lab is divided into development and technology that is focused on the present digital solutions and products to consumers and to next technologies and next big things that might matter to finance.

Person A was interviewed on 28th of July 2020 through a 39-minute-long Skype meeting. He is a COO in company X which is a Finnish finance company. Person A is responsible for business development in company X. He is doing system development through agile development methods. He has worked at his previous employer in a blockchain project.

Evgeny Shebanin was interviewed on 4th of August 2020 through a 39-minute-long Teams meeting. He is a Senior IT Developer at Nordea Finance. He is not so familiar with factoring because he has mostly worked with reporting processes at Nordea, but he has private experience from factoring. He has, in addition, worked in the insurance industry in insurance companies for a long time. From those companies he has a lot of experience in factoring and payment reconciliation.

4.3 Results from the interviews

The results of the qualitative research are presented in this chapter. The interview results were processed through thematic analysis where five themes arose from the results which were: consortium, platform economy, smart contracts, risks blockchain solves in factoring and challenges in blockchain. The research results have been divided into sub-chapters according to these themes. In table 5, is presented the answers from interviewees to the themes. The plus signs (+) represent positive outlook to the theme, the minus signs (-) represent negative outlook to the theme and empty cell represents no reply to the theme from the interviewee. The actual replies regarding the themes are presented in the following chapters.

Table 5 Answers to themes from the interviewees

Main themes	Laatikainen	Luoma	Person A	Shebanin
Consortiums	**+**	**-**	**+**	
Platform economy		**+**		
Smart contracts	**+**			
Risks blockchain solves in factoring	**+**	**+/-**	**+**	
Challenges in blockchain	**+**	**-**		**+**

4.3.1 Consortiums

In table 6 are presented the main results regarding a consortium which are then discussed in more detail below the table. In the column “Possibilities” are presented the main possibilities consortiums have to offer and, in the column, “Challenges” are presented the challenges related to the presented possibilities.

Table 6 Main results regarding consortiums (Laatikainen, 07.05.2020; Luoma, 27.08.2020; Person A, 28.07.2020)

POSSIBILITIES	CHALLENGES
Financial institutions could form a consortium to develop a blockchain solution for factoring. It could bring savings to the parties involved.	The advantages of blockchain are limited. People need to be willing and ready to adapt to the technology. Competitive reasons might cut this possibility off.
Transparency could be achieved as everyone in a consortium blockchain could see an invoice sent by the seller and received by the buyer.	All billing systems and ERP systems would need to be developed to send data that could be transmitted through blockchain, which is still a long way ahead.
Financing for invoices could be gathered from private persons and institutional investors. One could buy invoices from a specific vendor through a fully automated set of parameters.	The information flows would need to be figured out to be able to implement this.

Markus Laatikainen who is a leader in IT in Nordea Finance sees potential in blockchain. He explains that blockchain is a distributed ledger technology which could be implemented to factoring. After the initial hype about blockchains the discussion has quieted down. (Laatikainen, 07.05.2020) Head of OP innovation lab, Kristian Luoma, sees that blockchain and distributed ledger technology solutions are still in the future but there are some applications of them already. He sees that the advantages of blockchain are limited. (Luoma, 27.08.2020) Person A is aligning with Luoma's vision that the world needs to be ready to utilize blockchain in a reasonable way. He explains that through his former employer, he examined how invoice batches and accounting data could be transmitted through blockchain. The conclusion in that project was a consortium or a bloc formed by multiple banks. The project did not see the finish line as it was foreseen that the market was not ready for that kind of application of blockchain at that point in time. (Person A, 28.07.2020)

Laatikainen brings up Nordea's we.trade system in Trade Finance which was launched around two years ago. It is a consortium of banks operating in a closed system. All the banks have a precise copy of the ledger and they collaborate through the system. As the execution side of the blockchain when factoring is considered, Laatikainen states that Ethereum is the ledger technology which would be the most suitable one to use.

Ethereum is an ecosystem which has its own cryptocurrency ETH which is valued in gas price. The blockchain solutions in we.trade are based on Ethereum but they are created inside a private system. We.trade follows smart contract's principles as the contracts are able to validate themselves. It could be a possibility that financial institutions would join forces and develop revolutionary blockchain solutions together but Laatikainen does not consider this as the best solution. He sees that competition cuts this possibility off. He thinks that it is good to have competition and different players in the field. Cooperation could bring savings but, in the end, it is the consumers who decide whose services they will use. Laatikainen ponders that banks will most probably begin their blockchain development with closed ecosystems similar to the we.trade solution. (Laatikainen, 07.05.2020)

According to person A, the advantage of consortium would be transparency as everyone in the chain could see that the invoice has been sent by the seller and received by the buyer. The advantage of transparency is crucial but also the advantage of getting all billing systems and ERP systems to send data that could be transmitted through blockchain, that is still a long way ahead. This kind of consortium could be probably executed by an operator much like fellow finance, states person A. Finance for the factoring invoices could be gathered from private persons and institutional investors. In the consortium, one could buy certain vendors' invoices and it would be fully automated by a set of parameters. It would be important to figure out the information flows in this kind of solution. (Person A, 28.07.2020)

4.3.2 Platform economy

In table 7 are presented the main results regarding platform economy which are then discussed in more detail below the table. In column "Possibilities" are presented the main possibilities consortiums have to offer and, in column "Challenges" are presented the challenges related to the presented possibilities.

Table 7 Main results regarding platform economy (Luoma, 27.02.2020)

POSSIBILITIES	CHALLENGES
A common marketplace for financial institutions to finance and insurance invoices, price risks, and solve double-financing issues.	The marketplace does not need to be solved through blockchain technology. There is a lot more potential in big data.
A party who will see the potential market and create a new marketplace or some present billing system will end up so big that it will rule the market in the future.	What are the rules in the marketplace? Who can participate? Whom are the ones bidding for the invoices? How does the pricing work? Who is distributing the revenue share to the stakeholders? How are the stakeholders being rewarded for their success in the market?
Operators could incorporate their billing systems into the marketplace and receive a revenue share.	Billing systems in different countries are built very differently.
From a technological point of view, there are no obstacles.	People take a lot of time to adapt to new technologies and see their potential.

Kristian Luoma sees that platform economy is something that has a lot of value these days. Though, he sees that this whole idea of platform economy does not need to be solved through blockchain technology. He sees a lot more potential in big data. He explains that there was this product, OP invoice loan, which his innovation lab in OP Financial Group produced. They wanted to note the platform economy in that solution. The idea was that for example accounting firm Visma's Netvisor could be used to directly purchase factoring. The sent invoices were used as a collateral to the factoring funding provided for the invoices. Luoma states that it is not the most traditional way of factoring but from its principals it is. One of the viewpoints to the project was this platform economy. It created a new kind of value as in OP they were able to get access to the invoice batches that Netvisor billing software had. They managed to change credit ratings among other things. Luoma states that other technologies like artificial intelligence, machine learning and big data were used in the project but blockchain was not applied. Though, they considered applying it. (Luoma, 27.07.2020)

Luoma sees that in the future, there could be a marketplace for a purpose of bidding for invoices. This would be an important development step for the whole factoring business. It is possible that a new operator would surface the market that would provide the new marketplace. The marketplace could be used to finance and insurance invoices, price risks for the invoices and solve issues with double financing. A factoring invoice would be created once and then financed through the marketplace which would work so that the invoices inside would compete against each other with another marketplace which would include banks and insurance companies who would want to finance those invoices. So, kind of like a platform economy which would be run by one or two centralized operators. (Luoma, 27.07.2020)

Luoma sees that it would be the place where factoring contracts would be made, it would make the ergonomics better and enhance competitive advantage. Financial institutions and other operators in the market, could incorporate their billing systems into the marketplace and receive revenue share. The marketplace Luoma ponders that of course there should be decision on what are the rules on the marketplace, who can participate, who are the ones bidding for the invoices, how does the pricing work, who is distributing the revenue share to the stakeholders and how the stakeholders are being rewarded for their success in the market. According to Luoma, this would end up in that traditional factoring in traditional channels would come to its end. Though, he states that blockchain will not bring this change nor cooperation between banks. He predicts that there will be a party who will see that potential market, or some present billing system will end up so big that it will rule the market in the future. According to Luoma, it is only possible in theory that the government would create such a marketplace but not in practice. There might be too little interest from the government and tax authorities' side. When a global system is considered, Luoma sees that once again, it is possible in theory but not in practice. The billing systems in different countries are built very differently. Even though things would be possible in theory, in practice, consumers and people in general, take a lot of time to adapt new technologies and see their potential. From a technology point of view, there are no obstacles in his opinion to make this work. (Luoma, 27.07.2020)

4.3.3 Smart contracts

In table 8 are presented the main results regarding smart contracts which are then discussed in more detail below the table. In the column “Possibilities” are presented the main possibilities smart contracts have to offer and, in the column, “Challenges” are presented the challenges related to the presented possibilities.

Table 8 Main results regarding smart contracts (Laatikainen, 07.05.2020)

POSSIBILITIES	CHALLENGES
Banks could start factoring with closed smart contracts, which have as counterparties only the companies that are settled in the factoring agreement. Then there would be a minimal risk of money laundering. Smart contracts could be used in factoring so that as a set of specific rules materialize, an automatic payout happens.	Suppose there is a mistake in the smart contract, how a rollback can be made as typically information cannot be deleted from the blockchain after added. Enough exceptions need to be programmed into the contracts for them to be able to handle different situations. It is important to be able to stop the payout if the agreement terms are not met.
Non-fungible assets could be used in smart contracts to represent the value of invoices, and fiat money would not need to be used. As these tokens remain in the ecosystem, they can be traded there to buy, e.g. cryptocurrencies.	An interface to bank accounts needs to be built. There are not many ready solutions to that. A Swiss foundation owns Ethereum, and this brings issues if banks are willing to build a direct interface between bank accounts and Ethereum as this would bring additional costs.

According to Laatikainen, smart contracts could be utilized in factoring. Banks that are more advanced in the field of technology and insurance companies, already utilize smart contracts. Smart contracts are contracts where you can program code and intelligence and then they will implement themselves. Smart contracts work so that the information from the invoice is exported into the Ethereum blockchain ecosystem. A timestamp is given to the invoice and it gets a value in token which is always unique. The actual smart contract is based on code to which this timestamp is added to. When some set of specific rules in the code materialize, predefined tasks happen automatically in the blockchain. As there are not any humans conducting any manual work inside the contract, the contacts are close to artificial intelligence and machine

learning. As some set of rules materialize, an automatic payout happens. (Laatikainen, 07.05.2020)

In smart contracts, as everything happens inside the blockchain, there needs to be an interface to the outer world, for example, into a bank account. At the moment, there are not too many solutions for these interfaces which is why many banks do not want to deal with blockchain. This interface needs to be properly developed before these smart contracts can work in a way they are wanted to work. Cryptocurrency Bitcoin is not really owned or managed by anyone but there is a Swiss foundation behind Ethereum. This brings issues as if banks are willing to build a direct interface between bank accounts and Ethereum. As this would bring additional costs as banks would need to pay a fee to the Swiss foundation to use their ecosystem. (Laatikainen, 07.05.2020)

If we consider a factoring smart contract with non-fungible assets, we get a token value as we export the invoice into the smart contract. If the value of the invoice is 15 000 euros, we can put 15 000 euros of value into the tokens and then use the tokens as means of payment. As the automatic payout happens inside the contract as certain conditions are met, the bank does not need to transfer real, fiat money into the customer's bank account. The tokens which are substitutes to the euros, can stay in the Ethereum ecosystem. As they remain in the ecosystem, they can be traded there and used to buy other cryptocurrencies, other tokens or stocks or derivatives from the stock exchange. In the future, all stocks, housing loans and really everything that includes a contract can be made into a smart contract. It is still unsure if traditional fiat money or tokens would be used. Laatikainen notes that the European central bank might also create cryptocurrencies which would be ETH20 compatible. Meaning, they would work in the Ethereum ecosystem. This would then create interesting, new opportunities. (Laatikainen, 07.05.2020)

According to Markus Laatikainen, tokens could be utilized in a way that you could exchange the information of a bank card to a token. Then this token could be used for example in Apple Pay. Tokens are heavily encrypted so if someone steals your token,

it is useless to them as it needs to be known where a specific token can be used for it to work. Laatikainen mentions derivatives and stocks as a perfect example of something that could be transferred into tokens. These tokens can be used as trading tools as they have a monetary value, and their number is not limited. (Laatikainen, 07.05.2020)

As blockchains are fully open ecosystems, there can be any kinds of operators as there are not any boundaries for anyone to use the ecosystems. The best solution for banks would probably be to start factoring with closed smart contracts which only have as counterparties, the ones that are settled in the factoring agreement. There is then a very little risk of money laundering. In addition, smart contracts have advantages in that as if there are a lot of counterparties that are not known sufficiently and cannot be fully trusted. (Laatikainen, 07.05.2020)

There is the risk in smart contracts that what if there is a mistake, how can we make a roll back. At the moment, in Bitcoin C, if something is done, it cannot be erased. In Ethereum, there is not a solution where you could erase information from the blockchain. There have been discussions around Ethereum 2.0 that this kind of solution would be needed. Laatikainen notes that it depends on how smart the smart contract is for it to be able to handle exceptions. If an invoice is claimed, it depends on what kind of conditions are coded into the contract, for the contract to be able to handle different kinds of situations. The more exceptions are coded into the contracts and the better they are automated, the better they meet the needs of everyday situations. It is important to be able to for example stop the factoring payout if there is something in the agreement terms that would stop the payout. Laatikainen points out that humans cannot intervene in smart contracts. They are not like computer software that you can develop and fix. Blockchain is an autonomous world that cannot be tampered. (Laatikainen, 07.05.2020)

Laatikainen gives an example of a taxi company which will in future have cars that drive themselves and no humans are needed. The cars can drive by themselves and load themselves in garages at the end of the day. The customers will handle the

payments of taxi rides with blockchain. They will be able to just show their cell phone screen to the taxi and select the destination. The taxi company can work as a purely digital autonomous organization as it can handle the daily work and bookkeeping automatically. These future autonomous organizations can work as smart contracts in Ethereum. The only thing that is missing is the interface between the Fiat bank world and the Ethereum ecosystem. However, non-tangible assets like tokens could provide the solution to this. First fields of business that these smart contracts will hit will be factoring, trade finance and housing. Laatikainen mentions that there is already a Finnish digital DIAS home sale service which is based on Ethereum. (Laatikainen, 07.05.2020)

4.3.4 Risks blockchain solves in factoring

In table 9 are presented the main results regarding the risks blockchain solves in factoring which are then discussed in more detail below the table. In column “Risk” is presented the identified risks with the risk category they belong to and in column “Solution” are presented the offered solutions to the identified risks.

Table 9 Main results regarding risks blockchain solves in factoring (Laatikainen, 07.05.2020; Luoma, 27.07.2020; Person A, 28.07.2020)

RISK	SOLUTION
Human errors in manual work (Operational risk)	• Blockchain enables cheaper and cost-effective ways to handle and automate business.
Balloon invoices and invoice fraud (Financial risk)	• Banks need to know their customers, and they need to be trusted counterparties. More risks are involved if there are more companies that the banks do not know and banks operate over country borders. • If financial institutions send invoices instead of the vendor to the buyer, the financial institution can track that the buyer receives the invoice. • Digital systems have digital traces of actions, which makes it more difficult to defraud. • Transparency in blockchain enables the mitigation of fraud risk as the information flows are transparent.

	• Intelligent customer selection through an analysis of customers' ledgers.
Private, closed databases and untrustworthy counterparties (Operational risk)	• Challenge if there is information that needs to be shared among multiple operators and counterparties. Blockchain allows the usage of a platform where all information is public and transparent. This platform can then be used to validate tasks in the transaction process.

Factoring is a traditional business which has its issues with gray market and balloon bills. When everything goes into digital format, it will be more difficult to defraud and the risks of defraud will be smaller. It is good with digital systems that there will always be a digital trace of actions which can be traced if criminals have not been able to cover their tracks. It is possible that as the banks take their time to get involved into blockchain business, the criminals will be so ahead of banks that their actions will go unnoticed. Laatikainen considers that there are risks in blockchain technology but notes that there are risks in factoring in its present format as well. (Laatikainen, 07.05.2020)

Person A states that the problem of transparency is something that could be solved by utilizing blockchain. It would be a real asset to financial institutions, vendors, and buyers to be able to see the information flow of the transactions made. (Person A, 28.07.2020) Kristian Luoma agrees on the matter of transparency. He sees that blockchain could solve the problem of the same invoice being financed multiple times, but he sees that even blockchain is not a watertight solution to that matter. (Luoma, 27.07.2020) Person A agrees with Luoma that the biggest threat to a financer is that the same invoices are sent to multiple financial institutions or vendors sent fraudulent invoices where the product is never transported to the buyer and buyer reacts only after 90 days to the payment reminders. These kinds of invoices cause credit risk if a company's business is not well known. According to person A, transparency enables the mitigation of fraud risk and fraudulent invoices called balloon invoices. Balloon invoices are invoices that are never sent to the buyer to pay but only sent to the financer to finance. Vendor collects credit and the buyer never pays invoices to the financer. The number of these kinds of invoices can be decreased if the ecosystem is

built in a way that takes this angle of incidence into consideration. (Person A, 28.07.2020) To avoid balloon billing and invoice fraud, banks need to know their customers and they need to be trusted counterparties who banks handle agreements and transactions with, according to Laatikainen. If there are more companies who the banks do not know and banks operate over the country borders, there are more risks involved. (Laatikainen, 07.05.2020)

Every operator has their own, private, closed database where only few have access to. This brings challenges if there is information that needs to be shared among multiple operators and counterparties. Laatikainen gives an example from the trade finance side where there are multiple counterparties in trades. There is for example a Chinese goods manufacturer, a bank, shipping company freight company, customs, Nordea as the second bank, Nordea's customer, and the end-customer. As there are so many participants in the transaction, it is not realistic that they would all trust each other. Blockchain is brought in to solve this trust issue as it allows the usage of a platform where all the information is public and transparent. This platform can then be used to validate tasks in the transaction process: did this one thing happen, did the goods leave the harbor, are the goods good to go from the customs and if the shipping company has approved the waybill. (Laatikainen, 07.05.2020) Person A agrees with Laatikainen that in cases where the financial institution sends the invoices instead of the vendor to the buyer, the financial institution can track that the invoice is actually received by the buyer. In cases where the vendor is responsible for sending the invoices, the financial institution only receives a copy of the invoice and then does not know if the invoice was sent to the buyer or not. As a solution to this risk, person A suggests intelligent customer selection through utilization of big data which would be based on analysis of customer ledgers. (Person A, 28.07.2020)

4.3.5 Challenges in blockchain

In table 10 are presented the main results regarding challenges in blockchain which are then discussed in more detail below the table.

Table 10 Main results regarding challenges in blockchain (Laatikainen, 07.05.2020; Luoma, 27.07.2020; Shebanin, 04.08.2020)

CHALLENGES	
Interface between blockchain and other systems	• There is not a good interface existing to use blockchain in combination with other systems. It is too difficult for consumers to buy ETH.
Money laundering	• Banks are afraid that someone might launder money using blockchain. Banks should examine blockchain as separate from cryptocurrencies. The technology behind blockchain is what provides opportunities.
Security	• Blockchain is not a secure way to transport information. Blockchain could be utilized through tokens, but the secure part should still be solved in another way. Ethereum has its own coding languages, so almost impossible to code viruses into the environment. Ethereum is based on coding language Solidity with limited coding possibilities.
Dark cryptocurrencies	• Almost impossible to track who is behind transactions with dark cryptocurrencies. Criminal activities and money laundering take place in dark networks with these dark currencies. They can be so dark that they cannot even be detected.
Cost to use Ethereum ecosystem	• It cannot be used for free. It is a matter of cost for the financial institutions to transfer from traditional ways of doing to blockchain ecosystems. It might be less money that goes into blockchain in the long run as it is expensive to have own private data centers that need to be managed and kept up to date.
Blockchain is not needed	• Blockchain can be too versatile or too difficult. Simpler technologies and solutions would work better in many cases where blockchain has been considered as a solution.
Proof of Concept	• It is not easy create anything useful out of new things and technologies if there has not been a proof of concept. Solely bringing new technology to some product might not solve any problems or make the product better. There needs to be a few proofs of concepts for the business case to see which would be the best. PoC helps choose the right technology to use and decide between options that might cost the same if there is no budget.

The first real use case with blockchain was when insurance company Axa made an Ethereum based system. Laatikainen explains that it worked so that if someone's flight was delayed, he/she would get money back from insurance. It worked automatically so that Ethereum got information from computer software that is updated by airport whether the flight departed on time. If the flight was late, the flight ticket insurance automatically paid the customer the insurance compensation. This idea did not take off because of the issues between interfaces. At the moment, it is too difficult for people to buy ETH which is the currency of Ethereum. (Laatikainen, 07.05.2020) Luoma emphasizes that blockchain is not a secure way to transport information, it is the opposite. Of course, blockchain could be utilized through tokens but still the secure part should be solved through some other way. He does not see that blockchain would be the best way to for example transport confidential documents. (Luoma, 27.07.2020) On the other hand, Laatikainen notes that Ethereum has its own coding language so that it would be almost impossible to code viruses into the environment. The coding itself is limited so that you can only code certain things. Ethereum is based on coding language Solidity which is developed by Vitalki Buterin from coding language Python. (Laatikainen, 07.05.2020)

Laatikainen adds that there are risks in dark cryptocurrencies which have been made dark on purpose. In these kinds of cryptocurrencies, it is almost impossible to investigate who is behind transactions. With Bitcoins, for example, it is public information what happens inside the blockchain. You can find out who transfers coins from wallet to another. Laatikainen suspects that criminal activities and money laundering takes place rather in dark networks with these dark currencies. They can be so dark that they cannot be even detected. (Laatikainen, 07.05.2020) Another problem with blockchain solutions is that it costs to utilize the Ethereum ecosystem. It cannot be used for free. It is also a matter of cost for the companies and financial institutions to transfer from traditional ways of doing to blockchain ecosystems. It might be less money that goes into blockchain in the long run as it is expensive to have own, private data centers which need to be managed and kept up to date. In our current system, organizations and banks have their own databases and software that is only in their private use. (Laatikainen, 07.05.2020)

Laatikainen argues that banks still have problems with blockchain as they are afraid that someone might launder money using blockchain and probably someone is using it for that purpose. Laatikainen states that Bitcoin started through a thought that banks are bad, and that Bitcoin is here for the rescue. Banks should look into blockchain as separate from the cryptocurrencies because it is more than that. The technology behind blockchain is what provides opportunities, and it would allow banks to develop their processes. (Laatikainen, 07.05.2020) On the other hand, Luoma states that blockchain is not really needed for anything. The concept of technology is only a way to agree on how information is being shared. Luoma sees that every solution he has seen of blockchain has proven that blockchain is too versatile or too difficult. Simpler technologies and solutions would work better in his opinion on many cases where blockchain has been considered as a solution. (Luoma, 27.08.2020)

From Luoma and Shebanin's experience, it is difficult to create anything useful of new things and technologies if there has not been a proof of concept. Solely bringing new technology to some product might not solve any problems with it or make the product better. The most important thing in any product development is to understand the problem from the customer point of view and from there you can start solving it. It would be more difficult to pick some technology and then start to think how it could be used to make some product better. (Luoma, 27.07.2020) Shebanin states that it is important to try proof of concept to see if something would be a good solution before implementing it to processes. He considers that there needs to be a clear business case and an interest to simplify a process to be handled. If there is no interest, then there is no point in bringing it to the table. This goes out to all technologies. If there is not enough interest, why to bring the technology to the company. Shebanin states that for the business case, there needs to be a few proofs of concepts to see which would be best. It is a common problem that proof of concepts are not utilized enough. He reminds us that there are a lot of cases where proof of concepts would be needed to be able to help with choosing the right technology to use and in helping to decide between options that might cost the same if there is no budget. Shebanin emphasizes that it is important to examine already implemented projects in the company to be able to learn from them and collect both good and poor user experiences. He states that in Nordea Finance there is still a lot to be developed from a technology point of view. For

companies to start implementing new technologies, it requires someone to really explain the benefits of those technologies. It is key to know how the technologies might ease daily life, especially for the ones dealing with customers. (Shebanin, 04.08.2020)

Laatikainen explains that as Ethereum is updated to Ethereum 2.0, the proof of work will be changed to proof of stake. This change enables that the number of transactions to be processed through blockchain would increase significantly. If it will be possible to lower the costs and increase the volume of transactions incrementally, it will be so much cheaper than any other way of processing. It is almost inevitable that stock market trading or trade finance or factoring or housing will transfer into blockchain. Blockchain enables so much cheaper and cost-effective ways to handle and automate business. Blockchain also allows these processes to be secured. In Laatikainen's opinion, there is not any other technology out there that would compete with the capabilities and possibilities of blockchain. (Laatikainen, 07.05.2020)

5 DISCUSSION AND CONCLUSIONS

This chapter provides a summary of the thesis, then moves onto provide answers to the research questions, and then comparisons between literature and research results are made. Finally, the robustness and limitations of the thesis are evaluated, and future research suggestions are given.

5.1 Summary

This thesis's objective was to describe ways to develop traditional factoring through private and consortium blockchains in Finnish factoring companies located in Finland. The research was carried out using a qualitative research method with an explorative outlook on the topic. The research approach was inductive, and the research strategy was a case study. The research was constructed using a semi-structured interview method where a predetermined interview question set based on the title of the topic was used. Data-based content analysis and thematic design were used as the methods of data analysis. The thematic design was also used in the systematic academic literature and use case review. The theoretical framework was structured to give insight into factoring, blockchain, the factoring market in Finland, and the risks related to factoring. Through academic literature and use case review, a deeper understanding of the existing literature and research topic was provided. Also, use cases from invoice finance were provided to understand how blockchain could be utilized in traditional factoring. The empirical study of factoring development using blockchains was constructed by interviewing four professionals from the finance and IT fields. The research results provide valuable insight into the current state of blockchain technology and its possibilities for traditional factoring in the Finnish factoring companies.

5.2 Conclusions

This thesis's main research question was, "*How could factoring be developed by using private and consortium blockchains?*". To answer this main research question,

research questions 1 and 2 and their sub-questions need to be answered first. **RQ1** *"What has been previously written about the use of blockchains in invoice finance?"* was examined through a literature review. Blockchain solutions were identified to reduce paperwork, administrative and service costs, and reconciliation costs of banks. High development and integration costs are typical, but the costs of blockchain decreased in the long run. Contracts and documents can be stored on the blockchain for automation purposes. Through automation, processing times, and human risks can be reduced. The blockchain solutions were identified to be less complex and less costly over time. The transparency provided by blockchain was identified to improve trust between suppliers and customers. It also made transactions traceable and auditable. Invoice fraud was also decreased. Reliability and the quality of data collected in the development processes were identified as a challenge. There can also be challenges with companies' technical capabilities, organization readiness, and integration with stakeholders.

The feature that data added to the blockchain cannot be removed or altered turned out to be a challenge with smart contracts. They need to be programmed so that vulnerabilities are addressed, and failure-prone scripts are removed. Challenges with domain-specific languages for the Ethereum platform, formal testing, and automated formal verification were also noted as challenging. Duplicate work can be reduced in consortiums by synchronization between systems. Settlement, payment, and clearing activities, as well as efficiency and speed of transactions, can be enhanced. There are challenges with capacity and high energy consumption of the consensus methods. Block sizes are limited to store only a limited number of transactions. In consortiums, consensus can be reached through a much lower computing power than traditional blockchain solutions as the participants in permissioned consortium networks are known. There is a possibility of 51% attacks and double-spending with PoS. Also, hard forks need to be considered where all nodes in a blockchain network need to update their versions to the newest one for the network to work properly. Also, transactions are registered in public ledgers, which can be a privacy issue. Patterns can be recognized, and user identities can be linked to addresses through public ledgers. Communication between DLT systems and legacy systems still needs to be improved,

and regulation, policies, and supervision systems regarding illegal use of blockchain, for example, terrorist financing, money laundering, and capital control.

SRQ1.1 "*What kinds of previous blockchain use cases are there is invoice finance?"* was examined through a use case review. Many previous use cases were identified based on the review. Blockchain-based smart contracts have been used to automate factoring agreements using tokens as representatives of factored invoice's value. Smart contracts have also been used in a platform that was used to automate invoicing, financing, and payments. The company has since closed. The system included a procurement platform where corporations could offer to buy or sell goods. SMEs then bid for the anonymized offers and got financing for them. When a bid was accepted, the trade was executed in a smart contract. When the receivable related to the trade was paid, tokens were released automatically from the smart contract.

Financial institutions have created consortiums that have been used to secure transactions and make them cheaper and transparent. Blockchains have been used to build a consortium for corporations and their vendors to finance supply chains. Invoices are added to an ERP portal from where their details are added to a smart contract. Vendors' KYC information and credit limits are checked, and credit is debited to vendors' accounts. The amount equivalent to the debt is automatically credited when the credit is due. Consortiums have also been used to offer invoice factoring and open account solutions. There have been challenges in the development phase on how to integrate all network participants' payment systems, security protocols, transaction processing rules, and compliance processes. There was also one solution that connects existing APIs to systems and business networks in all industries. Hyperledger Fabric has also been used to create marketplaces for SMEs to seek finance for their invoices. When an invoice is added to the marketplace, the software analyzes the different fields on the invoice and creates combinations of hashes on them. This allows the software to identify differences between invoices when new invoices are added to the marketplace and detect malicious attempts of fraud.

The second research question was, *"How private and consortium blockchains can be used to develop traditional factoring according to the qualitative interviews?*". To be able to answer this question, sub-questions need to be answered first. **SRQ2.1** *"How can consortiums be used in factoring?"* raised many thoughts in the interviewees. It was considered that financial institutions could form a consortium to develop a blockchain-based factoring solution. Transparency could be achieved as everyone in a consortium blockchain could see an invoice sent by the seller and received by the buyer. Financing for invoices could be gathered from private persons and institutional investors. One could buy invoices from a specific vendor through a fully automated set of parameters. The advantages of blockchain are limited, and people need to be willing and ready to adopt the technology. There is a lot of competition in the financial markets, so consortiums might be hard to set up. Billing systems and ERP systems would need to be developed to send data that could be transmitted through blockchain, which is still a long way ahead. Also, to implement a blockchain-based consortium solution, the information flows would need to be figured out.

Through **SRQ2.2** *"How can smart contracts be used in factoring?"*, it was identified that banks could start factoring with closed smart contracts, which have as counterparties only the companies that are settled in the factoring agreement. Then there would be a minimal risk of money laundering. Smart contracts could be used in factoring so that as a set of specific rules materialize, an automatic payout happens. Non-fungible assets could be used to represent the value of invoices, and fiat money would not need to be used. As these tokens remain in the ecosystem, they can be traded there to buy, for example, cryptocurrencies. Typically, information cannot be deleted or changed from the blockchain after it has been added there. If there were a mistake in the smart contract, it would need to be solved how a rollback could be made. Enough exceptions need to be programmed into the contracts for them to be able to handle different situations. It is important to be able to stop the payout if the agreement terms are not met. An interface to bank accounts needs to be built. There are not many ready solutions to that. Also, Ethereum is owned by a Swiss foundation, and this brings issues if banks are willing to build a direct interface between bank accounts and Ethereum as this would bring additional costs.

SRQ2.3 *"What kinds of risks can blockchain solve in factoring?"* resulted in many insights into blockchain's capabilities. It was considered that blockchain enables cheaper and cost-effective ways to handle and automate business, leading to fewer human errors in manual work. Balloon invoices and invoice fraud could be decreased as financial institutions send invoices instead of the vendor to the buyer; the financial institution could track that the buyer receives the invoice. Banks need to know their customers, and they need to be trusted counterparties. More risks are involved if there are more companies that the banks do not know and banks operate over country borders. Transparency in blockchain enables the mitigation of fraud risk as the blockchain transactions are available for everyone to see in participants' networks. There are challenges with private, closed databases and untrustworthy counterparties if information needs to be shared among multiple operators and counterparties. Blockchain allows the usage of a platform where all information is public and transparent. This platform can then be used to validate tasks in the transaction process.

SRQ2.4 *"What are the key challenges in using blockchain technology in the context of invoice finance?"* brought up many unresolved issues with DLT in the context of invoice finance. The interfaces to use blockchain with other systems are still underdeveloped. It is also too difficult for customers to buy ETH as easy to use platforms that do not seem to exist yet. There are challenges with money laundering as banks are afraid that someone might launder money using blockchain. Banks should separate cryptocurrencies and DLT to be able to see its opportunities. There are though dark currencies used to execute criminal activities and launder money. It is almost impossible to track those kinds of transactions as they take place in dark networks. Blockchain might not offer enough security on its own. Ethereum has its own coding language, so it is almost impossible to program viruses into the environment. This provides some level of security to the blockchain solutions based on Ethereum. Also, it costs to use the Ethereum ecosystem as a Swiss foundation owns it. The cost might be less money that goes into blockchain in the long run as it is expensive to have own private data centers. It was also identified that bringing new technology to some product might not solve any problems with it or make the product better. PoCs helps with choosing the right technology and solution. It is important to

examine already implemented projects in the company to learn from them and collect both good and poor user experiences. It is also good to keep in mind that simpler technologies and solutions would work better than blockchain in many cases.

As the second research question's sub-questions have been answered, the ***RQ2*** *"How private and consortium blockchains can be used to develop traditional factoring according to the qualitative interviews?"* can be concluded. Factoring companies could form consortium marketplaces where factoring companies could offer receivables' financing, and insurance companies could offer receivables insurance, and companies could seek financing for their receivables. Factoring companies and insurance companies could bid for invoices, which would result in better pricing. Marketplace platforms could be automated so that, for example, factoring companies could automatically bid for invoices that match their risk tolerance and interests. Factoring companies could also transfer their contracts into smart contracts where factoring agreements could be executed automatically and transparently.

To provide an answer to the main research question, "***How could factoring be developed by using private and consortium blockchains?"*** a comparison was made between the previous literature and this thesis's results. Similar results and insights were identified from both sources. As the literature and use case review were comprehensive, they provided more versatile and in-depth results than this thesis's smaller-scale results. Both sources considered consortiums and smart contracts as good solutions to develop traditional factoring. Consortiums could be executed as larger-scale solutions, such as large invoice financing marketplaces, or as smaller-scale solutions between banks and their customers. This thesis's results reflected that the marketplace would not necessarily need to be executed through DLT, but it could be executed using other solutions. Thus, removing the development and integration costs of DLT and keeping the marketplace solution as simple as possible. Smart contracts could be used to automate factoring agreements. Neither this thesis's results nor the previous research provided detailed guidelines or technical instructions on how the factoring contract could be executed inside a smart contract. More research is needed regarding this topic. Both sources of results agreed that blockchain solutions

are still partly underdeveloped and do not yet offer a solution to all matters regarding traditional factoring. Blockchain's security and privacy issues need to be solved, as well as capacity and block size limitations. Ethereum 2.0 brings some fixes, but it still cannot solve all the underlying issues with DLT. Previous research considered some solutions to issues regarding DLT systems inability to connect to legacy systems. This thesis's results were not as optimistic about the current solutions and considered that this issue needs to be still solved to connect smart contracts into banks' customers' accounts. Both sources considered tokens as the best current solution for factoring smart contracts. This thesis's results though, considered that the interfaces to trading with tokens are not developed enough and not the most user-friendly.

There needs to be enough capital in organizations and technical readiness to be able to implement blockchain technology. It is expensive to develop processes and software, and it takes a lot of time and effort. The future world needs many coders and professionals who have a deep understanding of DLT and the opportunities and risks that come with it. Factoring companies need to examine DLT to really understand its capabilities and consider if it is the correct technology to integrate into their factoring solutions. If DLT is decided to be integrated, companies specialized in DLT need to be consulted. PoCs need to be compared to find the most suitable solution for the company's needs.

This thesis provides new insights into the blockchain and factoring research fields. This study concentrated on studying traditional factoring that has not been studied as much as other invoice finance forms. This study provides development ideas of blockchain from the Finnish factoring companies' perspective. No studies concerning this exact topic were not found in the comprehensive literature review.

5.3 Robustness, limitations and future research

When assessing this research's robustness, it needs to be considered that this research is conducted using a qualitative method. The study has been conducted by

doing a comprehensive data collection process. The data from the interviews is based on professionals' views and experiences. The interviewees are professionals in their fields of expertise. The study's results cannot be generalized as the sample of interviews has been small. The research questions and objectives were formed after careful consideration. The research questions support each other and create a cohesive whole. The data used in this research is relevant in terms of the research questions and study's objectives. The data sources and citations have been marked according to Harvard's citing instructions. The data sources are international, containing local and international sources of literature. The data in the research is from primary and secondary sources, including data from the interviews, scientific publications, research articles, news articles, literature, blogs, organizations' financial statements, and company websites using LUT Research Portal, LUTPub, LUT Primo, Semantic Scholar, Google, Google Scholar, ResearchGate, DEStech Publications, Theseus, IEEE Xplore and libraries in the Helsinki area. The data has been collected from sources that are trustworthy and qualitative. Data has been collected diversely from different sources, and the data is presented critically. The articles and online journals used in the research have been published in trustworthy sources in companies and newspapers' websites. The scientific literature has been published between the years 2015-2020 with a few sources from 2006 and 2007 as sources for methodology. Sources can be seen containing information that is as valid to this day as on the year they were published. The literature writers are professionals in their fields of study and are a trustworthy and high-quality source for this study.

For this study, a systematic literature review of previous research was conducted. It was challenging to find relevant research on this thesis topic, as it has not been widely researched. The word "factoring" also has meaning in Mathematics and Computing, so by searching with the word "factoring", lots of unnecessary publications emerged. This made it challenging to find the most relevant publications. Factoring has been researched more from the finance perspective than from the technology perspective that this thesis examines. There have been many studies regarding supply chain finance and its development with blockchain, but the form of financing differs from the traditional factoring. It does not mean that the research on supply chain finance and its development with blockchain would be useless. On the contrary, the research can

be utilized as the financing forms are both concentrated on a similar basis, and some parts of the processes are equivalent.

The research's results are considered unique and valid as the research results are formed after comprehensive, qualitative interviews with the topic's professionals. The results that contain similar views were identified through the literature and use case review. This thesis's results can be seen as reliable because there was much research to support the results, even though the studies examined through the literature and use case review did not match the thesis's topic identically. Many of the studies' results are generally regarding blockchain solutions and can be applied to traditional factoring with some modifications. This research provides good contributions to the existing literature by raising challenges and opportunities that support the existing literature and examining use cases of blockchain specific to traditional factoring.

This research was constructed on a theoretical level and did not dive deep into blockchain's technical aspects nor take a closer look at the detailed factoring processes. More interviews could have been made to gain a more comprehensive understanding of the topic and examine even more ideas on how blockchain could be used in traditional factoring. This research only focused on how factoring could be developed through blockchain technology. However, as factoring is still quite manual in bigger banks and financial institutions, it would be interesting to study how the manual processes could be developed into fully automated processes. The research was limited to consider only interviews with professionals working in Finnish companies in Finland. Only the factoring market in Finland and its operators were examined, as many markets' capture would have been too wide of a topic due to differences in finance sectors, processes, and legislation. No analysis of any specific factoring company nor a competitor analysis was made because it is too difficult to find quality data for those kinds of analyses. It would require separate research. Technical details were left out of this study as this study was built from the businesses' viewpoint. Going into too much technical detail would have directed this research away from the business solutions and development ideas. It would have also made this research too heavy. The research ended up being quite wide, but it is still a coherent

whole. The research topic could have been a bit more limited. The result of wide limitation was that it was impossible to dive deeply into each subtopic and the technical side.

Further research is still needed about the technical execution of factoring smart contracts. Future research could also be done on the insurance companies' or the vendors' perspective to factoring development as this thesis focused on the factoring companies' perspective. It would also be interesting to study the kinds of business and technical developments that could be made to a specific factoring company's processes on a detailed level.

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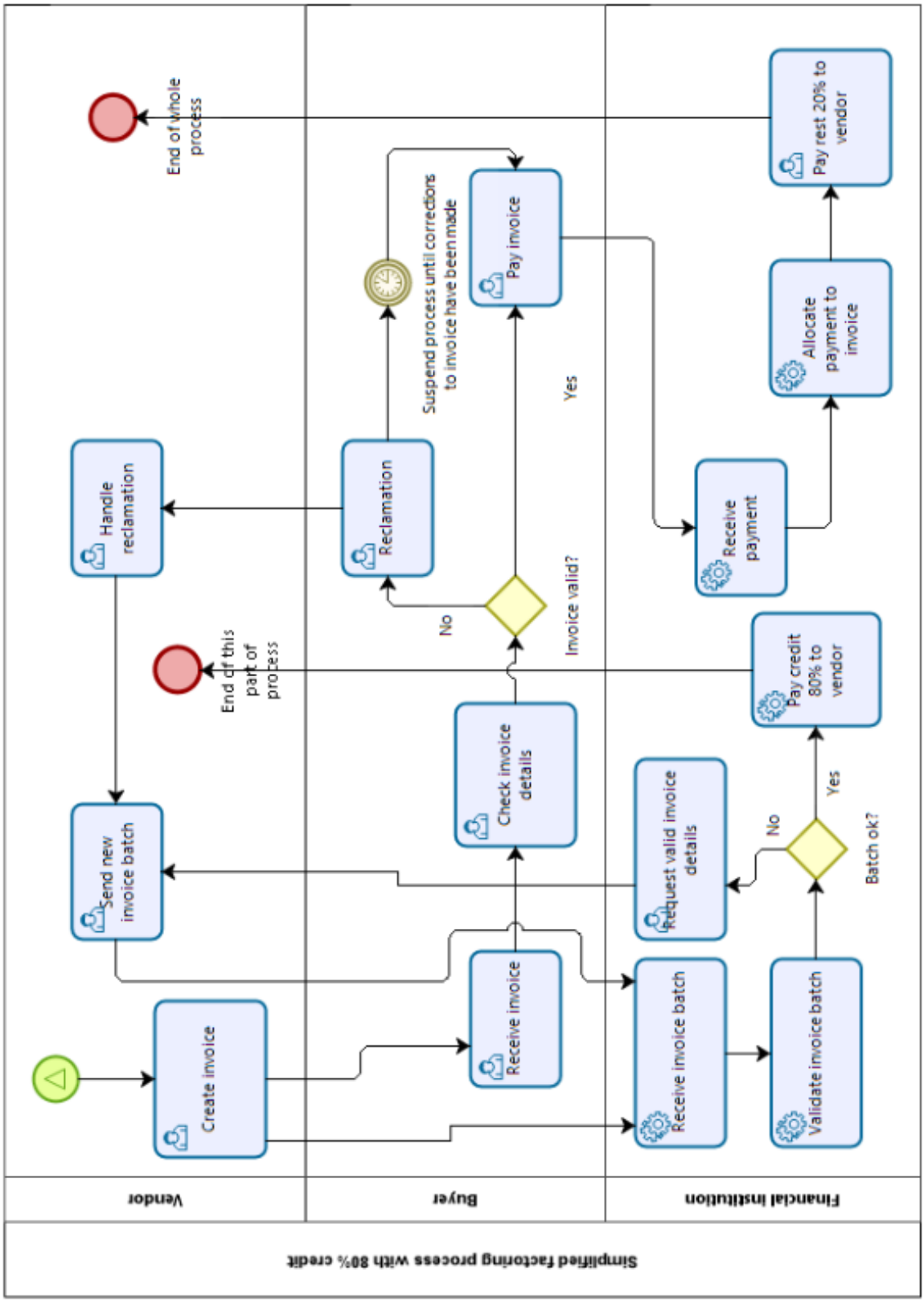
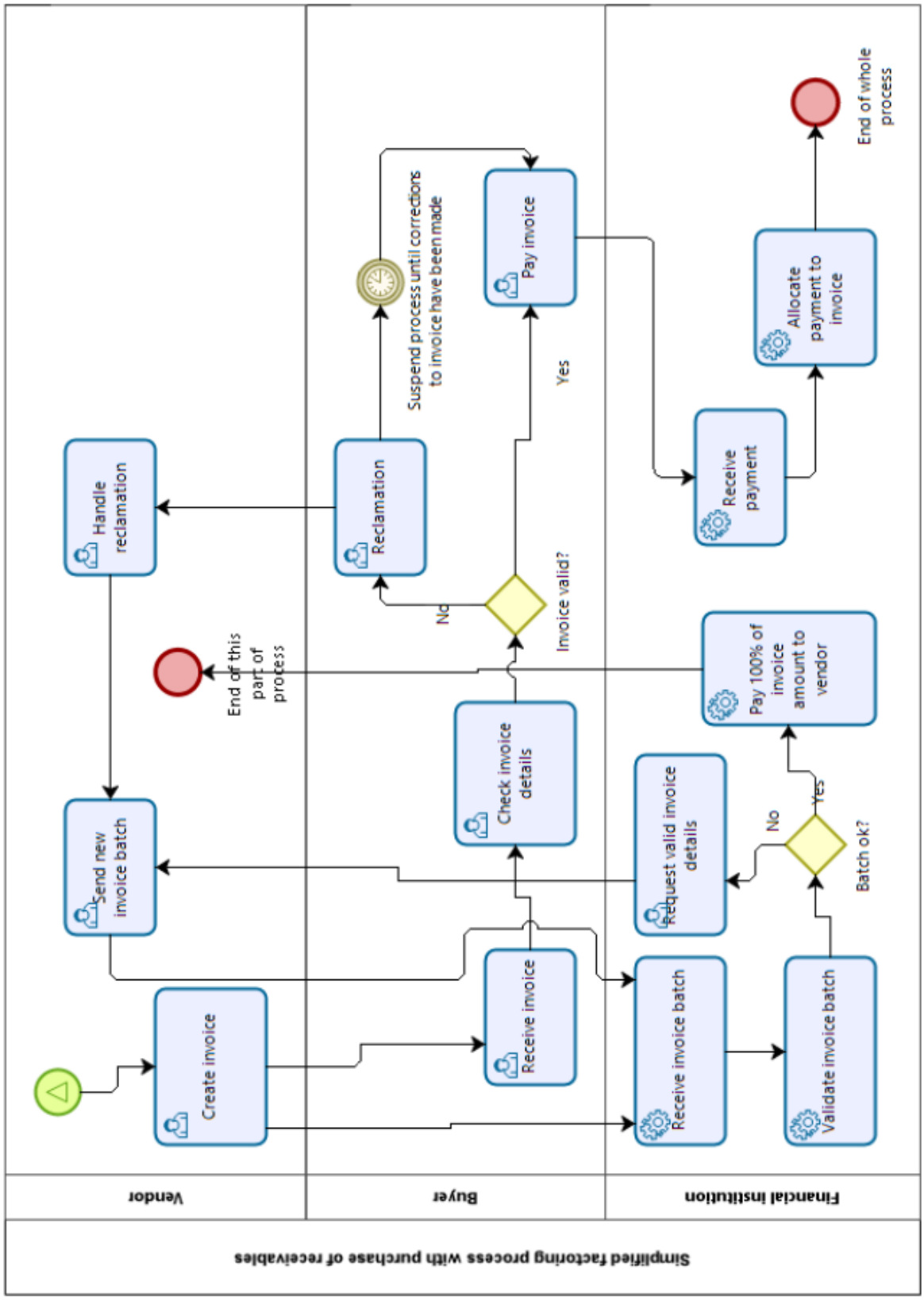
APPENDICES

Appendix 1. Simplified factoring process with 80% credit



Appendix 2. Simplified factoring process with purchase of receivables



Appendix 3. Searches in English for literature review

Searches in English for literature review			
Search word/sentence	**Database**	**Number of search results**	**Number of relevant search results**
Blockchain	Semantic Scholar	26200	7
	IEEE Xplore	6583	0
	LUT research portal	9	1
	LUT Primo	36645	5
	LUTPub	102	3
	Theseus	392	9
Accounts receivable	Semantic Scholar	3500000	1
	IEEE Xplore	44	0
	LUT research portal	5	0
	LUT Primo	99288	0
	LUTPub	3353	0
	Theseus	16146	2
Blockchain in factoring	Semantic Scholar	9230000	10
	IEEE Xplore	1	1
	LUT research portal	0	0
	LUT Primo	469	12
	LUTPub	81	3
	Theseus	212	3
Invoice finance blockchain	Semantic Scholar	1570	13
	IEEE Xplore	2	1
	LUT research portal	0	0
	LUT Primo	482	17
	LUTPub	19	0
	Theseus	28	1
Accounts receivables financing using blockchain	Semantic Scholar	592	2
	IEEE Xplore	0	0
	LUT research portal	0	0
	LUT Primo	280	2
	LUTPub	36	3
	Theseus	119	3
Development of traditional factoring using blockchains	Semantic Scholar	1070000	0
	IEEE Xplore	0	0
	LUT research portal	0	0
	LUT Primo	185	3
	LUTPub	67	1
	Theseus	165	3

Risks related to factoring	Semantic Scholar	2970000	0
	IEEE Xplore	3	0
	LUT research portal	0	0
	LUT Primo	19435	3
	LUTPub	3569	0
	Theseus	17161	0
Consortium in invoice finance	Semantic Scholar	1590	0
	IEEE Xplore	0	0
	LUT research portal	0	0
	LUT Primo	1030	4
	LUTPub	37	0
	Theseus	64	0
Platform economy in invoice finance	Semantic Scholar	948	1
	IEEE Xplore	0	0
	LUT research portal	0	0
	LUT Primo	2512	3
	LUTPub	137	0
	Theseus	436	1
Smart contracts in factoring	Semantic Scholar	78200	3
	IEEE Xplore	1	1
	LUT research portal	0	0
	LUT Primo	1633	4
	LUTPub	649	0
	Theseus	2071	7
Risks blockchain solves in factoring	Semantic Scholar	11600	2
	IEEE Xplore	0	0
	LUT research portal	0	0
	LUT Primo	73	1
	LUTPub	50	2
	Theseus	136	5
Challenges in blockchain	Semantic Scholar	3010000	8
	IEEE Xplore	1486	4
	LUT research portal	1	1
	LUT Primo	14296	18
	LUTPub	86	3
	Theseus	241	6

Appendix 4. Searches in Finnish for literature review

Searches in Finnish for literature review			
Search word/sentence	**Database**	**Number of references**	**Number of relevant references**
Lohkoketju	Semantic Scholar	2	0
	IEEE Xplore	0	0
	LUT research portal	0	0
	LUT Primo	17	2
	LUTPub	29	1
	Theseus	148	4
Lohkoketjut myyntisaatavarahoituksessa	Semantic Scholar	1	0
	IEEE Xplore	0	0
	LUT research portal	0	0
	LUT Primo	0	0
	LUTPub	0	0
	Theseus	0	0
Myyntisaatava	Semantic Scholar	0	0
	IEEE Xplore	0	0
	LUT research portal	0	0
	LUT Primo	0	0
	LUTPub	7	0
	Theseus	32	1
Myyntisaatavien rahoitus	Semantic Scholar	115	0
	IEEE Xplore	0	0
	LUT research portal	0	0
	LUT Primo	1	0
	LUTPub	22	0
	Theseus	194	2
Myyntisaatavarahoituksen kehittäminen lohkoketjujen avulla	Semantic Scholar	0	0
	IEEE Xplore	0	0
	LUT research portal	0	0
	LUT Primo	0	0
	LUTPub	0	0
	Theseus	0	0
Myyntisaatavarahoitukseen liittyvät riskit	Semantic Scholar	19	0
	IEEE Xplore	0	0
	LUT research portal	0	0
	LUT Primo	0	0
	LUTPub	0	0
	Theseus	0	0

Laskujen rahoitus konsortiossa	Semantic Scholar	0	0
	IEEE Xplore	0	0
	LUT research portal	0	0
	LUT Primo	0	0
	LUTPub	1	0
	Theseus	4	0
Laskujen rahoitus alustataloudessa	Semantic Scholar	0	0
	IEEE Xplore	0	0
	LUT research portal	0	0
	LUT Primo	0	0
	LUTPub	0	0
	Theseus	3	0
Älykkäät sopimukset myyntisaatavarahoituksessa	Semantic Scholar	2	0
	IEEE Xplore	0	0
	LUT research portal	0	0
	LUT Primo	0	0
	LUTPub	0	0
	Theseus	0	0
Riskit, joita lohkoketjut ratkaisevat myyntisaatavarahoituksessa	Semantic Scholar	0	0
	IEEE Xplore	0	0
	LUT research portal	0	0
	LUT Primo	0	0
	LUTPub	0	0
	Theseus	0	0
Lohkoketjujen haasteet myyntisaatavarahoituksessa	Semantic Scholar	0	0
	IEEE Xplore	0	0
	LUT research portal	0	0
	LUT Primo	0	0
	LUTPub	0	0
	Theseus	0	0